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Odisha Economic Association**

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Referees

Odisha Economic Journal expresses sincere gratitude to the following experts for their comments, suggestions and recommendations on draft papers:

Aparajita Biswal, Department of Economics, Rama Devi Women's University, Bhubaneswar.

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Editorial

It is possible to notice a somewhat greater emphasis on human capital - health and education - in this issue of the *Odisha Economic Journal* even as there are analyses at the macroeconomic level in terms of aspects of growth and performance of key sectors.

The opening article (Pareswar Sahoo and Motilal Mahamallik) takes a tour de force of macroeconomic measures undertaken by the Indian government during recessions at different points in time. Broadly comparable policy responses have been applied to recessions stemming from supply-side disruptions, demand-side weaknesses, or interconnected factors — yet these measures frequently fall short of their intended outcomes. It observes that a single, uniform policy framework may not be adequate to address every form of economic downturn. Instead, a targeted approach rooted in Keynesian and post-Keynesian thinking has shown greater effectiveness in restoring economic stability and driving recovery from recessions.

The second article (by Vachaspati Shukla and Santosh Kumar Dash) examines the much-awaited consumption data (2022-23) to trace changes as might have occurred since 2011-12 in patterns and growth underscoring inequality across income classes. Interestingly, it points to a shift from necessities to non-food items including healthcare, education and durable goods; this has also been noticed in lower and middle deciles in rural areas. It suggests a slimming of inequality in rural India and signs of an improvement in living standards across income groups.

In their analysis of the non-linear relationship between financial development (FD) and renewable energy consumption (REC), the article (by Pabitra Kumar Jena and Aqib Mujtaba) derives its empirical core by testing the Financial Kuznets Curve (FKC) hypothesis across 16 G20 countries from 1996 to 2022. The findings suggest that the relationship follows an inverted N-shaped FKC pattern. The identified optimal FKC trajectory shows that FD initially suppressed, then accelerated, and subsequently restrained renewable energy consumption as FD progressed from lower to higher levels.

In a focused inquiry into implications of period poverty the article (by Shakuntala Ghadai and Madhusudan Nag) investigates the roles of caste identity and household economic status in determining menstrual hygiene behaviours among young Indian women aged 15 to 24 years, drawing on data from the fifth National Family Health Survey (NFHS-5). By categorizing their menstrual hygiene practices into three groups: exclusively unhygienic, exclusively hygienic, and a combination of both, the study argues that household wealth exerts the strongest influence on menstrual hygiene practices, i.e., the adoption of hygienic products increase considerably as wealth rises. Caste-based disparities persist even when controlling for wealth, educational attainment, sanitation access, place of residence, and other household-level factors.

The following article (by Chodaganga Sahu and Bikash Padhan), in the Odisha context, examines the patterns and determinants of morbidity among over one million adults between the ages of 15 and 49 using data from the inaugural round of the Annual Health Survey (2011–12). The results indicate while the prevalence of acute illness was high in the northern and southern regions, the coastal regions were more affected by chronic illness. Notably, with rising wealth status, the probability of reporting chronic illness increases while that of acute illness decreases.

In an assessment of progress towards SDG-4, focusing on disparities in educational attainment across Indian states, the article (by Manohar Sagara, Sarala Dasari and Hastimal Sagara) underscores structural disparities that tend to be concealed within aggregated national-level data. Using information drawn from the SDG India Index 2023–24 and relevant national datasets, the study develops a multidimensional evaluative framework that encompasses indicators related to access, equity, learning outcomes, physical infrastructure, gender parity, teacher competence, and higher education enrolment across eleven selected states. The results show that southern Indian states generally perform better across several educational dimensions relative to their northern counterparts. The last article (by Manjunath, D. Sujatha Susanna Kumari and Trinadh Nookathoti) explores the disparity in financial literacy between Scheduled Caste women both in urban and rural Karnataka. The findings reveal a substantial gap in financial literacy, with urban women outperforming their rural counterparts. This difference is almost wholly attributable to the endowment

effect in terms of education, income levels, access to information, and availability of financial resources. Interestingly, membership in self-help groups exhibits a marginal positive relationship with financial literacy pointing to the inadequate efforts in imparting broader financial education.

The reflective note (by Nilakantha Rath), drawing upon a past experience by a pragmatic agronomist and irrigation expert, makes an important point about advantages of redesigning water distribution system in the Odisha context. It is argued that a thoughtful water management at the micro level can significantly enhance productivity including ensuring greater retention of and, hence, benefits from, fertilisers and manure applied. The resultant farm income can be equitably redistributed and the scope for farm employment can improve.

As India increasingly integrates traditional knowledge into global innovation frameworks and digital landscapes, the research note (by Deepa V. K. and Harilal Madhavan) engages with an interesting perspective around safeguarding traditional/indigenous intellectual property rights (IPRs) keeping the local community centrestage. Taking the case of Kerala's IPR policy, it argues that the traditional knowledge protection extends beyond legal frameworks to encompass deeper questions of epistemic justice, community rights, and ecological sustainability.

The book review (by Sandhya Krishnan) in this issue examines a volume on post-independence development peregrination of India.

Keshab Das
Editor-in-Chief
Odisha Economic Journal

Macroeconomic Measures in India: Economic Recessions, Keynesianism and Beyond

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Pareswar Sahu
Motilal Mahamallik

Abstract

Since the neophyte of Keynesian ideas, it has been widely prescribed and followed by economies, throughout the Globe, in order to address economic recession. This paper examines macroeconomic measures undertaken by the Indian government during recessions at different points in time. More or less similar measures were used during recessions arising from either supply or demand, or interdependence, and independent of both constraints, which often fail to offer the expected results. A tailor-fit policy may not be suitable for the reduction of all types of economic recessions. A customized policy (Keynesian and post Keynesian) tool is proved to be appropriate for reviving and stabilizing the economy from economic recessions.

Keywords: Fiscal policy, monetary policy, economic recession, pandemic, fiscal profligacy, equilibrium

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Introduction

Economic recessions are common worldwide.¹ They often occur with varying degrees across the globe (Crafts & Fearon, 2010; Kose et al., 2020) (Table A1), either due to demand constraints, supply constraints, interdependence, or independent of both types of constraints, which may, in turn, be due to endogenous or exogenous (war/ natural epidemic) factors. The fundamental disequilibrium in the economy mostly arises due to political uncertainty, social unrest, economic instability, trust deficits, or disequilibrium in product, labour, and money markets (Dasgupta & Rajeev, 2020). A supply constraint occurs when the economy's ability to produce output at a given price level is

influenced by known or unknown factors. When households' capacity, willingness to consume and invest at a given price level is lost, and production is disturbed demand constraints appear (Patnaik, 2020). Supply-induced recessions tend to be characterized by decreased output and increased prices, while demand-induced recessions are featured by both decreased output and prices.² Supply shocks are often more challenging to deal with because (i) demand-side policies that increase output may result in further price increases and (ii) available supply-side policy tools may not be equipped or able to counter the shock (e.g., an increase in global oil prices). Supply and demand constraints befalling within one country become interdependence.

In a globalized world, instability in one country often affects the economy of other countries. For example, the COVID-19 outbreaks created fear of economic uncertainty and loss of human life worldwide.³ Stringent preventive

¹ Recessions are characterized by decreases in output and employment. In other words, recession is "significant decline in economic activity that is spread across the economy and lasts for more than few months' Demand constraint occurs due to unemployment, unutilized capacity of plants and raw materials. It is often observed in capitalism. The shortage of labour, equipment and raw materials leads to supply constraint which is encountered in socialism. The mixed economy faces both supply and demand constraints (Patnaik, 2020).

² 'CO' stands for corona, 'VI' for virus, and 'D' for disease. The disease was formally referred to as '2019 novel coronavirus' or '2019-n CoV'. The COVID-19 virus is a new virus linked to the same family of viruses as Severe Acute Respiratory Syndrome (SARS) and some types of common cold.

³ Before COVID-19 led lockdown, the Indian economy faced a supply-side problem largely on account of 'Demonetization' implemented in 2016, 'Goods and Service Taxes' brought in 2017 and slowdown in credit growth (Sengupta & Vardhan, 2020). A demand constrained economy is one where the rise in demand increases the level of income, output and employment in the economy without increasing the price level while the reverse of it is the supply constrained economy (Patnaik, 2020).

measures like ‘social distancing and ‘economic lockdown’ undertaken by countries to restrict the spread of the virus (Table A2) created an independent demand-and-supply constraint, leading to an economic recession during 2019-21 across much of the globe. Similar measures in the Indian subcontinent led to a supply bottleneck, even as the country was already struggling with a typical Keynesian demand-constrained equilibrium.⁴ A sudden rise in temporary unemployment and uncertain economic conditions led to a demand constraint. However, these constraints became independent of one another [*supply-constrained Keynesian equilibrium*] (Dasgupta & Rajeev, 2020)]. Neither increases in demand response (Keynesian theory) to supply nor the supply to demand (Say’s Law) could alleviate the constraints.

In India the National Democratic Alliance government at the Centre visualizes the concept of Viksit Bharat and commits to bring about an economic change in the country by 2047 (Maiti & Goldar, 2025). In the meantime there is the outbreak of war between Russia and Ukraine as well Iran and Israel supported by the United States. Wars have larger global implications on energy, water, infrastructure, climate and finance (Chenoy, 2026a). Although the world demands to end the war between Iran and Israel, it is not yet to stop due to unwillingness of the US in fulfilling the demands of Iran. When 20% of global oil which comes through Hormuz is blocked by Iran the escalation of oil prices threatens global recession (Chenoy, 2026b). Globalization as a basic feature, India has voluminous part in global trade with the countries involved in war (Sunil, 2026) and it may fall in the trap of recession.

Taking into account the influence of the outbreak of war between countries across the globe on the Indian economy, this study re-examines the effectiveness of fiscal and monetary policy tools used by the Indian government to bring the economy back during different recessions using an appropriate set of indicators from 1980-81 to 2020-21, which covers both interdependence and independent supply and demand constraints.⁵ Literature examined policy tools used to revive the economy amid either during demand or supply or dependent or independent demand and supply constraints (Shomali & Giblin, 2010; Pandey et al., 2018).

⁵ The indicator consists of growth rate of Gross Domestic Product, investment and saving, wholesale price index, State of economy and tools of fiscal and monetary policy used over time.

Indian government has been applied more or less similar types of measures during all types of recessions irrespective of the reasons of occurrence and found ineffective in deriving expected results. No tailor-made policy may be fit for all types of economic instability. Keynesian and post-Keynesian policy tools may be appropriate for reviving and stabilizing the economy.

Section I

Theoretical Underpinnings

Acceleration of economic growth is possible through maintaining 'full employment levels of income and output (Rao, 1952)'. Different Mechanisms have been proposed by schools of thought from the Classical period onward to maintain full employment levels of income and output during recessions (Hudea, 2015).

The Classical school advocated an automatic corrective market mechanism to maintain the full-employment equilibrium level⁶. This line of advocacy was quite popular until the Great Depression (GD) of the 1930s⁷. The recession before the Great Depression of the 1930s was due to supply constraints (output). In order to break the supply constraints, employments were increased through offering lower wages to labourers which in turn raise the level of profit. Higher profits led to greater investment and employment. Fiscal policy had little role to play as per the *Laissez faire* economy. However, during the GD, the auto-corrective mechanism did not boost investment indefinitely under the pressure of the trade union⁸. It was due to a demand constraint. The idea

⁶ The proponents of full employment level of income, output and employment determination during the period 1776 to 1930 are regarded as classical.

⁷ The classical theory believes in full employment equilibrium in an economy based on '*Laissez faire*' perfectly competitive market condition because unemployment relates to frictional and seasonal unemployment only. If such type of unemployment exists, it can be eradicated by lowering wage and interest rate. The flexibility in wage rate brings full employment in the labour market which in turn leads to optimum output in goods market. It is because saving and investment being function of rate of interest, flexibility in interest rate automatically converts saving into investment in zero time gaps resulting equality of income and expenditures. The inter-linkage of goods and labour market brings about combination of aggregate demand and perfectly inelastic supply, which is full employment level of output.

⁸ A number of industrial unions were formed during 1930 like United Automobiles Workers and United Mines Worker, which came together in the Congress of Industrial Union along with American Federation of Labour and dominated organized labour in United States.

of wage flexibility, as conceived by the Classical School, operated within a restricted domain up to a certain wage level. It was well recognized by Keynesians (Harvey, 2016). Keynesians argued that investment is '*the factor*' to maintain a full employment level in the economy. Although the Classical School was of the same view to some extent, differences emerged regarding the sources of investment. When Classical School assumes that private investment is the only mechanism for maintaining full employment, Keynes and Keynesians advocated 'public investment' to sustain full employment during periods of synchronisation with private investment. The role of fiscal policy came to the forefront. Keynes's prescription of public investment was a recommendation on what the Classical School was silent about⁹. Private investment enhances the income of the higher-income group, while public investment, along with private investment, boosts the income of all sections of the population, specifically lower- and middle-income groups. The marginal propensity to consume of the lower- and middle-income groups is higher than that of the high-income group (Jappelli & Pistaferri, 2014).

Industrialization, excess capacity in the consumption goods industry, elastic supply of working capital (Rao, 1952), animal spirit behaviour of human beings in decision making (Begg, 1982) and almost stationary population growth¹⁰ are a few important assumptions for the effective function of fiscal policy tools. During the late 1960s and 1970s, violations of certain assumptions led to economic recession in Organisation for Economic Co-operation and Development (OECD) countries. Public investment could not ensure economic stability¹¹ due to the relatively high population growth rate and the rational behaviour of economic agents. The new classical school argued that the wage

⁹ The Classical school speaks about government intervention but it is restricted to extent help for the smooth functioning of the market mechanism. However, Keynes view of government intervention is intervention in the form of public investment through fiscal policy which enables income to equalize with expenditures when investment falls short of saving in bringing full employment level of income and output in goods

¹⁰ Keynes assumed short run and existing skill, quantity of labour, quality and quantity of equipment, technique of production, degree of competition, taste and habits of consumer, social structure and more or less closed economy as given to preserve capitalism.

¹¹ The economic conditions changed over past 40 years from capital saving to capital using with a fast growth rate of population. What were taken as given by Keynes became variable over time. The economic problems became growth, dynamics and inflation instead of stagnation.

flexibility mechanism could restore the full-employment equilibrium without state intervention, given rational economic agent behaviour. Wage reductions in OECD countries during the 1960s helped fill the unemployment gap by drawing on the available pool of involuntary unemployed labour, contradicting the Keynesian idea. The employed workers did not resist the wage cut, as apprehended by Keynes, in the presence of a large army of unemployed labour force. Firms began to realise (through the development of rational behaviour) that they could raise profits by lowering the wage rate (Hoover, 1988). Government investment through fiscal and monetary policy could not ensure full employment when all economic agents behaved rationally. When economic agents realised that prices of goods and services and income would rise by equal proportions through fiscal and monetary policy, they would not raise their demand. Keynesians believe that increasing employment raises output and the rate of inflation. However, according to the new classical theory, firms keep output constant when they realise that the increase in profits is due to a rise in both inflation and the wage rate. Elsewhere, it is noted that fiscal policy, rather than monetary policy, is effective in the presence of ‘complete price flexibility’, ‘rational public expectation’ and ‘white noise economic shocks’ (Galbacs, 2015).

The global economy entered a new phase of disequilibrium during the 1980s as the idea that imperfectly competitive market conditions were prevalent gained widespread acceptance. The wage flexibility mechanism, as propagated by the new classical school, failed to ensure equilibrium because of the following new lower-ceiling argument. The New-Keynesian argued that wages cannot decline further below a certain level. The wage decline: (i) affects the incentive to work and the quality of the labour force negatively, (ii) increases the possibility of withdrawal of the labour force from the job market, and (iii) involves high transaction costs for new recruitment. Counter-cyclical monetary¹² and/or fiscal policy can restore equilibrium, as New Keynesians argue.

New-Keynesian mechanisms were effective before the 2009 economic slowdown. During the economic slowdown of 2009, involuntary unemployment intensified due to ‘pessimistic expectations’ among economic agents, not

¹² A counter cyclical monetary policy is one which stabilizes both inflation and output around a set target.

because wage cuts failed, as argued by the new-classical school¹³. Pessimistic expectations of economic agents often contract effective demand, which, in turn, reduces labour demand and increases unemployment. Demand for labour is determined by aggregate demand in the goods market and not by the wage rate (Greenwal & Stiglitz, 1987). However, the money wage determined in the labour market influences the general price level, inflation and income distribution. It is the central theme of the Post Keynesian School in determining inflation. Price and income policies are appropriate tools for controlling inflation, according to the post-Keynesian view¹⁴. Fiscal, monetary, and Income policies were three well-accepted tools used to revive the economy¹⁵ The Post-Keynesian Mechanism failed during the COVID-19 recession of 2020.

The classical approach advocates rectifying the supply constraint through an automatic market mechanism. In contrast, the demand constraint is corrected through fiscal and monetary policy under the Keynesian mechanism. Monetary policy is less effective at stimulating growth when interest rates are very low, because the total supply of money is exhausted by speculative demand. It is effective at very high interest rates because the total supply of money is used to meet transaction demand. Between the above-mentioned two rates of interest, the relative strength of money supply and investment determines the effectiveness of fiscal and monetary policy. The New Keynesian School proposes correcting the interlinked demand and supply constraints through

¹³ The different schools of thought from the Classical to New-Keynesian mostly emphasized “wage” as the main determinant of equilibrium. However, the expectation of economic agent is the main factor determining equilibrium as argued by the Post-Keynesians.

¹⁴ The Post-Keynesian school rejects the automatic market mechanism of new-classical and price and wage stick-ness of new Keynesian since wage cut reduces consumption and hence aggregate demand contracting the level of income and output. As per Post-Keynesian school effective demand which is determined by entrepreneurs expectation of future demand, can fully utilize the resources in operating at its full potential in short and long run. Extending beyond full employment to the theories of income distribution, growth and stability, they argue that endogenous bank lending determines the supply of money not the central bank. Inflation is not the result of conflict over the distribution of available income and output not of excess demand. It is a social phenomenon, not a monetary phenomenon. Inflation or stagflation can not be controlled through monetary and fiscal policy. It is the income policy that works effectively, equitably and adequately. Fiscal and monetary policy instruments contracting the level of economic activity, reduces the amount of income and output available for distribution thereby heightening the social conflict underlying the inflationary process.

¹⁵ Fiscal, monetary and income policies are injected to generate income sufficient to make demand equality with supply to maintain full employment output through investment in productive activities in an economy where there is demand constraint and both demand and supply are interlinked to each other. .

counter-cyclical monetary and fiscal policy (Greenwal & Stiglitz, 1987). Both independent demand and supply constraints characterised the COVID recession.

Section II

Interdependent Supply and Demand Constraint and Policy Measures

The tools of fiscal and monetary policies were found effective in case of demand constraint in achieving growth rate during normal time (1981-82, 1983-85, 1988-90, 1992-94, 1995-98, 1999, 2002, 2003-08, 2014-15, 2016-17 and 2017-18) (Government of India, 2020). The same set of tools was not successful during the economic recession resulting from supply constraints, demand constraints and interdependence of both in India¹⁶ (Chakraborty & Harikrishnan, 2022; Mundle & Sahu, 2021) (Tables 1, 2 and 3). The ineffectiveness of policies during droughts (1982-83, 1985-88, 2002-03, 2009-10 and 2010-11), except 2009-10, is attributed to the interdependence of demand and supply constraints. Injection of liquidity through monetary policy failed to generate adequate income due to supply constraint which in turn yields insufficient demand (demand constraints). In a similar manner the fiscal policy tools recognized as transfers payments could not generate demand required to increase the level of output.

Weak decision-making at the national level, fiscal imbalance due to a decline in revenue generation, a rise in transfer payments, and a 3.1% decline in crude oil production due to agitation in Assam are responsible for the recession, which was driven by demand constraints during 1990-91¹⁷. Further, the lack of the desired level of oil imports widens the recession, leading to inflation. Fiscal policy (expenditure containment, tax rationalisation, tax compliance and tax effort, and the promotion of saving and investment) used to control inflation proved ineffective. The direct tax relief and efficient management of public distribution, to some extent, raised demand in the economy. The level of

¹⁶ Abnormal situations arise due to either natural or external factors or both, where natural factors may be drought or a pandemic. Fiscal and monetary policies were successful during 2009-10 due to favourable agricultural and industrial performance, even amid drought (Sahoo & Bishoni, 2022), and global market uncertainty during 2008-09.

¹⁷ The proportion of expenditures on capital formation has declined from 40% to 32.7%. In comparison, that of transfer payments from the central government to states and union territories has increased from 30.7% to 42.7% during 1980-81 to 1990-91 (Government of India 1990-91).

demand was not sufficient to encourage investment to raise output. The rise in Statutory Liquidity Ratio from 38 to 38.5% and selective credit controls on bank advances for stock of price-sensitive essential commodities under monetary policy could not control the excessive money supply (Mahamallik & Sahu, 2023).

Demand constraints stemming from domestic structural constraints, inflationary pressures, and the global economic slowdown during 2012-14 significantly reduced growth. During the 1991-92 recession, global market uncertainty rendered fiscal and monetary policies ineffective in achieving the targeted growth rate.

The application of tools similar to those used during both normal and economic slowdown periods, without exploring suitable policy alternatives, is responsible for the failure.

Table 1: Tools of Fiscal and Monetary Policy Used in India (1980-2021)

Period	Fiscal Policy	Monetary Policy	Objective
1980-81 to 1984-85	PIT, CT, food subsidy, RLEGP and NREP, Infrastructural Investment, de-licensing of 25 prioritised industries, (compulsory deposit scheme for income tax payers, surtax, surcharge on PIT payable by all classes of companies, tax holiday and incentives for long-term saving, special paper bond in 1981)	CRR (1981 to 1985), SLR (1981 to 1983;1984-85), FCR (1983-85), soft loan (1983-85), Interest rate on advances (1983-85), Borrowing from commercial bank and discretionary finance, MR, season credit policy and enlargement of financial structure during 1981 to 1983, ECRF during 1983-84 and export credit refinance, discretionary power to commercial bank in releasing sanctioned working capital, liberalization of flow of credit and exemption from selective credit control in 1984-85	EG (RG in 1981-82)
1985-86 to 1989-90	MVAT, CED concessions for small scale units, Investment Deposit Account Scheme, and PIT concessions to exporters in 1986-87, surcharge on PIT, CT, wealth tax and custom duty, domestic air fares and upper class railway fares and external assistance initiatives in 1987-88, concessions to agricultural and agro based activities, investment allowance and duty reliefs to selected industries and incentives for export	CRR, SLR and MR (1985-90), FCNA (1985-87; 1988-89), Lending rate for borrowers (1985-89), ECRF (1985-87; 1989-90), call money (1988-90) FCR, freedom to commercial bank to fix rate of interest on deposit of maturities of less than one year within a ceiling limit of 8 percent, rate of interest for maturities of 91 days, and persuasion in 1985-86, differential interest rate structure in 1986-87, deposit interest rate, discretionary credit policy, instructions regarding coordination among banks and sick financial institutions, conversion of short term to long term loans, reschedule investment credit and relaxation from interest and penalties in 1987-88, Treasury bills, relaxation/imposition from RBI authorization for term loans, extension of maximum period of repayment and reduction of margins of housing loan in 1988-89, interest rate on refinance under 182 days refinance facility, minimum lock in period for long term fund, restriction on refinance of non-food credit, incremental non-food credit deposit ratio, warning for violating the stipulation and level of credit ceiling in 1989-90	EG and Equity

	production in 1988-89		
1990-91 to 1994-95	Custom duty in 1990-91, concessional import duty, and capital expenditures	CRR (1990-92; 1993-95), SLR (1990-91; 1993-94), FCNA (1992-93; 1994-95), MR (1990-93) ECRF1(1990-92), incremental non-food credit deposit ratio, charge on unutilized portion of credit limit of large size borrowers and debt relief in 1990-91, Bank rate, interest on short term deposit, advances of all categories and export credit and imposition of ceiling on withdrawal of big borrowers in 1991-92, lending rate for advances in 1992-93, interest rates on deposit and loans and minimum lending rate in 1993-94, adhoc treasury bills, reduction of price on rice, abolition of duty on sugar, reduction of import duty in 1994-95	FD and EG
1995-96 to 1999-2000	PIT (1996-2000), CT (1996-2000), CED (1996-97; 1998-99), MVAT, Monthly budgeting of departments, expenditure cut on staff cars, electricity, telephone bills and official entertainments, complete ban on purchase of new vehicles and conferences in hotels, closer of several offices abroad, 25% cut in foreign travels budget, impounding additional DA for officers drawing a monthly salary of 3500 rupees and above, tax relief to small scale industry, agriculture and environmental protection and MAT in 1996-97; increase in tax free reimbursement on medical expenses, tax deductions on educational institutions, hospitals, incentives on house building, tax holiday to industry set up in backward areas, commercial production of minerals and telecommunication sector, reduction and exemption of import tariffs, interest payment and subsidy in 1998-99	CRR (1995-2000), SLR (1996-98) ceiling on borrowing from RBI through ad hoc treasury bill, open market operation, reduction of import duty, reduction on import restriction on manufactured consumer goods and reduction in custom and excise duties in 1995-96, call money rate in 1996-97, ways and means advances, and Bank rate in 1997-98, Bank rate and repo rate in 1998-99, repos and lending against collateral of Government of India Securities, cheque writing facility, interest rate swaps and forward rate agreements, two tier bond, FCNA, interest rate surcharge on import finance and minimum rate of interest on overdue of export bill in 1999-2000.	FD
2000-01 to 2004-	Rationalization of Taxation, VAT, containment of social and	Liquidity Adjustment Facility, licensing to commercial bank for capital market, credit delivery system focusing small scale industry, and renewed efforts to reduce non-performing assets	FD

05	economic revenue account expenditure and borrowing, securities transaction tax in 2004, tax on all cash withdrawal, PIT in 2003-04, central VAT, service tax, defense expenditures, Interest Payment, subsidies, tax holiday benefits for small-scale industries and industrial units set up in industrially backward states and district in 2001, permission to set up industry	of commercial banks, permission to sound bank and well managed non-banking financial companies to insurance business, new banks in private sector, certificate of deposits, commercial papers, supervision of banks and their subsidiaries and government shareholding in nationalized bank in 2000-01,	
2005-06 to	Custom duty (2005-07; 2009-10), CED (2005-07; 2009-10), rectifying anomalies like inverted duty structure, tax exemptions, voluntary tax compliance, VAT, outcome budget and FRBMA in 2005-06, tax on donations, direct tax exemptions, service tax, interest rate, subsidy, accrual accounting in government, and performance audit in 2006-07, FRBMA, ceiling on guarantee, consolidated sinking fund, guarantee reduction fund, VAT by states, outcome budget, non-plan expenditure, restriction on fresh recruitment and creation of new post, administrative reform, review of functioning of state public sector undertaking and contributory pension scheme for newly recruited staff in 2007-08, import duty on tradable goods whose prices showed unprecedented increase, tax relief and increased	Bank rate (2005-06; 2008-09), CRR (2005-10) and RRR (2005-09), RR (2006-09), ceiling on interest rate on non-resident rupee deposit and export credit on foreign currency, standard advances for personal loan, capital market exposures, residential housing beyond 20 lakhs and commercial real estate loans, risk weight on exposure of commercial real estate, permission to primary dealers to diversify their activities in 2006-07, ceiling on interest rate on non-resident rupee deposit and export credit on foreign currency, average cut off yield on 182 Treasury Bills, overseas investment limit, prepayment of external commercial borrowing, ceiling rate of interest payable by non-banking financial corporations and risk weight on residential housing loans to individuals in 2007-08, SLR in 2009-10	

	plan expenditure in 2008-09, MTFRP, setting up an expert group to advice on pricing on petroleum products, people's participation in public sector undertaking and structural changes in direct taxes and harmonized GST and development of infrastructure in 2009-10		
2010-11 to 2014-15	FRBMA and MAT (2011-13); PIT (2011-13; 2014-15) CED, custom duty and increase of service tax base and its exemption (2010-15) fiscal concession to agriculture, food processing, energy and infrastructure, simplification of procedure on small scale industries, containing non-plan and raising plan expenditures and debt reduction in 2010-11, surcharge on CT in 2011-12, restriction on subsidies, modernization of business process of tax administration and subsidies in 2012-13, Investment allowance, tax holiday, tax concession on foreign dividend and roll back provision in advanced pricing agreement scheme in 2014-15	RRR (2010-13; 2014-15), CRR (2010-12; 2013-15), OMO and market stabilization scheme in 2010-11, RR (2011-13; 2014-15), Marginal standing facility rate, daily marginal standing facility borrowing, weekly auction of cash management bill and SLR in 2013-14, and SLR in 2014-15	FD and EG
2015-16 to 2019-20	GST (2016-20); MTFRP (2016-17; 2018-19); CT (2017-18; 2019-20); PIT (2017-19) Integration of railway budget with the union budget, advancement of date of union budget to 1 st February, elimination of plan and non-plan expenditure classification in 2016-17, custom duty, addressing concerns and facilitating measures, exemption and rate in	RRR, marginal standing facility rate and withdrawal of legal tender status of specified bank notes in 2016-17, RR and OMO in 2018-19, RR in 2019-20	EG

Source: Government of India (2020): Indian Economic Surveys from 1980-81 to 2019-20 and International Monetary Fund (2020): “World Economic Outlook”.

Notes: PIT = Personal Income Tax, CT = Corporation Tax, RLEGP = Rural Labour Employment Guarantee Programme, NREP = National Rural Employment Programme, CRR = Cash Reserve Ratio, SLR = Statutory Liquidity Ratio, EG = Economic Growth, FD = Fiscal Discipline, FCNA = Interest rate on Foreign

Currency Non- resident Account scheme, MR = Margin Requirements on Consumer Credit, FCR = Food Credit Refinance, ECRF = Export Credit Refinance Facility, MVAT = Modified Value Added Tax, VAT = Value Added Tax RG = Revenue Generation, MSME = Minor, Small and Medium Enterprises, GST = Goods and Service Tax, MAT = Minimum Alternate Tax, FRBMA = Fiscal Responsibility Budget Management Act, MTFRP Medium Term Fiscal Restructuring Programme, OMO = Open Market Operation; CED = Central Excise Duty, RRR = Reverse Repo Rate, RR = Repo Rate

Table 2: State of the Indian Economy from 1981-82 to 2020-21

Year	Growth rate of GDP	Saving	Domestic Capital	Inflation	Remarks
1980-81	8	18.8	18.8	1.4	Normal
1981-82	8.1	18.1	18.1	1.5	Stagnant
1982-83	7.7	15.6	15.6	1.0	Stagnant
1983-84	4.3	16.6	16.6	1.6	Normal
1984-85	4.3	16.6	16.6	1.6	Stagnant
1985-86	4.3	16.6	16.6	1.6	Stagnant
1986-87	4.3	16.6	16.6	1.6	Stagnant
1987-88	3.9	16.6	16.6	1.6	Stagnant
1988-89	10.5	18.0	18.0	1.0	Normal
1989-90	6.7	13	13.0	0.1	Normal
1990-91	5.9	13.1	13.1	15.1	Potential overvaluation. First inflection due to the liberalisation due to the first crisis and high inflation
1991-92	1.5	9.9	9.9	16.6	Stagnant
1992-93	5.1	11.46	11.4	7	Normal
1993-94	8.8	13.5	13.5	10.8	Normal
1994-95	7.5	14.8	14.8	10.4	Stagnant
1995-96	7.5	15.1	15.1	1.4	Normal
1996-97	7.4	13.2	13.2	1.4	Normal
1997-98	8.2	15.1	15.1	1.5	Normal
1998-99	6.5	15.3	15.3	1.8	Stagnant
1999-00	6.4	14.8	14.8	6.5	Stagnant
2000-01	4.8	13.5	13	1.5	Normal
2001-02	5.8	15.6	15.6	1.8	Normal
2002-03	4	14.5	14.5	0.2	Stagnant
2003-04	8.5	16.6	16.6	1.4	Normal
2004-05	7.5	16.7	16.7	6.5	Normal
2005-06	8.5	14.2	14.2	1.5	Normal
2006-07	10.7	15.7	15.7	1.5	Normal
2007-08	6.5	16.8	16.8	1.5	Normal
2008-09	6.7	13	13.1	0.1	Global crisis and recovery of the developed financial
2009-10	8.8	13.7	13.7	1.2	Stagnant
2010-11	8.8	14	14.0	1.5	Stagnant
2011-12	6.7	13.9	13.9	1.1	Global Recession
2012-13	5.1	13.8	13.8	1.4	Global crisis, economic recession, commodity price
2013-14	6.8	16.8	16.8	1.1	Global crisis, economic recession, commodity price
2014-15	7.5	14.4	14.4	1.0	Normal
2015-16	7.5	13.1	13.1	1.7	Global Recession and a new recession
2016-17	6.2	16.3	16.3	1.3	Normal
2017-18	7.5	16.5	16.5	1	Normal
2018-19	6.8	14	14	1.5	Global Recession
2019-20	5	14	14	1.6	Global Recession
2020-21	1.4	14	14	1.6	Global Recession

Source: Same as Table 1.

Section III

Independent Supply and Demand Constraint and Policy Measures

The recession during 2019-21, unlike many earlier recessions, is an outcome of the COVID pandemic. Stringent measures to curb the pandemic's spread led to independent demand and supply constraints. The Indian economy derailed from the growth path during this period (Dasgupta & Rajeev, 2020). To combat the situation, direct government fiscal intervention (Mukhopadhyay, 2021), a multi-pronged approach combining wider fiscal and monetary policy (Farnaro & Wolf, 2020; Dua, 2020; Moharir, 2022; Goyal, 2022) and a policy that fights inflation, unemployment, inequality in distribution of income/ wealth and ecological imbalance (Skidelsky, 2020) were prescribed. The Indian government implemented a minimum life-support fiscal policy alongside a credit-induced monetary policy under ABA. These policy measures were far from the expert's recommendations and amounted to only a slight modification of the ongoing fiscal and monetary tools (Table 2). The minimum life support fiscal policy was an extension of the ongoing public distribution programme, along with minimum cash transfers to poor households, for a limited period. These measures are not appropriate for boosting the economy in such a situation (Chakraborty & Thomas, 2020; Pal & Ray, 2022).

An intervention through the public distribution system, supplying free food grains to poor households along with a stipulated cash transfer, is nothing but a populist policy in the name of fiscal tools. Populist's policy lack growth-stimulating effect. A wider fiscal intervention in a Keynesian framework, capable of restoring confidence among producers and consumers, was the need of the hour. Instead of a liberal, broader fiscal policy measure, a wait-and-see policy was adopted, leaving the economy in the hands of the market. Entrepreneurs grasped the opportunities offered by the government through a credit-induced monetary policy at lower interest rates. They did not invest in the absence of demand in the economy and hoarded it (Dasgupta & Rajeev, 2020).

Fiscal stimulus packages (federal transfers to the states for infrastructure building, tax rebates, temporary income tax cuts, cash for clunkers, and financial aid for first-time homebuyers) were unable to stimulate growth during the Financial Crisis and

Great Recession of 2007-2009 (Taylor, 2018). The failure of fiscal and monetary policy tools to stimulate growth in selected countries during recessions is evident (Tables 4 and 5).

Minimum guaranteed cash transfers to poor and middle-income households might have increased trust among economic agents. With the opening of the economic activities, even if the policy prescription [particularly monetary policy (Patra & Bhattachayya, 2022)] recovered the economy to some extent, the larger output loss due to lack of private consumption and investment (Mukhopadhyay, 2021; Sheel, 2022; Gupta, 2022) and the further reduction of government expenditures in the Union budget 2021-22 (Mundle & Sahu, 2021) resulted in the presence of dependent demand and supply constraints (Mundle, 2020). The policy measures did not revive the economy as expected (Can growth, 2022) and resulted in high inflation (Mundle, 2022). As a retaliatory measure, the government adopted a restrictive monetary policy, raising interest rates. It led to further recession in the economy. Inflation is due to a lack of output relative to demand, resulting from trust deficiencies among economic agents, which in turn depend on the level of demand. A major part of the demand in the economy comes from poor and middle-income households, as observed in their contribution (97%) to GST (Indian Express, 2023). In order to increase trust among the economic agents for a continuous rise in demand, which would put pressure to raise the level of investment, a large volume of investment on cottage and small scale industries, roads, solar energy and irrigation to boost agriculture, tax exemption on basic needs and increasing tax exemption slab of income tax were applied after abolition of stringent measures (Mahamallik & Sahu, 2023). It is also argued that government expenditures should be directed toward financing small and medium enterprises and helping vulnerable sections of society. The voluminous investment package is to be financed through state debt monetisation (Kar & Naido, 2020). The state faces huge fiscal constraints. The Central government lacks credibility and faces debt management issues (Kasliwal, 2020). Further, regulation of consumer credit, directives to shift credit from less to more productive uses, setting maximum limits, and lending for certain purposes should be pursued under monetary policy. In other words, growth-oriented fiscal policy, counter-cyclical monetary and income policy may help revive the economy.

Table 3: Growth Rates of Selected Countries (in %)

Country	Q4-2019	Q1-2020	Q2-2020	Q3-2020	Q4-2020	Q1-2021
Australia	0.4	-0.3	-7.0	3.5	3.2	1.8
China	1.2	-8.7	10.0	2.8	3.0	0.4
USA	0.5	-1.3	-8.9	7.5	1.1	1.5
UK	0	-2.8	-19.5	16.9	1.3	-1.6
USSR	-0.5	0.7	-2.6	0.7	-0.2	0.0
India	0.6	0.8	-25.9	23.1	9.3	2.1

Source: <https://stats.oecd.org/index.aspx?queryid=350>

Note: The growth rate relates to the percentage change from the previous quarter.

Section IV

Conclusions

Recession is a typical phenomenon of an economy. It occurs at varying degrees due to either a demand or a supply constraint, or to both independently or in combination. Both endogenous and exogenous factors give rise to these constraints. Economic policy measures are required to reduce the impact of these constraints and expedite economic growth. Various schools of thought have prescribed mechanisms at different points in time for this purpose. The classical and Keynesian schools of thought dominate the domain of prescriptions. The other schools of thought are mostly extensions of the former or the latter. The Indian government mostly applies either classical or Keynesian or combination of both macroeconomic measures during recessions at different points in time. More or less similar measures were used during recessions arising from either supply or demand, or interdependence, and independent of both constraints, which often fail to provide the expected results. With the change in the economic world order and socio-economic situation of the country a tailor-fit policy may not be relevant for the alleviation of all types of economic instability. Customized policy tools (Keynesian and post-Keynesian) are shown to be appropriate for reviving and stabilizing the economy.

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Appendices

Table A1: Economic Downturn across Globe

Downturn	Cause	Socio-economic Condition	Severity (UN)	Suffering Countries	Remedial Measures	Remarks
GD 1930s (1929-39)	Stock Market, Banking and International Trade Crisis (Sofya, 2008), fiscal and monetary policy (Crafts & Fearson, 2010)	Less than 20%GTO (Kose <i>et al</i> , 2020) Habit of people to be rich, Neglect of agriculture, more weightage to industry, less proportionate growth of wage than productivity, high tariffs, and concentration of capital in a few hands due to heavy weightage of the automobile industry, opening of banks without federal or state restriction, installments credit in USA. Individual to collective bargaining, pro-union legislation.(Sofya 2008; Crafts & Fearson 2010), protection of industry from trade union (Ohanian 2009) DC	25% in USA	(USA, UK, Germany, Italy, Norway, South Africa, Poland , Australia) North America, central and eastern European Countries (Albers & Ubele 2015)	SCMM, limited government intervention with voluntary co-operation of business and labour, trade barriers, public charge on immigrants, government expenditures through public programs in 1931	SCMM failed,
ER 1973-75 or 1970s	Sharp rise in oil prices due to Iranian revolution	50% GTO (Kose <i>et al</i> 2020) DC (Dasgupta & Rajeev 2020)	9% in USA	Western world	MP and FP	MP and FP failed
ER 2007-09	Asset inflation, easy access to credit, increase in installment debts (Shomali & Giblin 2010)	Less than 55% GTO (Kose <i>et al</i> 2020) DC ((Dasgupta and Rajeev 2020))	10% in USA		Expansionary MP and FP	MP and FP succeeded
ER 2020-21	COVID-19	400% GFO (Kose <i>et al</i> 2020) DC and SC ((Dasgupta & Rajeev 2020))	14.7% in USA	Whole world	Expansionary MP and life induced FP	

Source; Available literatures

Note: GD = Great Depression, ER = Economic Recession, SCMM = Self -corrective Market Mechanism, MP = Monetary Policy, FP = Fiscal Policy, DC = Demand Constraint, SC = Supply Constraint, UN = Unemployment, GTO = Global Trade Openness and GFO = Global Financial Openness

Table A2: Tools of Fiscal and Monetary Policy in Selected Countries during COVID-19

Country	Fiscal Measures	Monetary Measures	Remarks
Australia	Payroll tax relief for businesses, discount utility bills, cash payments to vulnerable households, health spending, construction, infrastructure packages and green investment, Asset-backed securities to small banks and non-bank financial institutions, loan guarantees between the Commonwealth government and participating banks, Job Trainer Skills package, Job Maker program, loss carry-backs and personal income tax cut, national vaccination, aged-care and disability, women, retirement flagship Job Keeper and wage subsidy program, tax reliefs for low and middle income earners	Policy rate cuts, yield curve target, term funding facilities, government bond purchases, longer-term repos, broadening the range of eligible collateral for open market operations, swap line, allowing banks to utilize some of their large buffers, regulatory concession for six months, Dividend payment restrictions and Insolvency relief measures for businesses	Financial support to business, low and middle income household and banks,
China	Epidemic prevention and control, production of medical equipment, accelerated disbursement of unemployment insurance and insurance to migrant workers, tax relief, social security contributions and additional public investment.	Liquidity injection via open market operations, re-lending and re-discounting facilities for manufacturers of medical supplies and daily necessities, MSME and agricultural sector, RRR cuts for MSME, reducing interest on excess reserves, expanding banks' credit line to private firms and MSEs, financial relief to affected households, corporates and regions	Financial support to low income household
USA	Investing in public health, time-bound assistance to families, communities and businesses, unemployment benefits; student loan payment relief; deferring collections of employee social security payroll taxes; identifying options to help renters and homeowners avoid evictions and foreclosures; forgivable Small Business Administration loans, help small businesses; establishment of hospitals; expansion of virus testing; one-time tax rebates to individuals; food safety net for the most vulnerable; prevent corporate bankruptcy providing loans, guarantees, and backstopping Federal Reserve 13(3) program; 2 weeks paid sick leave; 3 months emergency leave for infected; food assistance; transfers to states for unemployment insurance. Expansion of Small Business Administration loan subsidies.	Reduced Federal funds rate, cost of discount window lending and cost of swap lines; Purchase of Treasury and agency securities; Expanded overnight and term repos; broadened U.S. dollar swap lines; temporary repo facility for foreign and international monetary authorities. Commercial Paper Funding Facility; Primary Dealer Credit Facility; Money Market Mutual Fund Liquidity Facility; Primary Market Corporate Credit Facility; Secondary Market Corporate Credit Facility; Term Asset-Backed Securities Loan Facility; Paycheck Protection Program Liquidity Facility; Main Street Lending Program; and Municipal Liquidity Facility; mortgage forbearance for 12 months, suspending foreclosure sales and evictions of borrowers for 60 days, and offering loan modification options.	
USSR	compensation for frontline medical staff, health and safety inspectors; sick leave, leave pay to individuals under quarantine; unemployment benefit ; lump sum benefit for 3 months to children up to 3 years of age; one-time lump sum benefit to children within 3-16 years; lump sum benefit to each child of families whose parent lost job up to 6 months and schoolchildren and children in one-parent families; interest rate subsidies for SMEs and important enterprises; tax deferrals for most affected companies; deferrals on social contributions for SMEs in affected sectors for 6 months; tax holiday on all taxes excluding VAT and social contributions for SMEs, sole proprietors and NGOs providing social services; refunding of tax for 2019 of registered self-employed and partial refund on 2020 taxes; reduction of eligibility age to register as self-employed; partial refund on the social contributions	Reduction of key rate by 200 bps, preemptive sale of FX reserves and FX sales; increasing the limit on FX swap operations, temporary introduction of long-term refinancing instrument; Forbearance on provisioning for restructured corporate and SME loans to all sectors; extension of deadline for full provisioning of restructured corporate loans; refinancing facility to support SME lending; reduction of interest rate on CBR refinancing loans; permission to bank to value securities and foreign exchange operations; reduction of the Deposit Insurance Fund contribution; measures to protect retail borrowers suffering from pandemic; deferrals of loan payments up to six months for affected citizens and SMEs; restructuring loans to	Financial support to business and low income household

	of sole proprietors; deferrals on rent payments to all levels of government, zero rent to the federal government for three months for SMEs in affected sectors; grants for SMEs in affected industries for two months, subsidized and forgivable loans for enterprises in affected industries; subsidies to enterprises in selected affected industries; zero import duties for pharmaceuticals and medical supplies and equipment; grants to firms hiring people who lost jobs in 2020; guaranteed loans to SMEs and affected industries; subsidies to airlines, airports, automakers, and others; state-owned bank, airlines and development institution re-capitalization and expanded eligibility for subsidized mortgage lending.	affected retail borrowers and SME; Measures to support retail and mortgage lending; provision of services of non-bank financial institutions and remote customer services; measures in the field of AML/CFT and currency control; new credit risk assessment methods and lower risk weights in mortgage lending freed about Rub 300 bn; reduction of risk buffers for unsecured loans and cancels risk buffers for consumer loans; lifting the cap on banks' fees for online retailers	
UK	Increasing payment to vulnerable section, property tax holiday, direct grants to small and most affected firms, compensation of sick pay leave and additional funding for National Health Service, public service and charities, postponement of value added and income tax for a temporary period, trade credit insurance, minimum financial support to protect job, cash transfer to poor and business having shutdown, payment to support job	Reduction of bank rate, expansion of central banks holding of government bonds and non-financial corporation bond, incentives for lending real economy, additional liquidity to government, loan guarantee schemes, contingent term repo facility, reduction of counter cyclical buffer rate and maintaining systematic risk buffer rate	Support business and increase social safety

Source: <https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19>

India's Changing Consumption: Growth and Inequality Trends

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Abstract

Using India's Household Consumption Expenditure Survey (HCES) 2022-23 and the comparable 2011-12 round, this paper asks three questions: how the composition of household expenditure has changed, where real consumption growth has been concentrated across the distribution, and whether the intervening decade reduced consumption inequality. Three results stand out. First, the decline in food budget shares and the corresponding expansion of non-food expenditure are broad-based, but the transition is sharper in rural India and among lower and middle deciles. Second, real consumption growth is positive across most of the distribution, with stronger gains in non-food expenditure than in food expenditure, implying that improvements in living standards have operated largely through mobility, services, durables, and health-related spending. Third, inequality has declined in both rural and urban India, yet large gaps remain in categories that map directly into human capital and economic security, especially education, health, rent, and durable goods. These findings suggest that India's consumption transition is real but incomplete.

Keywords: Household Consumption Expenditure, Consumption Patterns, Consumption Inequality, MPCE, HCES 2022–23

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1 Introduction

Household consumption is a key indicator of welfare because it captures both current living standards and the way households reallocate resources as economic conditions change. India's Household Consumption Expenditure Survey (HCES) 2022-23 is therefore especially important: it provides the first nationally comparable evidence on consumption after a gap of more than a decade since 2011-12. The release of these data has renewed debate on whether rising expenditure in India reflects broad-based welfare gains, changing preferences, or persistent inequality masked by aggregate averages. (Subramanian, 2024; Mehrotra and Kumar, 2024; Anand, 2024; Ghatak and Kumar, 2024; Bansal et al., 2024). Household consumption expenditure data continue to serve as the primary source for assessing inequality, poverty, and living standards in India (Jha et al., 2010; Kumar et al., 2019; Pawde et al., 2022; ZSen & Das, 2018). The release of HCES 2022–23 has consequently stimulated a growing body of research focusing on poverty and inequality in the country (Bansal et al., 2024; Shukla, 2025; Himanshu et al., 2025; Agrawal et al., 2026; Panagariya & More 2026).

This paper studies that question through the lens of structural change in household budgets. The core research question is straightforward: between 2011-12 and 2022-23, how did the composition, real growth, and distribution of consumption evolve across rural and urban India and across the consumption distribution? Existing discussions of the new HCES have documented aggregate increases in Monthly Per Capita Consumption Expenditure (MPCE), declining food shares, and lower measured inequality (Shukla, 2025; Subramanian, 2024; Bansal et al., 2024; Maurya and Shrivastava, 2024). Our objective is to move beyond those headline figures by connecting three margins of change that are usually discussed separately: changes in budget shares, changes in real purchasing power after adjusting for inflation, and changes in dispersion between the bottom and top of the distribution.

The paper makes three contributions. First, it provides a distribution-sensitive account of the consumption transition by tracing expenditure patterns across decile groups rather than relying only on all-India averages. Second, it estimates real growth separately for food and non-food expenditure and decomposes the increase in MPCE into detailed commodity groups, which clarifies which items

account for the observed rise in living standards. Third, it studies whether the narrowing in aggregate inequality also appears within specific expenditure categories. This matters because a fall in overall inequality does not necessarily imply convergence in access to services with high welfare content, such as education, healthcare, or housing. Throughout, the interpretation is deliberately cautious: expenditure shares reveal reallocation within budgets, but they do not by themselves identify welfare improvements in every category or establish causal mechanisms.

The discussion proceeds as follows. Section 2 outlines the key findings from the 2022–23 consumption survey, focusing on aggregate consumption indicators. Section 3 comprehensively examines the composition of the consumption basket in rural and urban areas, highlighting variations across decile classes. Section 4 highlights the shifts in consumption patterns between 2011–12 and 2022–23. Section 5 analyses the growth in real consumption across decile classes using aggregate indicators and explores the factors driving this growth. Section 6 looks at consumption inequality across various items in rural areas during the 2011–12 and 2022–23 survey periods. The conclusion summarises the key insights from the study.

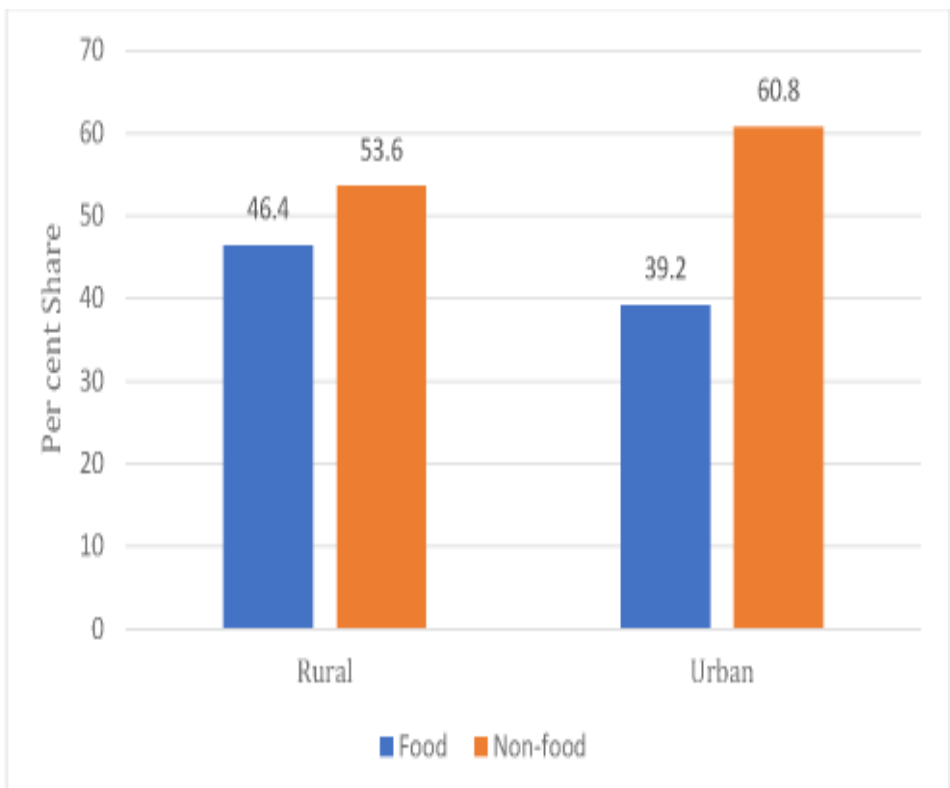
2 Data, Measurement, and Aggregate Consumption Patterns

The analysis uses published tabulations from NSS Report No. 591 for HCES 2022-23 and NSS Report No. 555 for 2011-12. Households are ranked by MPCE and grouped into deciles separately for rural and urban India. For the growth analysis below, nominal expenditure is deflated using sector-specific consumer price indices so that comparisons are made at 2011-12 prices. This design allows us to distinguish three related but conceptually different objects: current budget shares, real expenditure growth, and distributional dispersion. Before turning to the distributional detail, it is useful to establish the aggregate composition of spending in 2022-23.

The aggregate pattern is consistent with a mature but incomplete Engel transition. In rural India, food accounts for 46.4% of total expenditure and non-food for 53.6% (Figure 1). Table 1 presents a breakdown of spending by composition. The largest rural food components are beverages and processed foods (9.6%), milk and milk products (8.3%), and cereals and pulses (6.9%).

On the non-food side, conveyance (7.5%), medical expenditure (7.1%), durable goods (6.9%), and fuel and light (6.7%) take the largest shares.

Figure 1: Consumption Composition in 2022-23 Round



Source: Author's Calculations based on HCES 2022 23 data.

In urban India, the shift away from food is more advanced: food accounts for 39.2% of expenditure and non-food for 60.8%, with relatively large shares for conveyance (8.6%), durable goods (7.2%), rent, taxes, and cesses (6.8%), fuel and light (6.3%), health (5.9%), and education (5.8%) (Table 2).

A comparative analysis of consumption patterns between rural and urban sectors yields notable insights. First, the allocation disparity between food and non-food expenditure in the rural sector is 7.2 percentage points (pp), with 46.4% allocated to food and 53.6% to non-food. This disparity is notably

wider in urban areas, with a difference of 21.6 pp (39.2% on food vs. 60.8% on non-food). Second, the rural sector allocates a significantly higher proportion of its expenditure to cereals and pulses (1.9 pp), vegetables (1.6 pp), eggs, fish, and meat (1.3 pp), and milk and milk products (1.1 pp) than urban areas do. Third, both regions allocate an equivalent proportion of their expenditures to fruits and sugar. Fourth, in the context of non-food products, the rural sector spends 1.2 pp more on health than urban areas, indicating higher out-of-pocket costs. Finally, education is prioritised less in rural areas, accounting for just 3.3% of expenditures, compared to 3.8% allocated for pan, tobacco, and intoxicants. In contrast, the urban sector allocates 5.8% of its expenditures to education. Thus, the composition of non-food spending matters for interpretation. A larger share for education, rent, and durable goods is consistent with rising living standards and asset accumulation, whereas a larger health share may also reflect unmet public provision or high out-of-pocket costs.

3 Consumption Patterns across Decile Classes in 2022-23

Aggregate averages conceal substantial heterogeneity across the distribution. Thus, Analysing consumption across income groups provides insights into how spending priorities evolve as household resources increase. The population is categorised into ten decile groups (D1 to D10), with D1 indicating the lowest 10% of the MPCE distribution and D10 indicating the highest 10%. This section outlines major trends in consumption structure across the distribution.

3.1 Rural India

Table 1 illustrates the distribution of MPCE across major item categories for various decile classes in rural India. A closer look at the deciles suggests that the consumption pattern aligns with Engel's Law. The share of MPCE expenditure allocated to cereals and pulses, edible oils, vegetables, spices, and sugar declines as one ascends the decile ladder. Expenditure on processed foods and beverages is consistent across all decile groups, accounting for approximately 9.6% of the total MPCE. The allocation of shares for eggs, fish, and meat remains stable across deciles at around 5% of MPCE, decreasing to 4.1% for households in the top decile. The composition of food expenditures reveals that basic staples dominate the budgets of lower-income households, with their share diminishing as income rises.

Table 1: Composition of MPCE in Rural India (%)

Item	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	All
Cereals and Pulses	10.7	9.6	9.1	8.6	8.1	7.6	7.2	6.6	6.0	4.3	6.9
Milk & Milk Products	7.1	8.0	8.5	8.8	9.0	9.0	9.1	8.9	8.7	7.1	8.3
Edible Oil	5.8	5.3	4.9	4.6	4.3	4.0	3.7	3.4	2.9	2.1	3.6
Vegetables	7.9	7.2	6.8	6.5	6.2	6.0	5.6	5.2	4.7	3.5	5.4
Fruits	2.6	3.1	3.4	3.6	3.7	3.9	3.9	4.0	4.0	3.7	3.7
Spices	4.3	3.9	3.8	3.6	3.5	3.3	3.2	3.1	2.8	2.2	3.1
Sugar	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.8	0.7	0.5	0.8
Egg, Fish & Meat	5.2	5.4	5.3	5.4	5.3	5.2	5.1	5.0	4.8	4.1	4.9
Beverages, Processed food	9.1	9.4	9.6	9.5	9.6	9.7	9.8	9.8	9.6	9.6	9.6
Food	53.9	53.0	52.5	51.8	50.8	49.6	48.4	46.7	44.2	37.2	46.4
Pan, Tobacco & Intoxicants	4.3	4.0	3.8	3.8	3.8	3.8	3.8	3.9	3.9	3.5	3.8
Fuel and Light	9.0	8.4	8.0	7.7	7.5	7.3	6.9	6.6	6.2	4.8	6.7
Clothing and Footwear	7.7	7.3	7.1	6.8	6.7	6.4	6.3	6.0	5.7	4.8	6.1
Education	1.9	2.3	2.4	2.5	2.7	2.8	2.9	3.2	3.6	4.8	3.3
Medical	3.5	4.1	4.5	5.0	5.3	5.7	6.0	6.7	7.8	11.5	7.1
Household Consumables	5.8	5.6	5.5	5.5	5.4	5.5	5.4	5.3	5.1	4.2	5.1
Entertainment	0.5	0.7	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.3	1.1
Conveyance	4.7	5.3	5.6	6.0	6.5	7.0	7.6	8.2	8.9	9.1	7.5
Consumer Services	5.1	5.3	5.4	5.3	5.5	5.6	5.7	5.9	6.1	7.1	6.0
Durable Goods	3.5	4.0	4.3	4.6	4.9	5.3	5.8	6.3	7.2	11.7	6.9
Non-food	46.1	47.0	47.5	48.2	49.2	50.4	51.6	53.3	55.8	62.8	53.6
Total Expenditure	100	100	100	100	100	100	100	100	100	100	100

Source: Estimates are derived from NSS Report No. 591.

Among non-food items, the share of MPCE spent on fuel and light, clothing and footwear, household consumables, and pan, tobacco, and intoxicants declines from the lowest to the highest decile. Conversely, expenditure on medical expenses, durable goods, education, consumer services, transportation, and entertainment increases with higher consumption deciles.

The aforementioned analysis underscores the point that rich households prioritise long-term investments and quality-of-life enhancements, including healthcare, education, and durable goods. In contrast, lower-income households prioritise meeting immediate and essential needs.

3.2 Urban India

Table 2 indicates that food expenditure in urban areas accounts for 39.2%, which is markedly lower than the 46.4% recorded in rural areas. As anticipated, the proportion of food expenditure in urban areas decreases from 50.1% in D1 to 31.4% in D10. In contrast to the rural sector, median households (D5) allocate 44% of their expenditure to food and 56% to non-food items. Non-food consumption surpasses food consumption in all decile classes, except the lowest decile class.

Among food items in urban households, the share of expenditure across all categories declines from the lowest to the highest decile, except for Beverages

and Processed Food, which rises from 8.7% in D1 to 13.2% in D10 households. Urban households allocate the highest proportion of their food expenditure to Beverages and Processed Food (10.6%), followed by Milk and Milk Products (7.2%) and Cereals and Pulses (5.0%).

Table 2: Composition of MPCE in Urban India (%)

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	All
Cereals and Pulses	8.7	7.7	7.1	6.7	6.3	5.8	5.5	5.0	4.4	2.7	5.0
Milk & Milk Products	8.1	8.8	8.9	8.8	8.5	8.3	7.9	7.5	6.9	5.0	7.2
Edible Oil	4.7	4.0	3.6	3.2	3.0	2.8	2.5	2.2	1.9	1.2	2.4
Vegetables	6.6	5.7	5.4	5.0	4.7	4.4	4.0	3.7	3.2	2.1	3.8
Fruits	3.1	3.6	3.7	3.9	4.0	4.0	4.1	4.1	4.0	3.4	3.8
Spices	3.6	3.2	3.1	2.9	2.7	2.6	2.4	2.2	1.9	1.2	2.2
Sugar	1.1	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.4	0.3	0.5
Egg, Fish & Meat	5.5	5.0	4.6	4.5	4.4	4.2	3.8	3.5	3.3	2.2	3.6
Beverages, Processed food	8.7	9.1	9.2	9.3	9.7	9.6	9.7	10.1	10.5	13.2	10.6
Food	50.1	48.1	46.5	45.1	44.0	42.3	40.5	38.8	36.5	31.4	39.2
Pan, Tobacco & Intoxicants	3.1	2.9	2.7	2.7	2.6	2.6	2.5	2.3	2.3	2.1	2.4
Fuel and Light	10.0	9.0	8.5	8.0	7.5	7.1	6.5	6.0	5.4	4.1	6.3
Clothing and Footwear	6.9	6.5	6.3	6.1	5.9	5.7	5.6	5.4	5.2	4.4	5.4
Education	3.0	3.7	4.0	4.4	4.9	5.1	5.9	6.2	6.5	7.2	5.8
Health	4.2	4.6	5.0	5.2	5.1	5.4	5.7	5.9	6.2	7.1	5.9
Rent, Taxes and Cesses	1.3	2.2	2.8	3.4	4.2	5.2	5.9	6.9	8.4	10.9	6.8
Household Consumables	5.8	5.6	5.6	5.5	5.5	5.4	5.3	5.2	4.9	4.0	5.0
Entertainment	1.1	1.3	1.4	1.5	1.5	1.5	1.6	1.6	1.7	1.7	1.6
Conveyance	5.8	6.9	7.5	8.0	8.4	8.7	8.9	9.3	9.4	8.8	8.6
Consumer Services	5.2	5.2	5.4	5.4	5.4	5.4	5.5	5.6	6.0	7.0	5.9
Durable Goods	3.4	4.0	4.4	4.8	5.1	5.5	6.0	6.6	7.6	11.2	7.2
Non-food	49.9	51.9	53.5	54.9	56.0	57.7	59.5	61.2	63.5	68.6	60.8
Total expenditure	100	100	100	100	100	100	100	100	100	100	100

Source: Estimates are derived from NSS Report No. 591.

Non-food expenditure varies widely across income levels. Expenditures on items like pan, tobacco and intoxicants, fuel and light, clothing and footwear, and household goods decline with rising income. Conversely, spending on education (3.0% in D1 to 7.2% in D10), health (4.2% to 7.1%), durables (3.4% to 11.2%), conveyance (5.8% to 8.8%), and rent (1.3% to 10.9%) exhibit significant increases. Consumer services evince a modest increase, rising from 5.2% to 7.0%.

Taken together, the decile profiles show that the consumption transition is not confined to the top of the distribution. Yet they also make clear that convergence is incomplete. Lower deciles spend a larger share on necessities, while upper deciles command disproportionate access to goods and services that shape resilience, productivity, and social mobility. That distinction becomes even more visible once the 2022-23 structure is compared with the 2011-12 benchmark.

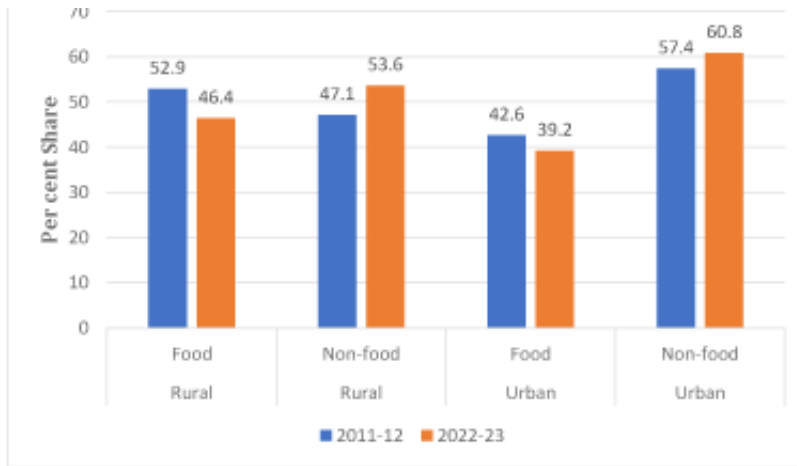
4 Changes in Consumption Patterns since 2011-12

Next, we discuss changes in household consumption patterns between 2011-12 and 2022-23. While Figure 2 illustrates changes across broad consumption categories, Table 3 presents the variation in consumption shares, calculated as the difference between 2022-23 and 2011-12. Decile estimates are constructed by ranking individuals by MPCE and then dividing the population into ten equal-sized groups, each representing 10% of the population. Decile 1 (D1) represents the poorest 10%, while Decile 10 (D10) represents the richest 10% of the population.

Three broad movements dominate the comparison. Food has become a smaller share of the household budget, processed and convenience-oriented items have gained salience within food, and non-food expenditure linked to mobility, services, and consumer durables has expanded. . These structural shifts indicate an increase in disposable incomes, evolving aspirations, and the gradual alignment of rural and urban consumption habits.

4.1 Declining Food Shares

The decline in food's budget share is one of the paper's most robust findings. In rural India, the food share falls from 52.9% in 2011-12 to 46.4% in 2022-23, a reduction of 6.5 percentage points. In urban India, it falls from 42.6% to 39.2% (Figure 2). Table 3 shows that this reduction is observed across nearly all deciles, with especially pronounced declines among lower and middle groups. In that sense, the shift is not merely an upper-tail phenomenon; it reflects a broad-based reallocation of expenditure away from basic food consumption.

Figure 2: Changes in Consumption Patterns (2011-12 vs 2022-23)

Source: Authors' calculations based on HCES 2022-23 and 2011-12 data.

This pattern is consistent with rising real incomes and Engel-type reallocation, but it also indicates that non-food commitments are absorbing a larger part of household budgets. By 2022-23, rural households from decile 6 upward spend more on non-food than on food, whereas in 2011-12 this was largely confined to the top decile. The widening reach of non-food dominance is therefore one of the clearest indicators of structural change over the decade.

Table 3 : Changes in Spending Share

(Percentage Points)

Item	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	All
	Rural										
Cereals and Pulses	-12.3	-11.2	-10	-9.3	-8.4	-7.9	-7	-6.5	-5.5	-3.3	-6.8
Milk & Milk Products	2.9	1.8	2.1	1.4	1	0.9	0.4	-0.1	-0.8	-1	0.3
Edible Oil	0.8	0.4	0.2	0	-0.2	-0.3	-0.4	-0.4	-0.5	-0.3	-0.1
Vegetables	-1.9	-1.9	-1.9	-1.6	-1.6	-1.3	-1.4	-1.4	-1.2	-0.7	-1.2
Fruits	1.6	1.6	1.6	1.5	1.3	1.3	1	0.7	0.5	0.2	0.9
Spices	-0.4	-0.5	-0.5	-0.6	-0.6	-0.9	-0.8	-0.8	-0.7	-0.3	-0.6
Sugar	-0.7	-0.8	-0.8	-0.9	-0.9	-1	-0.9	-0.9	-0.9	-0.7	-0.9
Egg, Fish & Meat	2.2	1.5	0.7	0.5	0.5	-0.2	-0.1	-0.1	-0.3	-0.5	0.1
Beverages, Processed food	1.4	1.8	2.1	1.7	1.6	2	1.9	2	1.8	1.3	1.7
Food	-6.4	-7.3	-6.7	-7.1	-7.2	-7.4	-7.3	-7.5	-7.6	-5.2	-6.5
Pan, Tobacco & Intoxicants	1.3	1	0.8	0.5	0.7	0.6	0.4	0.5	0.6	0.4	0.6
Fuel and Light	-2.8	-2.2	-2.2	-1.8	-1.6	-1.5	-1.5	-1.3	-1.2	-0.5	-1.3
Clothing and Footwear	-0.6	-0.6	-0.7	-0.8	-1	-1.3	-1	-1.1	-1.2	-0.9	-0.9
Education	0.3	0.4	0.2	0.3	0.2	0.3	0	-0.1	-0.3	-0.9	-0.2

Health	0	0.1	-0.2	0.3	0.4	0.3	0.5	0.3	0.6	1.3	0.4
Household Consumables	1.5	1.4	1.3	1.4	1.2	1.2	1.1	1	1	0.8	1.1
Entertainment	0.1	0.2	0.2	0.2	0.2	0.1	0	0.1	0.1	0.1	0.1
Conveyance	3.1	3.4	3.5	3.5	3.6	3.7	3.7	3.9	3.6	2.7	3.3
Consumer Services	1.9	1.8	1.6	1.3	1.4	1.4	1.1	1.3	1.2	1.1	1.3
Durable Goods	1.4	1.9	2.1	2.2	2.4	2.5	2.9	2.9	3.1	1	2.1
Non-food	6.4	7.3	6.7	7.1	7.2	7.4	7.3	7.5	7.6	5.2	6.5
Urban											
Cereals and Pulses	-10.6	-8.5	-7.2	-6.1	-5.3	-5	-4.2	-3.6	-2.8	-1.1	-3.7
Milk & Milk Products	1.9	1.2	0.7	0.4	0	-0.2	-0.3	-0.5	-0.2	0.1	0.2
Edible Oil	-0.3	-0.5	-0.6	-0.7	-0.6	-0.6	-0.6	-0.5	-0.4	-0.1	-0.3
Vegetables	-1.8	-1.6	-1.5	-1.4	-1.3	-1.4	-1.4	-1.1	-0.9	-0.3	-0.8
Fruits	1.3	1.3	1	0.7	0.8	0.5	0.4	0.3	0	-0.1	0.4
Spices	-1.1	-1.1	-0.9	-0.9	-0.7	-0.6	-0.4	-0.4	-0.3	0	-0.3
Sugar	-0.9	-0.9	-0.9	-0.9	-0.7	-0.7	-0.6	-0.5	-0.5	-0.2	-0.5
Egg, Fish & Meat	1.5	0.3	-0.3	-0.5	0	-0.1	-0.3	-0.2	-0.6	-0.1	-0.1
Beverages, Processed food	1.3	1.6	1.6	1.6	1.5	1.9	1.4	1.5	1.6	2.4	1.6
Food	-8.7	-8.1	-7.9	-7.5	-6.2	-6.2	-5.9	-5	-4	0.7	-3.4
Pan, Tobacco & Intoxicants	0.6	0.5	0.4	0.4	0.8	0.8	0.6	0.8	0.9	1.1	0.8
Fuel and Light	-0.9	-0.7	-0.5	-0.6	-0.6	-0.4	-0.6	-0.7	-0.7	-0.5	-0.4
Clothing and Footwear	-0.7	-0.8	-1	-0.9	-1.2	-1.2	-1.2	-1	-1	-1	-1
Education	0.4	0.3	0	0	-0.4	-0.7	-0.3	-1	-1.9	-1.8	-1.1
Medical	0.8	0.4	0.7	0.7	0.5	-0.1	0.2	0.3	0.2	0.7	0.4
Rent, Taxes and Cesses	-0.4	-0.5	-0.3	-0.4	-0.4	-0.1	0.1	0	0.8	0	-0.3
Household Consumables	1.2	1.1	1.1	1	1	1.1	1.1	1.1	1.1	0.9	1.1
Entertainment	0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	0	0	0	0
Conveyance	4	4.1	3.8	3.6	3.2	3	2.6	2.5	2.3	0.1	2.1
Consumer Services	1.8	1.7	1.7	1.5	1.2	1.2	0.8	0.5	0.2	-0.9	0.3
Durable Goods	1.7	2.1	2.3	2.6	2.4	2.7	2.6	2.3	2.2	0.5	1.6
Non-food	8.7	8.1	7.9	7.5	6.2	6.2	5.9	5	4	-0.7	3.4

Note: This table reflects the changes in consumption shares between 2011–12 and 2022–23.

Source: Estimates are derived from NSS Reports No. 555 and 591.

4.2 Dietary Transition to Processed Foods

The internal composition of food expenditure also changed sharply. In both rural and urban India, beverages and processed foods now account for a larger budget share, while cereals and pulses account for much less. In rural India, the share of cereals and pulses falls by 6.8 percentage points, compared with a 1.7 percentage point increase in beverages and processed foods. In urban India, cereals and pulses fall by 3.7 percentage points and beverages and processed foods rise by 1.6 percentage points. Lower-decile households also register increases in the shares of fruits and, in rural India, milk products and animal-source foods.

The most careful interpretation is that Indian diets are diversifying away from staple-heavy bundles, — possibly supported by the availability of subsidised

grains but not necessarily in a uniformly healthy direction. Simultaneously, the growing share of processed foods indicates an ongoing dietary transition shaped by convenience, evolving consumer preferences, and deeper market penetration of packaged products. The concurrent fall in vegetable consumption (–1.2 pp in rural and –0.8 pp in urban areas) further reinforces this shift in dietary patterns.

4.3 Structural Shift Toward Non-Food Consumption

The counterpart to declining food shares is the increased weight of non-food expenditure in both regions (Figure 2). In rural India, the non-food share rises from 47.1% to 53.6%; in urban India, it rises from 57.4% to 60.8%.

Table 3 shows that the largest positive changes are concentrated in conveyance, durable goods, household consumables, and, in several deciles, health expenditure. These shifts point to growing demand for mobility, market-mediated services, and household assets. Urban spending on education fell by 1.1 pp, possibly reflecting greater use of online learning platforms or increased dependence on public education. In contrast, conveyance expenditure increased substantially (by 3.3 pp in rural areas and 2.1 percentage points in urban areas), indicating rising mobility needs. Spending on durable goods rose by 2.1 pp in rural areas and 1.6 pp in urban areas, while household consumables recorded a 1.1 pp increase in both.

Interpretation again depends on category. Rising expenditure on conveyance and durable goods is consistent with improved connectivity and a greater capacity to finance consumer assets. Rising household consumables may reflect quality upgrading within routine purchases. Health expenditure, however, should be read with caution because a larger budget share may capture higher need or higher prices rather than better health outcomes.

4.4 Increasing Expenditure on Intoxicants

Spending on pan, tobacco, and intoxicants rose marginally, by 0.6 pp in rural and 0.8 pp in urban areas. This could reflect evolving social behaviours, stress factors, or even enhanced accessibility and affordability. The increase is quantitatively small relative to the larger reallocation toward transport, durables,

and services, but it is policy-relevant because even small increases in these categories can offset welfare gains for poorer households.

4.5 Structural Convergence in Spending Behaviour

Several dimensions of expenditure are converging across rural and urban India. The rural-urban gap in staple spending has narrowed, and both regions show higher shares for processed foods, conveyance, durable goods, and household consumables. These common movements indicate that market integration, rising aspirations, and wider access to consumer goods are reshaping budgets in broadly similar ways across space. Overall, it reflects a common shift toward lifestyle-oriented goods and services.

Yet convergence in composition should not be mistaken for convergence in welfare conditions. Urban households continue to devote much larger shares to housing, education, and several service-intensive categories, while rural households remain more exposed to basic food and health spending. The decade therefore brought partial convergence in budget structure, but not the disappearance of the underlying gaps in access, quality, and vulnerability.

4.6 Heterogeneity Across Income Deciles

Table 3 further shows that the decade's structural change is heterogeneous across the distribution. The decline in cereals, pulses, and vegetables is steepest in the lower rural deciles and in the lower half of the urban distribution. Poorer households also increase the shares of fruits, milk products, and, in some cases, eggs, fish, and meat, which is consistent with movement away from the most calorie-dense but least diverse food bundles. By contrast, the rise in beverages and processed foods is visible almost everywhere, including the middle and upper deciles.

The non-food changes are likewise uneven. Conveyance rises across almost all deciles, suggesting broadening mobility needs. Durable goods contribute more strongly in upper deciles, while consumer services and household consumables rise more for lower deciles in several cases. The distributional pattern therefore combines two processes: some categories are becoming more evenly accessible, while others remain strongly tied to position in the consumption distribution.

1 Real MPCE Growth between 2011-12 and 2022-23

Nominal MPCE rose sharply over the decade, from Rs. 1,430 to Rs. 3,773 in rural India and from Rs. 2,630 to Rs. 6,459 in urban India. This reflects a nominal consumption growth of 163.8% in rural areas and 145.6% in urban areas. Those increases, however, overstate improvements in purchasing power because they incorporate substantial inflation.

Consequently, adjusting for inflation is necessary for accurately estimating real consumption growth and for a meaningful welfare comparison. We use sector-specific consumer price indices published by MoSPI to construct real MPCE for total expenditure and, where possible, for food and non-food subaggregates. This adjustment is essential because the paper's central question is not how much nominal spending rose, but whether households were able to get more real consumption. The results in Table 4 show that real gains were substantial, but much smaller than nominal growth rates suggest.

5.1 Trends in Broad Categories

Table 4 presents the growth of key indicators of the consumption basket. First, it indicates that, when adjusted for inflation, the rural MPCE increased by 40.4%, while the urban MPCE rose by 33.5%. This reflects a CAGR of 3.1% in rural areas and 2.7% in urban areas, resulting in a rural-urban gap of 0.4 pp. This suggests a modest rate of real consumption growth at the national level and highlights regional disparities in growth patterns. Second, the data indicate a *marginal* convergence between rural and urban consumption levels. Third, the rise in non-food expenditure exceeds that of food expenditure in both rural and urban areas. This reinforces the previous observation of a distinct structural shift away from food spending. Fourth, rural areas exhibit higher overall growth rates in both food and non-food expenditures relative to urban areas. Food remains a relatively important component of consumption growth; however, the significantly higher real growth in non-food expenditure suggests an overall improvement in living standards and a diversification of consumption patterns in rural India.

Several insights arise throughout the decile distribution (see Table 4). *First*, real MPCE growth is positive across all deciles, but it is weakest at the top, especially in the urban top decile. In urban areas, consumption growth declines consistently

across higher deciles, whereas in rural areas, it shows a sharp drop only in the top decile, with stability between 41% and 45%. *Second*, across all deciles, non-food expenditure growth substantially exceeds food expenditure growth. The disparity in food and non-food consumption growth is more evident in rural areas, potentially indicating evolving rural aspirations, driven by rising incomes. *Third*, food expenditure growth is relatively uniform across rural deciles, except for a drop in the top decile (D10), indicating a broad-based improvement in basic consumption. *Fourth*, non-food expenditure growth is notably higher in the lower deciles than in the top decile across sectors, highlighting a bottom-up growth pattern that underscores the redistributive impact of growth. *Finally*, the muted consumption growth observed among the top deciles suggests saturation effects, in which higher-income households exhibit a reduced likelihood of proportionally increasing consumption with income.

Table 4: Real MPCE Growth across Decile Class (%)

	Rural			Urban		
	Food	Non-food	Total Expenditure	Food	Non-food	Total Expenditure
D1	27	63.2	41.4	27.7	92.7	55.6
D2	26.9	68.6	43.5	26.6	85.7	53.4
D3	28.9	66.7	44.3	23.5	79.9	50
D4	28.2	68.3	44.7	19.9	72.4	45.4
D5	27.7	68.6	44.9	20.4	64.5	42.9
D6	27	69.1	45.2	18.6	61.6	41.1
D7	26.7	67.7	45	16.9	58	39.1
D8	25.1	66.4	44.2	16.1	51.6	36.1
D9	21.9	63.2	42	16.1	45.9	33.8
D10	14.2	40.5	29.6	13.7	16.9	15.5
All	23.8	58.8	40.4	18.1	44.6	33.5

Source : Estimate are derived from NSS Reports No. 555 and 591

To evaluate the factors contributing to the increase in real MPCE between 2011-12 and 2022-23, the growth in real MPCE has been decomposed into broad categories of food and non-food items. The increase in real MPCE for each category is estimated by deflating the 2022-23 MPCE using item-specific CPI-Rural and CPI-Urban indices. The categorisation of price indices and MPCE for food items is coherent, thereby eliminating any complications in deflating the MPCE of food items. Nonetheless, discrepancies were observed in the categorisation of MPCE and price

indices for certain non-food items. To address this for the rural sector, categories such as household consumables, entertainment, conveyance, consumer services, durable goods, and rent, taxes, and cesses were integrated into a single group, “Miscellaneous.” For the urban sector, too, household consumables, entertainment, conveyance, consumer services, and durable goods were classified as “Miscellaneous”.

Rural Sector

Table 5 illustrates a significant structural transformation in household consumption patterns across both rural and urban sectors. Food items contribute less to consumption growth than non-food items across sectors, accounting for 29.8% in rural and 22.6% in urban areas. The contribution of food items to total MPCE growth declines progressively across higher deciles in both sectors, except in the top decile of the urban sector. This trend underscores a shift towards dietary diversification and evolving consumption patterns.

Table 5: Decomposition of Real Consumption Growth

Rural											
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	All
Cereals and Pulses	-17.1	-14.6	-12.1	-10.8	-9.3	-8.6	-7.4	-7.1	-6.3	-5.7	-8.6
Milk & Milk Products	14.4	12.4	13.7	12.3	11.7	11.2	10.4	9.1	7	4.1	9.5
Edible Oil	6.4	5.1	4.5	3.8	3	2.7	2.1	1.8	1.3	0.6	2.5
Vegetables	5.6	4.8	4.6	4.8	4.5	4.5	4.1	3.6	3.2	2.5	3.9
Fruits	7.4	7.8	7.7	8	7.7	7.7	7.3	6.9	6.4	5.6	7.0
Spices	1.5	1.3	0.9	0.7	0.6	0.2	0.1	0	0	-0.2	0.3
Sugar	1.3	0.9	0.7	0.6	0.3	0.1	0.1	-0.1	-0.4	-0.8	0.0
Egg, Fish & Meat	8.0	6.5	4.4	4.2	4.0	2.4	2.5	2.5	1.9	0.0	2.8
Beverages, Processed Food	10.9	12	13	12.2	12	12.7	12.8	12.7	12.4	12.2	12.4
Food	38.4	36.2	37.4	35.8	34.5	32.9	32	29.4	25.5	18.3	29.8
Pan, Tobacco & Intoxicants	6.0	5.0	4.6	3.9	4.2	4.1	3.4	3.8	4.0	3.0	3.9
Fuel and Light	0.5	1.5	1.6	2.1	2.3	2.4	2.4	2.5	2.0	1.7	2.0
Clothing and Footwear	5.9	5.6	5.2	4.7	4.3	3.5	3.7	3.4	2.8	1.7	3.6
Education	2.7	3.2	2.9	3.2	3.1	3.5	3.0	3.1	2.9	2.2	2.9
Medical	3.5	4.2	3.8	5.3	5.8	6.0	6.8	6.9	8.6	15.1	7.8
Miscellaneous	43.0	44.3	44.5	45.0	45.8	47.6	48.7	50.9	54.2	58.0	50.0
Non-food	61.6	63.8	62.6	64.2	65.5	67.1	68.0	70.6	74.5	81.7	70.2
Total Expenditure	100	100	100	100	100	100	100	100	100	100	100
Urban											
Cereals and Pulses	-10.2	-7.8	-7	-6.7	-5.9	-6.2	-5.1	-5	-3.9	-4.6	-5.7

Milk & Milk Products	11.8	11.4	10.6	9.8	8.9	8.0	7.2	6.2	6.3	6.0	8.0
Edible Oil	4.2	2.9	2.6	1.9	1.6	1.3	1.1	0.8	0.8	0.8	1.5
Vegetables	1.5	1.2	0.8	0.6	0.2	-0.5	-0.7	-0.5	-0.5	-1.1	-0.1
Fruits	5.9	6.4	6.0	6.0	6.6	6.0	5.8	5.4	4.9	4.4	5.6
Spices	1.0	0.6	0.5	0.2	0.5	0.5	0.7	0.5	0.7	0.9	0.6
Sugar	0.5	0.3	0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.4	-0.2
Egg, Fish & Meat	5.5	3.0	1.7	0.9	1.6	1.4	0.7	0.7	-0.7	-1.5	0.8
Beverages, Processed Food	9.1	10	10.3	10.5	10.5	11.5	10.6	11.3	11.8	20.5	12.1
Food	29.3	28	25.6	23	23.8	21.7	20	19.1	19.1	25	22.6
Pan, Tobacco & Intoxicants	3.1	2.7	2.6	2.5	3.1	3.4	2.8	3.3	3.5	7.1	3.6
Fuel and Light	7.8	7.2	7.0	6.0	5.5	5.6	4.6	3.7	2.8	0.1	4.4
Clothing and Footwear	5.5	4.7	3.8	3.7	2.8	2.6	2.5	2.4	1.9	-2.4	2.3
Education	3.7	4.4	4.3	4.5	4.1	3.6	5.3	3.7	1.5	-3.2	2.8
Medical	5.6	5.1	6.1	6.5	6.1	5.1	6.0	6.7	6.6	11.2	6.8
Rent, Taxes and Cesses	0.8	1.2	2.2	2.6	3.7	5.3	6.7	7.6	11.4	12.6	6.5
Miscellaneous	44.2	46.7	48.4	51.2	50.9	52.7	52.1	53.5	53.2	49.6	51.0
Non-food	70.7	72.0	74.4	77.0	76.2	78.3	80	80.9	80.9	75.0	77.4
Total Expenditure	100	100	100	100	100	100	100	100	100	100	100

Source: Estimates are derived from NSS Reports No. 555 and 591

In the rural sector, food consumption growth is primarily driven by beverages and processed foods (12.4%), milk and milk products (9.5%), and fruits (7%). Cereals and pulses demonstrated a negative impact on the overall rise in consumption, indicating improved dietary diversification and a shift away from staple-heavy diets.

In the lowest deciles, the highest contribution comes from milk and milk products (14.4%), followed by beverages and processed foods (8.0%), eggs, fish, and meat (8.0%), fruits (7.4%), edible oils (6.4%), and vegetables (5.6%). In contrast, consumption growth in the top deciles is primarily driven by beverages and processed foods (12.2%), as well as fruits, milk and milk products, with minimal contributions from other items.

Within non-food categories, 'miscellaneous', encompassing diverse items and services, exhibits the highest contribution, rising from 43% in the lowest decile to 58% in the top decile. This indicates that the gradual increase in rural consumption is increasingly driven by discretionary goods, suggesting an improvement in the lifestyles of rural households. Medical expenses rise across deciles, while other non-food categories contribute less and diminish as income rises.

Urban Sector

A similar pattern is evident in the urban sector. The primary contributors to MPCE growth are beverages and processed foods (12.1%), milk and milk

products (8%), and fruits (5.6%). In contrast, cereals and pulses exhibit a negative impact on total incremental consumption across deciles.

In the poorest deciles, consumption growth is primarily driven by milk and milk products (11.8%), beverages and processed foods (9.1%), fruits (5.9%), eggs, fish, and meat (5.5%), and edible oil (4.2%). The richest decile accounts for the highest contributions from beverages and processed foods (20.5%), milk and milk products (6.0%), and fruits (4.4%), while other categories show minimal or negative contributions. Notably, the share of beverages rises steadily from 9.1% to 20.5% across the deciles. In non-food categories, miscellaneous items, rent, and medical expenses make substantial contributions, with their proportions rising across deciles.

6 Inequality in MPCE

The Gini coefficient is the simplest measure of income inequality. According to the NSS Reports No. 555 and 591, the Gini coefficient of MPCE dropped from 0.283 in 2011-12 to 0.266 in 2022-23 in rural India, and from 0.363 to 0.314 in urban India. Those aggregate measures are useful, but they do not reveal where inequality remains concentrated across specific categories of expenditure. To complement the Gini, we therefore examine the ratio of average expenditure in the top decile to that in the bottom decile.

This decile-dispersion ratio (DDR) is attractive because it is transparent, easy to interpret, and policy-relevant. A DDR of 5 means that the richest tenth of households spends five times as much as the poorest tenth on a given item. In contrast, a Gini coefficient of 0.6 indicates severe inequality but is less intuitive for a general audience. Unlike a single summary statistic, the DDR makes it possible to see whether inequality is narrowing in basic consumption while remaining entrenched in categories linked to housing, human capital, or asset ownership. The measure is simple, but for the purposes of this paper that simplicity is a strength rather than a weakness.

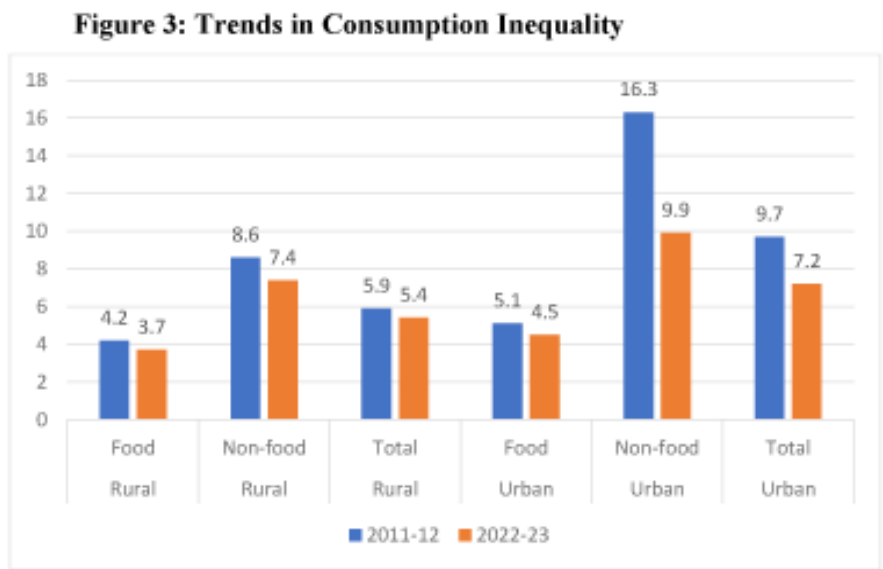
Figure 3 reports inequality in broad expenditure groups, and Table 6 presents item-specific DDR values for 2011-12 and 2022-23 in rural and urban India.

6.1 Rural Inequality

6.1.1 Incidence of Inequality

Figure 3 indicates that rural inequality in total MPCE remains sizeable but has fallen modestly: the top decile spent 5.4 times as much as the bottom decile in 2022-23, down from 5.9 in 2011-12. Food inequality is lower than non-food inequality, with DDR values of 3.7 and 7.4 respectively in 2022-23. This ordering is substantively important. It suggests that basic consumption is more evenly distributed than access to non-food goods and services, even after a decade of declining inequality.

Figure 3: Trends in Consumption Inequality



Source: Authors' calculations based on HCES 2022–23 and HCES 2011-12 data.

Table 6 shows that, within rural food expenditure, the largest remaining disparities are in fruits, milk products, beverages and processed foods, and eggs, fish, and meat. By contrast, cereals, pulses, edible oil, and vegetables exhibit relatively low dispersion. This is exactly what one would expect if essential calorie consumption has become more equal while quality-differentiated diets remain unequal.

On the non-food side, the most significant consumption gaps are observed in durable goods, health, education, entertainment, and conveyance. Wealthier

households are more inclined to purchase durable goods such as appliances and vehicles, and they typically allocate substantially more resources to private healthcare and education, in contrast to the public services accessed by poorer households. Discretionary expenditure on entertainment and conveyance, including travel and leisure pursuits, is more prevalent among wealthier households, reflecting their greater financial ability.

6.1.2 Change in Inequality

The rural DDR declines for total expenditure, food, and non-food between 2011-12 and 2022-23, and the reduction is especially visible in fruits, milk products, animal-source foods, conveyance, durable goods, education, and entertainment (see Column 4). This pattern is consistent with some broadening of access beyond the top of the distribution. Even so, the remaining levels of inequality are large enough that the improvement should be described as meaningful but incomplete.

Table 6: Consumption Inequality

Items	Rural			Urban		
	2011-12	2022-23	Change	2011-12	2022-23	Change
Cereals and Pulses	2.0	2.2	0.2	1.9	2.2	0.3
Milk and Milk Products	11.6	5.5	-6.1	7.7	4.5	-3.2
Edible Oil	2.8	2.0	-0.8	2.5	1.9	-0.6
Vegetables	2.5	2.4	-0.1	2.8	2.4	-0.4
Fruits	20.6	7.6	-13	18.6	7.9	-10.7
Spices	3.2	2.7	-0.5	2.5	2.5	0
Sugar	3.7	2.4	-1.3	2.3	1.8	-0.5
Egg, Fish and Meat	9.1	4.3	-4.8	5.6	2.9	-2.7
Beverages, Processed Food, etc.	6.4	5.8	-0.6	14.2	10.9	-3.3
Food	4.2	3.7	-0.5	5.1	4.5	-0.6
Pan, Tobacco and Intoxicants	6.2	4.4	-1.8	4.1	4.9	0.8
Fuel and Light	2.7	2.9	0.2	4.1	2.9	-1.2
Clothing and Footwear	4.0	3.4	-0.6	6.9	4.6	-2.3
Education	21.7	14.1	-7.6	33.7	17.6	-16.1
Health	17.4	17.7	0.3	18.5	12.2	-6.3
Rent	-	-	-	62.6	58.5	-4.1
Household Consumables	4.7	3.9	-0.8	6.5	5.0	-1.5
Entertainment	18.9	13.1	-5.8	15.7	11.6	-4.1
Conveyance	23.4	10.5	-12.9	47.8	10.9	-36.9
Consumer Services	11.2	7.5	-3.7	22.5	9.7	-12.8
Durable Goods	30.8	18.4	-12.4	61.1	23.5	-37.6
Non-Food	8.6	7.4	-1.2	16.3	9.9	-6.4
Total Expenditure	5.9	5.4	-0.5	9.7	7.2	-2.5

Source: Estimates are derived from NSS Reports No. 555 and 591.

6.2 Urban Inequality

6.2.1 Incidence of Inequality

Urban inequality is both higher and more layered than rural inequality. In 2022-23, the urban DDR is 7.2 for total MPCE, 4.5 for food, and 9.9 for non-food expenditure. The higher urban dispersion indicates that cities combine

diversification and opportunity with sharper stratification in market access. Put differently, urban households participate more intensively in the non-food economy, but they do so on highly unequal terms.

Beverages and processed foods exhibited the highest consumption disparity in the urban sector in 2022–23, with the richest households spending 10.9 times more than the poorest. Subsequently, fruits accounted for 7.9, while milk represented 4.5. The expenditure disparity across other food categories is narrower, ranging from 2 to 3.

The most significant inequalities in the non-food category were observed in rent (58.5) and durable goods (23.5), as well as in education, health, conveyance, entertainment, and consumer services. Comparable findings were recorded by Mitra and Shrivastav (2024).

These urban inequalities have direct policy relevance. High dispersion in rent points to the unequal burden of urban housing markets; high dispersion in health and education signals unequal reliance on private provision; and high dispersion in durable goods and conveyance reflects broader inequality in assets and mobility. The urban evidence therefore suggests that declining inequality in aggregate expenditure has not closed the gap in the infrastructure of everyday life.

6.2.2 Change in Inequality

Urban inequality declines markedly between 2011-12 and 2022-23, from 9.7 to 7.2 for total expenditure and from 16.3 to 9.9 for non-food expenditure. Bansal *et al.* (2024) demonstrated that the consumption spending gap between the top and bottom 10% households diminished during this period. The fall is broad-based and especially large for durable goods, conveyance, consumer services, and education. These changes indicate that some categories previously concentrated at the top became more widely accessible over the decade. The reduction in urban consumption inequality was primarily driven by fruits within the food category, and by durable goods, conveyance, education, and consumer services in the non-food category (see Column 7). Other items exhibited only slight reductions.

Overall, the level of urban inequality remains high in precisely the

categories that matter most for economic security: rent, health, education, and several service-intensive items. The correct conclusion is therefore not that urban consumption inequality has been solved, but that the structure of inequality has shifted. Basic access improved, yet key barriers to high-quality housing and privately purchased services remain substantial.

Across both regions, the inequality evidence supports a common interpretation. The decade brought compression in essential consumption and some diffusion of non-food access, but not full convergence in the categories most closely linked to human development and protection against risk. That distinction should shape how the new HCES evidence is read in policy debates.

7 Conclusion

This paper re-examines household consumption in India using the 2022-23 HCES and the comparable 2011-12 round. The central result is that India's consumption transition is broad-based but uneven. Food's budget share has fallen across most of the distribution, non-food expenditure has become the dominant component of household budgets in both rural and urban India, and real MPCE has grown for nearly all deciles. These patterns are consistent with rising purchasing power and an ongoing shift away from staple-centred consumption.

The paper's contribution is to show that these changes cannot be understood from aggregate averages alone. Decile-level evidence reveals that lower and middle deciles participated in the transition, particularly through rising real non-food expenditure and some diversification of food demand. At the same time, the decomposition of growth and the inequality analysis show that the strongest remaining gaps are concentrated in health, education, housing, durable goods, and other service-intensive categories. Falling overall inequality therefore coexists with persistent inequality in economically consequential forms of consumption.

Our findings have some policy implications. First, the decline in food shares should not be read as reducing the importance of food policy; rather, it shifts attention toward diet quality, food diversity, and the growing role of processed foods. Second, stronger real growth in non-food expenditure highlights the need

to expand affordable access to transport, housing, healthcare, and education, especially for lower deciles in urban areas and for rural households facing high out-of-pocket medical costs. Third, because inequality is now more concentrated in essential non-food services than in basic staples, welfare policy should focus less on average expenditure growth alone and more on reducing the unequal price and quality of foundational services. The HCES shows that while India has made progress in broadening basic consumption, closing the gap in capability-enhancing expenditure should be the immediate priority of the policymakers.

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Revisiting the Financial Kuznets Curve: How Financial Development, Governance, and Green Economy Drive Renewable Energy Consumption in Selected G20 Countries

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Abstract

This study investigates the non-linear relationship between financial development (FD) and renewable energy consumption (REC) by testing the Financial Kuznets Curve (FKC) hypothesis across 16 G20 countries from 1996 to 2022. To test the FKC hypothesis, both linear and cubic dynamics are implemented using different estimators: pooled OLS, fixed-effects, random-effects, and fully modified ordinary least squares. The empirical results reveal that the proposed research is an inverted N-FKC. The inverted N-shaped FKC is explicitly substantiated by the coefficients with $\hat{\alpha} < 0$, $\hat{\alpha} > 0$, and $\hat{\alpha} f < 0$. The positive optimal FKC indicates that FD curtailed, fostered, and curbed the REC as FD increased from low to high. In addition, green GDP and foreign direct investment aided the REC. This finding indicates institutional heterogeneity among the G20 countries. The results validate the need for G20 countries to balance and sustainably develop the financial sector to support the renewable energy transition.

Keywords: Financial Kuznets Curve; Financial Development; Green Economy; Renewable Energy Consumption

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Introduction

As the global population increases, the demand for both alternative energy sources and fossil fuels escalates. Sustainable energy should be prioritised over fossil fuels for environmental protection (Youm, 2000; Panwar et al. 2011). Renewable energy reduces greenhouse gas (GHG) emissions and provides energy security and independence from oil and gas. Renewable energy will grow in the global energy mix due to rising energy demand, a commitment to reducing climate pollution, technological advances, and government support.

RECs come from renewable sources like solar, wind, hydro, geothermal, and biomass. This marks a major shift away from non-renewable energy sources, particularly fossil fuels like coal, oil, and natural gas, which have long dominated global energy systems despite their environmental, economic, and geopolitical impacts. REC's ability to reduce GHG emissions and prevent climate change is making it popular. Research shows that renewable energy technologies like wind and solar power produce minimal emissions, while fossil fuels account for 75% of global CO₂ emissions and contribute to global warming. REC reduces energy security risks posed by unpredictable fossil fuel markets and geopolitically fragile regions while improving the environment. Renewable energy sources are frequently indigenous and limitless, protecting nations from oil and gas supply outages and price variations. The Paris Agreement (2015), which limits global warming to 1.5°C above pre-industrial levels, has hastened the phase-out of non-renewable energy and fossil fuels (UNFCCC, 2021). Renewable energy solutions for rural electrification and electricity access are growing in developing nations (Munasinghe, 2010). Global policies prioritise renewable energy-based sustainable development. Kayusuz (2007) added that renewable energy will modernise the energy sector and push countries' economic development and sustainability goals.

G20 countries,¹ which produce 80% of global GDP and 75% of GHG emissions, shape decarbonisation efforts with their REC policies (IEA, 2023). China, the world's top renewable energy investor, leads in solar and wind capacity and wants carbon neutrality by 2060. The US Inflation Reduction Act (2022) invests

Australia, Brazil, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Republic, Mexico, Russian Federation, South Africa, Turkey, United Kingdom and United States

²Where; $NC = CE + RD$

\$369 billion in clean energy, including tax credits for industrial and renewable energy. By 2030, Europe's Green Deal aims to use 40% renewable energy, with Germany and Spain leading in wind and solar adoption. India aims to build 500 GW of solar capacity by 2030 to meet its energy needs sustainably. Brazil, which relies on bioenergy and hydropower, gets over 80% of its electricity from renewable sources, demonstrating that large-scale REC integration is possible (EPE, 2023).

Recent research on the Kuznets (1955) curve shows an inverse-U shape, especially as nations migrate from basic to sophisticated financial systems, strongly reliant on banking operations and equity markets, and adopt new technology. Financial development fosters income equality and the switch to renewable energy by reaching more people. Although theoretically sound, no empirical evidence exists on the nonlinear relationship between financial development and renewable energy consumption. Researchers found nonlinearities in financial development and energy use using time-series data. Time-series data have been used to study these non-linearities across numerous nations (Chang, 2015; Yue et al., 2019), but the results are inconclusive. This research models the Financial Kuznets Curve (FKC) in a novel way, utilising energy efficiency indicators to assess environmental sustainability (Irfan et al., 2022; Khan et al., 2022). The study is premised on the following hypotheses:

H₀: There is an absence of an FKC inverted N-shaped relationship between financial development and renewable energy consumption.

H₁: There is a presence of an FKC inverted N-shaped relationship between financial development and renewable energy consumption.

Although recent, the N-shaped Environmental Kuznets Curve (EKC) was discovered in the 1990s. Since the N-shape was peripheral to mainstream data collecting and disregarded, the joint study yielded few findings during the second transitional phase. The N-shaped EKC was initially examined using fixed-effects models (FEM) and cross-sectional ordinary least squares (OLS) by Moomaw and Unruh (1997).

This study explores the FKC, the non-linear relationship between financial development (FD) and renewable energy consumption (REC). Our research tests the FKC in 16 selected G20 countries from 1996 to 2022 to examine the

inverted N-shaped relationship between REC and FD. By studying this inverted N-shaped FKC, we hope to fill a major research need. We found no prior research on the FKC inverted N-shaped relationship between REC and FD, incorporating external control variables like green GDP, governance indicators, FDI, TNRR, CO₂ emissions, and CPI. This link has been studied in several ways, but this dimension has not (Trinh et al., 2022; Mohsin et al., 2022). Based on data from selected G20 countries, this paper predicts an inverted N-shaped link between lnREC and FD. The inverted N-shaped FKC literature is underdeveloped; therefore, this study contributes to scholarly discourse.

This study makes several important contributions to the literature. First, it is the first study to examine the inverted N-shaped relationship between FD and REC using the FKC framework, focusing on the significance and pattern of the beta coefficient. The study examines the impact of FD on REC, including governance quality, green GDP, FDI, TNRR, CPI, and CO₂ emissions, with rigorous causality analysis. Third, by developing a green economy metric grounded in the literature, this research advances sustainable economic growth. This study uses a multidimensional financial development index with bank-centric components, unlike previous research that used aggregate indices. Notably, we fill the research gap noted by Doytch et al. (2023), who discovered no FKC for credit market development. We extend their study by disaggregating financial development characteristics to determine whether specific components affect renewable energy uptake. This disaggregated approach helps policymakers use financial sector development to achieve sustainable energy goals by revealing how different aspects of financial development affect the transition to renewable energy.

Structure of the rest of the paper: Section 2 reviews previous studies. Part 3 covers the theoretical foundation, model, data, and empirical estimation. Discussion and results are in Section 4. Section 5 summarises the work, while Section 6 examines policy implications and constraints.

2. Review of Literature

Financial Development and Renewable Energy Consumption

People with simple financial access invest more in the economy. The organisation's entry will advance green technology. Financial development

boosts energy technology and benefits the environment. Recent studies have examined the relationship between financial system development and energy consumption (Sadorsky, 2011; Çoban & Topcu, 2013; Mahalik & Mallick, 2014; Shahbaz et al., 2017). Financial development also benefits the environment and promotes the development of energy technology. Investing in renewable energy is environmentally and economically sustainable (Nawaz et al., 2021). Financially strong economies have clear execution procedures. The environment-growth-energy model encompasses financial development factors, as outlined in earlier studies (Farhani & Ozturk, 2015; Dogan & Seker, 2016). Sadorsky (2010) examines how levels of financial development affected energy consumption in 22 emerging economies from 1990 to 2006. This panel sample found that financial progress is associated with increased energy use.

Empirical data show a positive linear relationship between FD and energy demand; however, not all studies agree with this finding. The results' uncertainty suggests non-linearity. FD may initially boost REC demand by boosting business activity, thereby increasing energy demand. Many studies have examined non-linearity in the finance-energy relationship. Alvarado et al. (2021) examine the relationship between economic advancement and energy consumption in 27 European states, finding a strong correlation among founding EU members and a U-shaped trend among new members. Based on a panel of 85 nations, Doytch et al. (2023) found an inverted U-shaped relationship between FDI and economic growth, as well as between income and energy consumption.

Governance and Renewable Energy Consumption

For environmental quality and simulated variable interactions, governance is necessary because all study variables are interrelated. According to Rohrkasten (2015), the generation of energy from renewable sources will not progress on its own. Energy governance and policy are interconnected; hence, global renewable energy governance is crucial. Public finance and oversight are needed for renewable energy. It is impossible to guide them solely through government interventions such as planning (Jessop, 2018; Pierre & Peters, 2020). Nationwide energy availability grows with good governance (Stritzke et al., 2021). Sarkodie & Adams (2020) suggest that improved institutions, governance, and the rule of law can enhance the energy sector by empowering Sub-Saharan Africans.

Green energy governance must strike a balance between goals and foster cooperation. To grasp the issue, discourses must be translated (Smith et al., 2005). The regional administration must convince citizens that renewable energy is essential for growth. Olaniyi et al. (2025) in an African nation and Huang et al. (2022) in selected ASEAN countries find a positive influence of REC. Rafiq et al. (2024) examined the role of institutional quality in promoting renewable energy in 18 OECD countries. Studies contradict previous findings and show that government quality influences REC. Renewable energy is negatively influenced by governance quality (Asongu & Odhiambo, 2022) in 44 SSA countries, (Saadaoui & Chtourou, 2023) in Tunisia, (Pan et al., 2023) in 42 African countries (Nguyen & Dang, 2024), and in a panel of 147 developed and developing nations.

Green GDP and Renewable Energy Consumption

Green economies (GEs) address environmental and economic issues (Mealy & Teytelboym, 2022). Hassan et al. (2023) say it boosts economic growth and protects the environment. Green economic growth requires renewable and alternative energy (Stegemann & Ossewaarde, 2018). Most GDP, taxes, budget income, employment, and exports come from energy (Ram et al., 2020). Energy efficiency, decarbonisation, and growth of the fuel and energy sector are priorities in the global green economy (Omurova et al., 2021). Few studies have examined green funding, renewable energy investments, and green economic development. According to Hu et al. (2014), green finance supports the green economy. Green investment focuses on the enterprise, according to Zhou et al. (2019). Zhou examined the company's green investment status, obstacles, and solutions. The global, national, and business adoption of green economies promotes sustainable development (Ghaffari et al., 2014). Transitioning to sustainability, green investment, and ecologically balanced growth increased clean and renewable energy consumption in growing economies (Shahbaz et al., 2017). EKC theory states that rich nations replace polluting industrial structures with cleaner ones, increasing renewable energy demand (Grossman & Krueger, 1995). The Porter hypothesis states that well-designed environmental regulations, often part of green economic policies, can encourage innovation and efficiency, thereby promoting the adoption of renewable technologies. Green growth methods increase REC, especially in

nations that incorporate environmental factors into macroeconomic planning (Acheampong et al., 2021). Stricter environmental regulations and increased green infrastructure spending accelerate the adoption of renewable energy (Bhattacharya et al., 2016). Policy alignment through green economic frameworks promotes the REC, according to statistics. Most studies agree that GGDP supports REC, although others vary by country development, institutional quality, and energy mix. Green GDP increases REC in high-income countries but not low-income ones due to financial and technological constraints (Al-Mulali et al., 2015).

3. Theoretical Framework, Model, and Data

3.1 Theoretical Framework

The theoretical framework asserts that energy consumption depends on the need for commodities and services. Thus, we observe a neo-classical model of cost reduction, in which an organisation selects the best inputs, such as power, based on its technological competencies. Financial development is included in the manufacturing process to increase the productivity of all factors. The study incorporated the Financial Development variable aligns with the model proposed by (Adom & Amuakwa-Mensah 2016; Adom et al., 2019; Doytch et al., 2023).

We suggested that the production technique can be described as

$Y = AE^\alpha Z^\gamma$ (1) To reduce the expense of generating product Y, the Lagrangian function is expressed as:

$$L = P_E E + P_Z Z + \lambda[Y - AE^\alpha Z^\gamma] \quad (2)$$

where Y, P_E , E, P_Z , and Z represent the output, the prices of factors of production, the amount of energy input, the value of a complex good that approximates any additional components, and the aggregate quantity of the compound product. A denotes the total productivity of factors, dependent on the degree of FD and FDI. Additionally, $0 < \alpha, \gamma < 1$ represent the given input flexibility of the use of energy and the combined good, respectively, while λ denotes the coefficient of the Lagrangian multiplier.

The 1st order conditions for the issue in question are:

$$\frac{\delta L}{\delta E} = P_e - \lambda \alpha A E^{\alpha-1} Z^\gamma = 0 \quad (3)$$

$$\frac{\delta L}{\delta Z} = P_e - \lambda \gamma A E^\alpha Z^{\gamma-1} = 0 \quad (4)$$

$$\frac{\delta L}{\delta \lambda} = Y - A E^\alpha Z^\gamma = 0 \quad (5)$$

The 1st order condition produces, alongside the demand function for the combined good, the optimum function for energy demand:

$$E = \left(\frac{Y}{A}\right)^{\frac{1}{\alpha+\gamma}} \left(\frac{P_e}{P_z}\right)^{\frac{-\gamma}{\alpha+\gamma}} \left(\frac{\gamma}{\alpha}\right)^{\frac{-\gamma}{\alpha+\gamma}} \quad (6)$$

We propose that FD, Gov, GGDP, FDI, TNRR, and CO₂ emissions enter the model via affecting total factor productivity:

$$A = e^{(\theta FD + \eta Gov + \rho GGDP + \varrho FDI + \kappa TNRR + \nu CO_2)} \quad (7)$$

where $\theta, \eta, \rho, \varrho, \kappa$ and $\nu > 0$.

The decision for energy demand in Equation (6), upon substituting A in Equation (6), is expressed as:

$$E = \left(\frac{Y}{e^{(\theta FD + \eta Gov + \rho GGDP + \varrho FDI + \kappa TNRR + \nu CO_2)}}\right)^{\frac{1}{\alpha+\gamma}} \left(\frac{P_e}{P_z}\right)^{\frac{-\gamma}{\alpha+\gamma}} \left(\frac{\gamma}{\alpha}\right)^{\frac{-\gamma}{\alpha+\gamma}} \quad (8)$$

In logarithmic form, Eq. (8) becomes:

$$\begin{aligned} \ln(E) = & \frac{-\gamma}{\alpha+\gamma} \ln\left(\frac{\gamma}{\alpha}\right) + \frac{1}{\alpha+\gamma} \ln Y - \frac{1}{\alpha+\gamma} (\theta FD + \eta Gov + \rho GGDP + \varrho FDI + \kappa TNRR + \\ & \nu CO_2) - \frac{\gamma}{\alpha+\gamma} \ln(P_e) + \frac{\gamma}{\alpha+\gamma} \ln(P_z) \end{aligned} \quad (9)$$

Consequently, Equation (9) describes our framework of the theory. This is a fundamental formula to consider. We assume our hypothesis on the cubic relationship between FD when we integrate a cubic term for FD.

3.2 Model Specification

To simplify the examination of the cubic correlation between REC and FD. We incorporated the cubic form of FD, which, according to Sebri (2016), also provides flexibility for investigating the EKC. The cubic polynomial form of FD allows testing the validity of FKC by examining necessary conditions (e.g., Álvarez-Herránz et al., 2017; Sinha et al., 2018). The empirical formulation of the equation, presented in Equation(9), is reformulated as

$$\ln(REC)_{it} = \beta_0 + \beta_1 FD_{it} + \beta_2 FD_{it}^2 + \beta_3 FD_{it}^3 + \beta_4 GOV_{it} + \beta_5 \ln GGDP_{it} + \beta_6 FDI_{it} + \beta_7 TNRR_{it} + \beta_8 CO_{2it} + \beta_9 \ln CPI_{it} + \varepsilon_{it} \quad (10)$$

where REC is considered the dependent variable and FD, GOV, GGDP, FDI, TNRR, CO₂ emissions, and CPI are independent variables. To simplify the examination of the cubic correlation between REC and Financial Development, the empirical formulation of the equation presented in Equation (9) is reformulated as: Further, $\ln GGDP$ serves as green GDP and served as a proxy for the green economy, calculated using the specified formula in equation (11);

$$GGDP = GDP - NC - (GNI/100 * \% NRD)^2 \quad (11)$$

Prerequisite for FKC Occurrence (Based on Environmental Kuznets Curve Framework)

Equation 10 indicates that the relationship between REC and FD, in its linear, quadratic, and cubic forms, encompasses six distinct possibilities. The classification of elasticities determines the shape of the existing FKC, which can be U-shaped, inverted U-shaped, N¹ shaped, inverted N-shaped, or monotonic (i.e., non-existent). These conditions are essential for establishing a valid FKC (EKC)³.

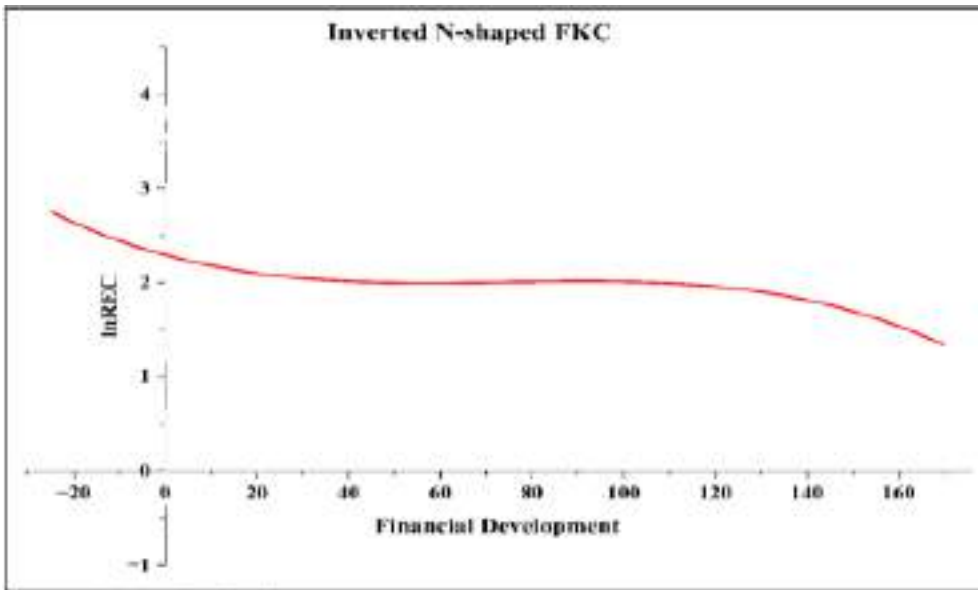
We aim to objectively explore FD and REC's quadratic and cubic relationship and N-shape FKC. Hasanov et al. (2021) present a detailed conceptual model for nonlinear income-environmental quality relationships. He emphasises that the “non-leading” elements in the income-environment relationship, the Traditional Environmental Kuznets Curve (EKC), must be carefully examined. This problem involves testing and comparing nonlinear correlations. We focus

² Where; NC = CE + RD

GGDP as Green Gross Domestic Product, GDP as Gross Domestic Product GDP (constant 2015 US\$), NC as Natural Capital (CE as Cost to the environment + RD as Resource depletion) as Adjusted saving; mineral depletion percent of GNI, GNI as Gross National Income and percent of Natural Resource Depletion as Adjusted savings; natural resources depletion (% of GNI) (Stjepanoviæ et al., 2017); FDI as foreign direct investment, net inflows (% of GDP); TNRR as Total natural resources rents (% of GDP); CO₂ as (metric tons per capita); and $\ln CPI$ as Consumer price index (2010 = 100).

on the cubic and N-shaped correlation between FD and REC, not the income^energy link. The main variable in this study is REC rather than environmental damage.

Figure 1: Inverted N-shaped Financial Kuznets Curve



Source: Authors' estimation

Figure 1 illustrates the association between financial development and the consumption of renewable energy during the study period. The figure illustrates that financial development has a curvilinear association with renewable energy consumption, indicating that REC initially rises with financial development, subsequently declines as financial development continues to increase, and ultimately rises again at elevated levels of financial development. It supports our theory that an inverted N-shaped Kuznets curve for financial development exists.

-
- ¹(i) If $\beta_1 > 0, \beta_2 = \beta_3 = 0$; FKC is monotonically increasing;
 - (ii) If $\beta_1 < 0$; FKC is monotonically decreasing;
 - (iii) If ; FKC is inverted U-shaped.
 - (iv) If ; FKC is U-shaped.
 - (v) If ; FKC is N-shaped, and
 - (vi) If ; FKC is inverted N-shaped.

3.3 Data Sources

Our study, which relies on data from 16 selected G20 countries, spans the period from 1996 to 2024. The countries and data were selected based on the available information from the World Bank database. The description of variables has been provided in Appendix Table E. The software used for result analysis includes EViews and Stata.

4 Empirical Methodologies

4.1 Description of the Principal Component Analysis (PCA)

Principal component analysis (PCA) is used to create composite indexes for financial growth and governance parameters. PCA condenses many strongly correlated variables into a small collection of variables (principal components) that explain most of their variance. This method eliminates multicollinearity from correlated variables, assessing the same notion in a multidimensional model. It avoids arbitrary variable selection and meets multidimensional conceptual descriptions by restricting the dimensionality of large datasets to improve interpretability and preserve information (Semmlow, 2008). Selecting orthogonal and uncorrelated main components with high variance (eigenvalue) lowers data redundancy, complexity, and interference in PCA. This method is used in research to evaluate the complex, interrelated, and multidimensional aspects of a single idea (Odhiambo, 2009; Asongu & Odhiambo, 2020). We create composite indices for financial development (Appendix Tables A and B) and governance (Appendix Tables C and D).

4.2 Econometric Estimation

Following a sequential econometric approach to obtain robust panel results, firstly, we test for slope heterogeneity using the methodology of Pesaran and Yamagata (2008) to see whether slope coefficients differ across cross-sectional units. Then, we test for cross-sectional dependence as common shocks, regional spillovers, and interlinkages among countries may affect the panel data (Qin et al., 2021; Lin & Wu, 2022) using the updated test proposed by Pesaran (2021).

Following the cross-sectional dependence results, we conduct panel unit root tests, such as the Levin-Lin-Chu (Levin et al., 2002) and Im-Pesaran-Shin (Im et al., 2003) tests, are used when there is no cross-sectional dependence. Finally, we test for a long-run relationship among the variables using Pedroni and Kao panel cointegration tests, acknowledging heterogeneity across cross-sections (Pedroni, 1999; Kao, 1999).

4.3 Panel Regression and Long-run Elasticity

The analysis of this study starts with Ordinary Least Squares (OLS) panel analysis. We use fixed-effect (FE) and random-effect (RE) models to minimise heterogeneity and endogeneity in panel data, and we estimate using OLS. A fixed-effects analysis compensates for this variance. Ben Aïssa et al. (2014) used the FMOLS test to evaluate long-run elasticity. It helps with serial correlation and endogeneity. Long-run elasticity coefficients were estimated non-parametrically. Despite a small sample, it maintains parameters. We might also explore linear and cubic connections between FD and REC in selected G20 countries using this method. Based on Pedroni (2001), Bilgili et al. (2016) developed panel FMOLS estimation.

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$$\hat{\beta}_{\text{GFM}}^* = N^{-1} \sum_{i=1}^N \hat{\beta}_{\text{FM},i}^* \quad (12)$$

however, $\hat{\beta}_{\text{FM},i}^*$ The estimate of FMOLS utilised for the i th country, along with the corresponding t -statistic, is

$$t_{\hat{\beta}_{\text{GFM}}^*} = N^{-1/2} \sum_{i=1}^N t_{\hat{\beta}_{\text{FM},i}^*} \quad (13)$$

4.4 Panel Dumitrescu and Hurlin (D-H) non-causality test

It is appropriate to examine the direction of causality when a long-run association exists among the series in panel data analysis. We employed the methodology proposed by Dumitrescu and Hurlin (2012), which provides a Granger non-causality test for heterogeneous panels.

5 Discussion and Results

Following the above sections, it is essential to first estimate the descriptive and correlation matrix, the CSD-SLH, first-generation panel unit root and cointegration, OLS, FE and RE OLS, and FMOLS as part of the long-run parametric analysis, and the D-H causality test.

Tables 1 and 2 present the estimated outcomes and the descriptive and correlation matrices for the indicator associated with the selected G20 countries.

Table 1: Descriptive Statistics

Variables	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
lnREC	2.282	1.004	-0.510	3.912	-0.4889	3.1398
FD	0.153	1.848	-2.922	5.537	0.7049	3.0666
Gov	-0.075	2.253	-4.724	3.484	-0.0186	1.5345
lnGDP	28.154	0.991	26.010	30.668	0.4538	3.2853
FDI	3.010	4.218	-0.013	29.433	2.3415	9.8149
TNRR	2.035	1.750	-3.606	12.731	1.8649	11.0023
CO ₂	6.150	4.220	0.787	20.469	1.1942	4.5256
lnCPI	4.516	0.492	0.855	6.296	-2.5354	16.6272

Source: Authors’ estimations.

The mean value of lnREC, FD, Gov, lnGGDP, FDI, TNRR, CO₂, and lnCPI are 2.282, 0.153, -0.075, 28.154, 3.010, 2.035, 6.150, and 4.516, respectively. Likewise, the standard deviation values of lnREC, FD, Gov, lnGGDP, FDI, TNRR, CO₂, and lnCPI are 1.004, 1.848, 2.253, 0.991, 4.218, 1.750, 4.220, and 0.492, respectively. Additionally, the panel of Table 2 shows that the correlation matrix indicates that all indicators (lnREC, FD, Gov, lnGGDP, , TNRR, CO₂, lnCPI) are negatively correlated with renewable energy consumption, as expected.

Table 2: Correlation Analysis

Variables	lnREC	FD	Gov	lnGGDP	FDI	TNRR	CO ₂	lnCPI
lnREC	1.000							
FD	-0.148	1.000						
Gov	-0.433	0.231	1.000					
lnGGDP	-0.139	0.313	0.411	1.000				
FDI	0.075	-0.262	-0.516	-0.345	1.000			
TNRR	-0.028	-0.076	0.080	0.079	0.098	1.000		
CO ₂	-0.447	-0.003	0.377	0.576	-0.001	-0.006	1.000	
lnCPI	-0.015	0.234	0.129	0.306	-0.076	0.108	0.050	1.000

Source: Authors' estimations.

Following the descriptive and correlation analyses, this study examined the panel's SLH and CSD tests, and their empirical assessments are shown in Table 3.

Table 3: Results of Cross-sectional Dependency and Slope Heterogeneity Test

CSD test: lnREC, FD, Gov Index, lnGGDP, FDI, TNRR, CO ₂ , and lnCPI		
	t-stat	Prob
Pesaran's	-2.819	1.9952
Friedman's	13.568	0.5585
<i>SLH test</i>		
Statistics	Values	p-value
Delta-tiled	14.146	0.000
Delta-tiled adjusted	17.326	0.000

Source: Authors' estimation

Table 3 shows that the SLH and corrected SLH are highly significant at the 1% level. Thus, the SLH test rejects the null hypothesis at the 1% significance level, suggesting heterogeneous slope coefficients. Table 3 CSD test results show no CSD because the p-value exceeds 0.05. The CSD test of the null hypothesis (Pesaran, 2021) fails to reject it, indicating that the selected G20 countries are not mutually dependent.

Table 4: First Generation LLC and IPS Unit-Root Test

Variables	LLC Test		IPS Test		Order
	At level	1 st Difference	At level	1 st Difference	
lnREC	-1.8305**	-11.2041***	1.6305	-12.1952***	I(1)
FD	0.8597	-13.5458***	4.2950	-14.1701***	I(1)
FD cube	-0.6451	-6.3072***	6.2002	-9.7175***	I(1)
Gov	-2.2523**	-25.1695***	-0.5893	-24.2848***	I(1)
lnGGDP	-6.0343***	-13.0883***	-1.2956*	-12.2047***	I(0)
FDI	0.6896	-13.3029***	-0.4353	-13.3924***	I(1)
TNRR	-7.0409***	-22.3073***	-7.8919***	-21.7844***	I(0)
CO ₂	-0.4290	-17.4877***	2.4981	-17.2286***	I(1)
lnCPI	-3.6832***	-3.3720***	1.1902	-4.8967***	I(0)

Source: Authors’ estimation

Note: ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively

Table 5: Results for Panel Cointegration Tests

Pedroni Cointegration		Stat	Prob
Modified PP test		3.1334***	0.0009
PP test		-4.0293***	0.0000
Augmented D-F test		-3.6900***	0.0001
Kao Cointegration			
Statistic		Value	p-value
Modified D-F test		-20.14861***	0.0000
D-F test		-10.2623***	0.0000
Augmented D-F test		11.6350***	0.0000
Unadjusted modified D-F test		-24.7049***	0.0000
Unadjusted D-F test		-10.7411***	0.0000

Source: Authors’ estimation

Note: ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.

5.1 Panel Regression

Table 6 shows panel regression results. Four estimating methods are used to estimate indicator coefficients: OLS, FE, RE, and FMOLS. Early financial systems decrease REC. The linear term of financial development (FD) has a negative and statistically significant coefficient (-0.10, $t = -5.51$). This contradicts Shahbaz et al. (2013), who concluded that financial development enhances access to capital and investment in renewable energy infrastructure. The squared term of FD has a positive and significant coefficient (1.14) at the 1% level, indicating a reversal at moderate financial development. However, the cubic term of FD has a substantial negative coefficient (-0.02, $t = -8.27$), suggesting an inverted N-shaped relationship in which excessive financial expansion may hurt REC. This pattern implies that initial financial development may limit renewable energy adoption, middle levels help it, and beyond a threshold, financial progress has diminishing marginal benefits. This non-linear trajectory aligns with Tamazian and Rao (2010)'s inverted U-shape theory, but our findings add an inflexion point. An inverted N-shaped FKC for energy consumption, with $\hat{\alpha} < 0$, $\hat{\alpha} > 0$, and $\hat{\alpha} < 0$, is found between $\ln REC$ and the financial development index in all four estimation methods (OLS, FE, RE, and FMOLS). With respect to credit market development measures, the consistent coefficient pattern across all panel techniques suggests an inverted N-shaped FKC of renewable energy consumption in our sample of 16 G20 countries. This contradicts Doytch et al. (2023), who examined credit market development indicators such as private borrowing, liquid liabilities, and money supply and found no FKC in energy consumption and credit expansion. Our findings differ from Yue et al. (2019), who examined 21 transitional nations using four financial development indicators (financial deposits, private borrowing, equity market capitalisation, and stock market turnover) and found that only stock market value had a significant impact, with no evidence of FKC.

Only Baloch et al. (2019) found a similar non-linear relationship among OECD nations, making our study one of the few to support the inverted N-shaped FKC experimentally. Our findings support those of Zakari et al. (2022) and Trinh et al. (2022), who found that sustainable financial development improves energy efficiency and reduces climate change risk. These findings partially contradict Khan et al. (2022), who argue that non-monetary asset investment harms the environment.

The composite Gov does not significantly affect renewable energy consumption across estimating methods, with an insignificant p-value indicating that institutional quality may not directly affect REC in the G20. This contradicts Le et al. (2020), who stressed the importance of governance quality in fostering renewable energy development legislation, regulations, and public trust. G20 countries have different governance and institutional systems, which may explain the variance. Green GDP shows a strong, positive, and significant association with REC (coefficient = 0.01, $t = 2.84$), indicating that sustainable economic growth encourages renewable energy. This supports Zafar et al. (2019), who found that environmental awareness and policy prioritisation increase renewable energy adoption in green growth economies. FDI positively and significantly affects REC (coefficient = 0.22, $t = 18.81$), validating Omri and Kahouli's (2014) and Sadorsky's (2010, 2011) technology spillover and capital infusion hypotheses. This supports the idea that foreign investment in energy infrastructure contributes capital, technological innovation, and management skills that promote renewable energy. The predicted positive coefficient ($\hat{\alpha}_1 > 0$) is proven empirically, as suggested by Doytch and Narayan (2016). Total natural resource rents (TNRR) have a negative and significant coefficient (-0.2982), showing that resource-rich nations underinvest in renewable energy. This data confirms the resource curse hypothesis, which posits that abundant natural resources lead to greater fossil fuel dependence and lower incentives for renewable energy investment ($\hat{\alpha}_7 < 0$). CO₂ emissions show a negative coefficient (-0.0326), indicating structural hurdles to renewable energy transitions in nations with high carbon-intensive energy systems ($\hat{\alpha} < 0$). Apergis and Payne (2010) found a negative link between fossil fuel dependence and renewable energy uptake.

CPI, a proxy for inflation, shows a substantial negative coefficient (-0.1043), supporting Destek's (2016) findings that inflationary pressures discourage renewable energy investment by raising costs and causing economic uncertainty ($\hat{\alpha}_{10} < 0$). However, energy prices reflect the economic business cycle; therefore, the relationship between inflation and renewable energy investment may vary.

Our findings complement prior studies while offering nuanced perspectives that warrant further investigation, notably by addressing the nonlinear influence of financial development and the constrained role of governance in the G20 context. The inverted N-shaped FKC advances theory by showing that policy

makers must carefully calibrate finance sector development strategies to optimise renewable energy outcomes. Initial negative association suggests that early-stage financial development may favour conventional energy investments, whereas a positive phase suggests that mature financial institutions can allocate resources to renewable projects. In the final negative inflexion, over-financialization may hinder sustainable energy transitions due to financial complexity. The strong positive effects of FDI and green GDP underscore the need to attract foreign investment and adopt sustainable growth initiatives. In contrast, reliance on natural resources and inflation pose structural and macroeconomic challenges that must be addressed to promote renewable energy adoption. Contrary to earlier findings, the governance effect was small, suggesting that institutional quality alone may not be enough without policies and economic incentives.

Table 6: Panel Data Regression

	OLS	FE	RE	FMOLS Coefficient	t-stat
FD	-0.0694*** (0.014)	-0.0752*** (0.009)	-0.0715*** (0.010)	-0.10***	5.51
FD square	0.0905 (0.000)	0.0924 (0.000)	0.0905 (0.000)	1.14***	30.13
FD cube	-0.0021** (0.056)	-0.0021** (0.057)	-0.0022*** (0.049)	-0.02***	-8.27
Gov	-0.0028 (0.932)	0.0064 (0.852)	-0.0026 (0.937)	-0.25	1.42
lnGGDP	0.3243*** (0.000)	0.3011*** (0.000)	0.3234*** (0.000)	0.01***	2.84
FDI	0.0134** (0.069)	0.0130** (0.079)	0.0118** (0.084)	0.22***	18.81
TNRR	-0.0326*** (0.000)	-0.0326*** (0.001)	-0.0318*** (0.001)	0.01***	5.80
CO ₂	-0.2982*** (0.000)	-0.3040*** (0.000)	-0.2980*** (0.000)	-0.16***	-51.37
lnCPI	-0.1043*** (0.009)	-0.0974*** (0.016)	-0.1066*** (0.007)	1.19***	19.22
Constant	-4.513*** (0.037)	-3.858* (0.080)	-4.477*** (0.038)		
Observations	432	432	432	432	432
R-squared	0.364	0.205	0.213		
No. of countries	16	16	16	16	16

Source: Authors' estimation

Note: ***, ** and * indicates significance levels at 1%, 5% and 10%, respectively

5.2 Heterogeneous Panel Causality Analysis

Another motivation for this research is to investigate the causal relationship between the dependent and independent variables in selected G20 countries. We use

heterogeneous panel causality; the results are shown in Table 7. According to heterogeneous panel causation, lnREC and FD, FD square, FD cube, GOV, GGDP, CO2, and lnCPI are bidirectional. There are also unidirectional connections between REC and FDI, as well as between TNRR and FDI. The results support previous research, indicating that renewable energy consumption is significantly influenced by, and in turn influences, financial development, governance, and environmental factors (e.g., Yilanci et al., 2019; Sharif et al., 2019; Khan et al., 2020; Kirikkaleli & Adebayo, 2021; Islam et al., 2022).

Table 7: D-H Causality Test

Null Hypothesis	Z-bar stat.	Prob.	Decision
REC → FD	6.5772***	0.0000	REC ↔ FD
FD → REC	6.8989***	0.0000	
REC → FDsq	5.757***	0.0000	REC ↔ FDsq
FDsq → REC	5.986***	0.0000	
REC → FDcu	5.2447***	0.0000	REC ↔ FDcu
FDcu → REC	6.2644***	0.0000	
REC → GOV	5.4937***	0.0000	REC ↔ GOV
GOV → REC	7.4382***	0.0000	
REC → GGDP	12.3041***	0.0000	REC ↔ GGDP
GGDP → REC	6.0380***	0.0000	
REC → FDI	5.5183***	0.0000	REC → FDI
FDI → REC	0.7684	0.4422	
REC → TNRR	2.8874***	0.0039	REC → TNRR
TNRR → lnREC	1.7467	0.0807	
REC → CO ₂	12.3154***	0.0000	REC ↔ CO ₂
CO ₂ → REC	9.0718***	0.0000	
REC → CPI	11.3932***	0.0000	REC ↔ CPI
CPI → REC	4.6192***	0.0000	

Note: * denotes 1% significance level; "↔" symbolises bidirectional causality, and "→" shows a unidirectional causality.

6. Conclusions

This study applies the FKC hypothesis to an inverted N-shaped panel dataset of 16 G20 countries from 1996 to 2024. Four-panel regression techniques, pooled OLS, FE, RE, and FMOLS, confirm an inverted N-shaped FKC via significant and patterned estimated beta coefficients ($\hat{\alpha} < 0$, $\hat{\alpha} > 0$, $\hat{\alpha} f < 0$). The study shows that FD and REC have a complex, non-monotonic connection. FD constrains REC early on, improves renewable energy adoption at intermediate financial maturity, and hinders it again when financial depth is extreme. This cubic non-linear pattern underscores the need for balanced, strategic financial-sector expansion to achieve sustainable energy transitions.

The research shows numerous key correlations between REC determinants. Green GDP positively affects REC (coefficient = 0.01, $t = 2.84$), highlighting the importance of environmentally adjusted economic performance in boosting clean energy adoption. This supports the idea that sustainable growth economies utilise renewable energy more. REC is positively correlated with FD (coefficient = 0.22, $t = 18.81$), supporting the idea that international capital flows promote renewable energy infrastructure, technology, and knowledge transfer. This shows that FDI drives G20 energy transitions. However, TNRR negatively affects REC (coefficient = -0.2982), supporting the resource curse hypothesis and suggesting that fossil fuel abundance crowds out renewable energy investment in resource-rich nations. CO₂ emissions have a negative correlation with REC (coefficient = -0.0326), highlighting structural limits and path dependencies in carbon-intensive energy systems. These findings show that fossil-fuel-dependent nations face significant hurdles in transitioning to renewable energy.

Governance quality has no statistically significant effect on REC in any model, refuting the idea that institutional quality drives green energy uptake. This unexpected result shows that aggregated governance indices may hide country-specific variances and contextual factors in G20 institutional performance. REC is negatively affected by inflation, proxied by the consumer price index (lnCPI) (coefficient = -0.1043), demonstrating that macroeconomic instability and inflationary pressures discourage renewable energy investment by raising costs and causing economic uncertainty.

The causality analysis shows a bidirectional relationship between REC and key factors, including FD, green economy, governance quality, CO₂ emissions, and inflation. The bidirectional relationship between renewable energy adoption and macro-financial variables suggests that renewable energy development affects the evolution of the financial sector, economic sustainability, institutional development, environmental outcomes, and price stability. These feedback processes demonstrate the complexity of the energy transition and the interdependence among economic, financial, environmental, and institutional factors.

The findings support the FKC theory and add to the literature in numerous ways. A comprehensive empirical investigation of cubic non-linearity in the

FD–REC nexus validates the inverted N-shaped FKC for credit market development indicators across G20 countries. This extends Baloch et al. (2019) and contradicts Doytch et al. (2023) and Yue et al. (2019), who detected no FKC in their samples. The study uses a rigorous approach, utilising various panel-data estimation techniques (pooled OLS, FE, RE, and FMOLS) and a variety of theoretically driven control variables, including green economy, governance indicators, FDI, TNRR, CO₂ emissions, and CPI. Third, the green economy, calculated using recognised methods, better reflects sustainable economic performance and renewable energy uptake. Using pooled OLS, FE, RE, and FMOLS estimators with a large set of control variables, the findings support the theoretical framework and add to the literature by showing quadratic and cubic non-linearity in the FD-REC nexus.

7 Policy Implications and Limitations of the Study

This study has major policy consequences. The selected G20 countries needed a coordinated, complex policy framework to enhance the benefits of renewable energy financing and minimise its drawbacks. Governments should modify their nationally determined contributions (NDCs) and align their renewable energy capacity objectives with the 2030 global aim to triple renewable deployment to reinforce their Paris Agreement commitments. Direct investments, concessional loans, green bonds, and fiscal incentives must be increased, especially in fast-growing areas with limited private investment, to close the financing gap. We should invest in adaptive electric grids and storage technologies to address renewable energy intermittency, and in market-based mechanisms like green certifications and carbon pricing to appropriately reflect the impacts of fossil fuels. To mitigate harmful effects on disadvantaged populations, G20 countries must cut fossil fuel subsidies and promote clean energy programs.

Advanced economies should increase development aid and international climate funding to help less developed G20 members switch to renewable energy. Industrial policies, including tax incentives, technological grants, and strategic trade protections, help domestic renewable energy equipment manufacturers. These efforts aim to establish sustainable, diverse, and inexpensive supply chains. Regulations should help “prosumers”-households and local companies that generate and use energy, by fostering decentralised energy models and fair

market access. A large public renewable energy support inventory and management system with investment results would improve transparency and efficiency. These complete solutions allow G20 countries to reinforce the finance Kuznets Curve dynamics identified in this study, promoting sustainable, inclusive, and low-carbon finance system growth. Thus, nations may regulate subsidies and funding for the credit market and for renewable energy and cleaner manufacturing. China's 2012 green finance law and Brazil's 2014 laws encourage banks to lend to low-carbon businesses and improve social and environmental performance.

The US offers tax incentives, grants, and loans for renewable energy manufacture, deployment, and research under the Inflation Reduction Act. The second main U.S. program, the CHIPS Act of 2022, provides renewable energy recipients with tax rebates and incentives. The 14th Five-Year Plan of China addresses utility-scale renewable energy, system growth, and storage. This study gives strong empirical support for an inverted N-shaped FKC for FD and REC, although it has drawbacks. Banking variables are used to calculate the composite financial development index, which excludes capital markets and green bonds, which may affect REC. Low-income and other countries are not covered by the analysis, which is limited to 16 G20 countries. Panel data are used to explore long-term relationships, ignoring short-run dynamics, sector-specific impacts, and cross-country variation. To validate and broaden these findings across economic contexts, future research should use time-series methods, other proxies, and non-linear models.

The analysis covers only G20 countries, limiting its applicability to other countries with diverse economic and institutional frameworks. To test whether the inverted N-shaped FKC holds in developing economies or regional groupings, future research could include them. To further understand institutions' roles in renewable energy transitions, disaggregated governance indicators or alternative institutional quality measures should be used to investigate the insignificant governance effect. Finally, future studies could use microeconomic data or sector-specific analysis to determine how financial development affects renewable energy adoption at different stages of the inverted N-shaped curve.

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Caste and Wealth Gradients in Menstrual Hygiene Practices among Young Women in India

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Abstract

Period poverty in India reflects not only household resource constraints, but also the unequal social conditions under which those resources are converted into menstrual care. This paper examines how caste and household wealth shape menstrual hygiene practices among young women in India using NFHS-5 data. The analysis focuses on women aged 15–24 years and classifies menstrual hygiene practices into exclusive unhygienic use, exclusive hygienic use, and mixed use. We estimate survey-weighted multinomial logit models and binary logit models for robustness checks. The results show that wealth is the steepest gradient in menstrual hygiene practices: hygienic product use rises sharply across the wealth distribution, while unhygienic use declines. Caste disparities remain even after adjusting for wealth, education, sanitation, residence, and other household characteristics. The caste–wealth interaction is modest overall, but becomes clearer when the outcome is defined as any hygienic use. Menstrual hygiene inequality in India thus reflects both material deprivation and durable social stratification. Policies centred on affordability alone are therefore unlikely to eliminate the remaining gaps.

Keywords: Menstrual hygiene, period poverty, caste, wealth inequality, young women, and India

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1. Introduction

Menstrual health is increasingly recognised as a public health, dignity, and human rights issue rather than something women should manage quietly on their own (Babbar et al., 2022; Day, 2018). However, the ability to manage menstruation safely and consistently also depends on access to recurring market goods, information, sanitation, and supportive social environments. The literature has long noted that these constraints can affect schooling, work, mobility, and well-being, even if the magnitude and channels differ across contexts (Babbar et al., 2022; Sumpter & Torondel, 2013). Oster and Thornton's (2011) experimental study cautions against assuming that product provision alone will mechanically transform outcomes. More recent In India, recent evidence shows menstrual hygiene practices are deeply unequal. Studies using National Family Health Survey (NFHS) data consistently show strong gradients by wealth, education, residence, and geography, with exclusive use of hygienic materials concentrated among better-off women and substantial disparities across states, districts, and rural–urban locations (Biswas et al., 2024; Chakrabarty et al., 2023; Goli et al., 2020; Karjee et al., 2023; Meher & Sahoo, 2023). Wealth-based inequality has been reported in both rural and urban India, and recent geospatial work shows that coverage remains especially weak in several central and eastern regions (Biswas et al., 2024; Singh et al., 2022b). Other studies show that mixed and unhygienic use continue to be common among young women, particularly where poverty, weak sanitation, and social disadvantage overlap (Roy et al., 2021; Singh et al., 2022a).

However, much of the existing literature remains largely poverty-centric. It documents wealth gradients in menstrual product use, but pays less attention to whether the same level of household resources yields similar outcomes across socially stratified groups. That omission matters in India, where caste remains a central axis of social, economic, and institutional life rather than a residual background characteristic. It shapes access to public goods, everyday dignity, and the returns women derive from education, services, and household resources (Joe, 2015; Darity & Ruiz, 2024). A wider literature on inequality in India makes the same point from a different direction: socioeconomic position alone does not exhaust disadvantage, since health system responsiveness, treatment access, and health outcomes remain patterned by overlapping social and material inequalities (Malhotra & Do, 2013; Pandey et al., 2017). From this

perspective, caste may shape menstrual hygiene not only because marginalised groups are poorer on average, but because social hierarchy conditions how income, schooling, infrastructure, and information are converted into safe and dignified menstrual care.

This study examines how caste and household wealth jointly shape menstrual hygiene practices among young women in India. We focus on women aged 15–24 years and use NFHS-5 data to distinguish among three outcomes: exclusive use of unhygienic materials, exclusive use of hygienic materials, and mixed use.

The rest of the paper is organised as follows. Section 2 reviews the literature. Section 3 describes the data and variables. Section 4 explains the empirical strategy. Section 5 presents the results. Section 6: concludes with concluding observations.

2. Review of Literature

Research on menstrual hygiene has grown substantially, though the evidence remains spread across several strands of scholarship. Three points are now well established. First, menstrual hygiene is not a purely private practice. It depends on repeated access to products, water, privacy, and sanitation, and is shaped by stigma, information, silence, bodily shame, household norms, social support, and the institutional context in which menstruation is managed (Day, 2018; Babbar et al., 2022; McCammon et al., 2020; Olson et al., 2022). Menstrual deprivation, therefore, is not only a matter of low purchasing power. It is also a question of dignity, belonging, and capability (Alugnoa et al., 2022; Wilbur et al., 2022).

Second, Indian evidence shows that menstrual practices are sharply stratified by wealth, education, residence, and region. Studies based on NFHS and related surveys consistently find that hygienic materials are used more often by richer, better-educated, and urban women, while unhygienic or mixed use remains concentrated among poorer and rural women (Goli et al., 2020; Karjee et al., 2023; Roy et al., 2021; Singh et al., 2022a). More recent work has sharpened these findings by documenting strong wealth-based inequality in both rural and urban India, alongside marked spatial clustering in low-use areas (Biswas et al., 2024; Chakrabarty et al., 2023; Meher & Sahoo, 2023; Singh et al.,

2022b). This literature shows that menstrual inequality is systematic rather than residual. The wealth gradient is especially steep. Richer women are more likely to use hygienic materials and less likely to rely on cloth or other unhygienic methods (Roy et al., 2024; Singh et al., 2022b). Geospatial analyses further show that national progress can conceal persistent local deprivation, often in areas with weaker sanitation, poorer public services, and broader social disadvantage (Biswas et al., 2024; Chakrabarty et al., 2023; Meher & Sahoo, 2023).

Third, a related literature links menstrual hygiene to reproductive health and broader well-being. Studies from India and other low- and middle-income countries find associations between unhygienic menstrual management, weak water, sanitation and hygiene (WASH) conditions, and reproductive or lower reproductive tract infections (Ademas et al., 2020; Anand et al., 2015; Das et al., 2015; Torondel et al., 2018). This strengthens the case for treating menstrual hygiene as a development and public health issue rather than as a narrow matter of household preference.

However, an important conceptual gap remains. Most studies include caste as one control among many, rather than treating it as a central dimension of menstrual inequality. Yet menstrual practices are formed at the intersection of markets, households, and social hierarchy. In India, caste can shape not only who has fewer resources, but also who has less privacy, weaker sanitation, poorer access to information, and less social freedom to manage menstruation without shame (Joe, 2015; Malhotra & Do, 2013; Pandey et al., 2017). Qualitative and socio-ecological research shows that menstrual behaviour is embedded in silence, stigma, bodily regulation, and unequal control over movement and space, especially in school, household, and community settings (McCammon et al., 2020; Olson et al., 2022; Parija et al., 2022). Recent qualitative work from rural Rajasthan similarly shows that menstrual practices are shaped by caste-based patriarchy, purity norms, sanitation spaces, sexual vulnerability, and restrictions operating across domestic and village spaces (Sabna & Dixit, 2025). These processes are likely to be sharper where caste hierarchy, gender norms, and poverty overlap, even when household wealth is similar (Darity & Ruiz, 2024; Joe, 2015). However, caste need not always appear as a dramatic interaction with wealth. It may instead persist as a background structure that shapes the level at which women enter the

distribution of menstrual well-being and conditions the everyday conversion of income, education, and infrastructure into hygienic use (Darity & Ruiz, 2024; Joe, 2015).

This paper addresses that gap. It brings caste into the analysis not as a routine control, but as a core dimension of menstrual inequality. It examines caste and wealth jointly, allowing us to distinguish between independent gradients and interaction effects.

3. Data and Sample

We use data from the NFHS-5 (2019-21), the latest nationally representative survey of women's health, household conditions, and related demographic characteristics in India. The analysis is restricted to women aged 15–24 years, as this period covers late adolescence and early adulthood, when schooling, marriage, dependence, and mobility are still in flux and may shape menstrual practices.

NFHS-5 records the materials women use during menstruation. We use this information to construct a three-category outcome: exclusive unhygienic use, exclusive hygienic use, and mixed use. This classification preserves behavioural variation that would be lost in a binary split. Mixed use likely reflects partial adoption under constraint. For robustness, we also estimate two binary outcomes. Any hygienic use, which combines exclusive hygienic and mixed use, and exclusive hygienic use, which is restricted to women using hygienic materials alone.

The main explanatory variables are caste and household wealth quintile. Caste is grouped into Scheduled Castes (SC), Scheduled Tribes (ST), Other Backward Classes (OBC), and General/Other. Wealth is measured using the standard NFHS wealth quintiles. Wealth is measured using the standard NFHS wealth quintiles: poorest, poorer, middle, richer, and richest. These variables anchor the analysis. Wealth captures household

material position. Caste captures durable social stratification that may shape access, information, infrastructure, and the conversion of resources into hygienic practice. The models also include a standard set of controls: age cohort, woman's education, age of household head, sex of household head, marital status,

religion, rural residence, mass media exposure, toilet facility, and region. These are included as observed correlates of menstrual hygiene and as potential confounders of the caste–wealth relationship.

The final analytical sample consists of 219,718 women with valid information on menstrual hygiene practices and all explanatory variables. All estimates use NFHS sampling weights and account for the survey’s stratified multistage design. NFHS identifies reported menstrual materials, not continuity of use, frequency of change, disposal conditions, pain, bargaining power, or the lived experience of stigma.

3.1 Descriptive Patterns

Table 1 presents the weighted characteristics of the sample. The study population is predominantly rural, with roughly 71 per cent of women residing in rural areas, and the largest social group is OBC, followed by SC. Most respondents have secondary education, while a substantial majority reports exposure to mass media and access to improved sanitation facilities. The sample remains socioeconomically heterogeneous across wealth quintiles and regions, providing sufficient variation to examine menstrual hygiene inequalities along multiple axes of stratification.

Table 1: Socio-demographic Profile of Women Aged 15–24 years, NFHS-5 (2019–21)

Variable	Unhygienic	Hygienic	Both	p-value	Weighted N
Age cohort					
15-19	22.45	50.00	27.55	<0.001	122,543.83
20-24	22.90	49.59	27.51		119,439.54
Wealth					
Poorest	46.71	24.69	28.60	<0.001	48,713.68
Poorer	29.22	37.46	33.32		52,765.36
Middle	18.19	51.88	29.93		50,830.67
Richer	11.11	63.23	25.66		48,409.27
Richest	5.02	76.87	18.11		41,264.39
Sex of household head					

Male	22.57	49.88	27.55	0.007	203,537.87
Female	23.24	49.32	27.44		38,420.99
Religion					
Hindu	22.66	50.18	27.16	<0.001	194,339.62
Muslim	25.59	43.14	31.27		36,881.55
Christian	14.48	63.04	22.48		4,987.61
Other	11.64	67.91	20.45		5,795.19
Caste					
SC	23.57	48.42	28.01	<0.001	33,473.33
ST	34.64	38.62	26.74		23,285.34
OBC	22.59	48.26	29.14		105,026.52
General/Other	15.16	60.49	24.35		45,420.47
Place of residence					
Urban	10.63	68.09	21.27	<0.001	71,697.97
Rural	27.68	42.18	30.14		170,283.40
Education					
Variable	Unhygienic	Hygienic	Both	p-value	Weighted N
No education	56.73	18.66	24.61	<0.001	15,764.15
Primary	46.74	25.05	28.21		15,077.41
Secondary	21.49	49.63	28.88		165,122.83
Higher	7.38	69.17	23.46		46,018.99
Mass media exposure					
No	45.93	27.02	27.05	<0.001	47,820.00
Yes	16.95	55.40	27.65		194,163.37
Toilet facility					
Improved	18.00	54.63	27.37	<0.001	178,180.50
Unimproved	27.22	44.46	28.32		7,682.58
No facility	39.95	32.24	27.81		45,669.46
Marital status					
Never in union	19.43	52.96	27.61	<0.001	153,739.36
Currently married/Living with partner	28.23	44.40	27.37		86,991.08
Widowed/Divorced/Separated	34.79	35.99	29.22		1,252.93
Region					
North	12.17	63.59	24.23	<0.001	34,527.97
Central	30.37	31.42	38.22		68,629.37
East	28.57	44.06	27.38		59,266.33
Northeast	30.87	34.14	35.00		8,544.63
West	21.33	63.81	14.86		30,557.17
South	9.24	70.32	20.44		40,457.91

Notes: Entries are weighted column percentages, with weighted cell counts in the final column. P-values are from design-adjusted Pearson chi-square tests for the association between each characteristic and menstrual hygiene practice.

Table 2 shows disparities in menstrual hygiene practices across both caste and wealth. By caste, hygienic use is the lowest among ST women and the highest among women in the General/Other category, with SC and OBC women in between. Unhygienic use is correspondingly more concentrated among historically disadvantaged groups. Even at the descriptive level, menstrual hygiene is socially stratified rather than evenly distributed.

The wealth gradient is even steeper. Hygienic use rises strongly across the wealth distribution, while unhygienic use falls steeply. Mixed use also declines with wealth, suggesting that rising household resources support not only initial adoption but also a more complete shift away from non-hygienic materials. The descriptive results indicate that both caste and wealth are salient correlates of menstrual hygiene behaviour, with the wealth gradient appearing particularly pronounced.

Table 2: Distribution of Menstrual Hygiene Practices by Wealth Quintile and Caste (Column %)

By wealth quintile						
Menstrual practice	Poorest	Poorer	Middle	Richer	Richest	Total
Unhygienic	46.71	29.22	18.19	11.11	5.02	22.67
Hygienic	24.69	37.46	51.88	63.23	76.87	49.79
Use both	28.60	33.32	29.93	25.66	18.11	27.53
Total	100	100	100	100	100	100
By caste						
Menstrual practice	SC	ST	OBC	General/ Other	Total	
Unhygienic	23.57	34.64	22.59	15.16	22.58	
Hygienic	48.42	38.62	48.26	60.49	49.74	
Use both	28.01	26.74	29.14	24.35	27.68	
Total	100	100	100	100	100	

Notes: Entries are weighted column percentages. The wealth and caste gradients presented here motivate the multivariable specifications reported in Tables 3–5.

4. Empirical Strategy

4.1 Outcome

Because the three mutually exclusive categories - exclusive unhygienic use, exclusive hygienic use, and mixed use - are discrete and non-ordered, we estimate a multinomial logit model with exclusive hygienic use as the reference category. These categories may reflect partial access, intermittent affordability, or transitional adoption (Meher & Sahoo, 2023).

Let $Y_i \in \{1,2,3\}$ denote the menstrual hygiene category for woman i , where 2 indicate exclusive hygienic use. The multinomial specification is written as:

$$Pr(Y_i = j) = \frac{\exp(X_i\beta_j)}{\sum_{k=1}^3 \exp(X_i\beta_k)}, j = 1,2,3 \dots\dots\dots (1)$$

with category $j = 2$ taken as the reference outcome. Results are reported as relative risk ratios (RRRs) for ease of interpretation.

4.2 Baseline Specification

We begin by estimating the following main-effects model:

$$Y_i = f(\text{Caste}_i, \text{Wealth}_i, Z_i) \dots\dots\dots (2)$$

where Caste_i denotes the respondent's social group and Wealth_i denotes household wealth quintile. Z_i is a vector of covariates that includes woman's education, age of household head, sex of household head, marital status, religion, rural residence, mass media exposure, toilet facility, and region.

This specification serves two purposes. It tests whether caste disparities persist net of household economic position. It also tests whether the wealth gradient survives after controlling for other correlates of menstrual hygiene.

4.3 Interaction between Caste and Wealth

To assess whether the association between wealth and menstrual hygiene

practices differs across caste groups, we extend the baseline model by including interaction terms between caste and wealth quintile:

$$Y_i = f(\text{Caste}_i, \text{Wealth}_i, \text{Caste}_i \times \text{Wealth}_i, Z_i) \dots\dots\dots (3)$$

This specification tests whether the wealth gradient in menstrual hygiene differs across caste groups. Because interaction terms in nonlinear models are not easy to interpret directly, we do not rely on coefficient signs alone. Instead, we use joint Wald tests for the interaction block and examine adjusted predicted probabilities across caste–wealth cells. This matters in our setting. Even when individual interaction coefficients are weak, adjusted probabilities may still show meaningful differences across groups. Our interpretation, therefore, rests on both the overall interaction test and the predicted probabilities.

4.4 Robustness Checks

The multinomial model preserves the mixed-use category, but that “use both” category may still pool heterogeneous behaviour. We therefore estimate two binary logit models. The first defines any hygienic use as one for women reporting either exclusive hygienic use or mixed use, and zero otherwise. This captures the extensive margin of adoption. The second defines exclusive hygienic use as one only when hygienic materials are used alone. This is a stricter outcome. These checks test whether the main patterns depend on how mixed users are classified and whether interaction is more visible at the adoption margin than in the full three-category outcome. For binary outcome, we estimate:

$$Pr(H_i = 1) = \frac{\exp(X_i\gamma)}{1 + \exp(X_i\gamma)} \dots\dots\dots (4)$$

where H_i alternatively denotes any hygienic use or exclusive hygienic use. Results are reported as odds ratios with adjusted predicted probabilities.

All estimates account for the NFHS-5 survey design. We apply sampling weights and adjust standard errors for stratification and primary sampling units throughout. This yields nationally representative estimates and correct inference.

5. Results

5.1 Multivariable Multinomial Estimates: Main Effects

Table 3 reports the multinomial logit estimates, with exclusive hygienic use as the reference category. Household wealth emerges as the strongest gradient in menstrual hygiene practices. As wealth rises, the relative likelihood of both exclusive unhygienic use and mixed use falls sharply relative to exclusive hygienic use. The pattern is steep, monotonic, and precisely estimated.

Caste remains associated with menstrual hygiene practices after conditioning on wealth and the full set of covariates. OBC women show higher relative risk of non-exclusive hygienic use than SC women, while General/Other women show lower relative risk. The ST coefficients are less consistent across contrasts. In the mixed-use contrast, OBC women again show a higher relative risk, while ST and General/Other women do not differ significantly from the SC reference. The pattern is not one of a uniform caste ordering in every comparison. But caste does not disappear once household economic position is taken into account.

The covariates are also informative. Education is strongly associated with a lower relative risk of unhygienic and mixed use. Rural residence is associated with lower exclusive hygienic use, while mass media exposure is associated with better menstrual hygiene. Lack of toilet access is associated with greater reliance on unhygienic materials. Menstrual hygiene is thus shaped not only by household resources, but also by information and basic infrastructure.

Table 3: Multinomial Logit Model of Menstrual Hygiene Practice: Main Effects

Variable	IRR	
	Unhygienic vs Hygienic	Use both vs Hygienic
Social group (ref. SC)		
ST	1.155*** (0.042)	1.002 (0.034)
OBC	1.162*** (0.036)	1.092*** (0.026)
General/Other	0.871*** (0.031)	0.879*** (0.026)
Wealth quintile (ref. poorest)		
Poorest	0.661*** (0.016)	0.888*** (0.024)
Middle	0.388*** (0.012)	0.692*** (0.021)
Richer	0.251*** (0.010)	0.540*** (0.019)
Richest	0.122*** (0.006)	0.357*** (0.014)

Age cohort (ref. 15–19)		
Age 20–24	1.220*** (0.026)	1.217*** (0.023)
Education (ref. no education)		
Primary education	0.770*** (0.038)	0.915* (0.046)
Secondary education	0.309*** (0.012)	0.642*** (0.026)
Higher education	0.134*** (0.006)	0.471*** (0.021)
Household characteristics		
Variable	RRR	
Age of household head	1.000 (0.001)	1.002*** (0.001)
Female household head	0.954* (0.024)	0.988 (0.022)
Marital status (ref. never in union)		
Currently married/living with partner	1.093*** (0.026)	0.968 (0.020)
Widowed/divorced/separated	1.246* (0.159)	1.125 (0.135)
Religion (ref. Hindu)		
Muslim	1.416*** (0.051)	1.487*** (0.046)
Christian	0.771*** (0.058)	0.896* (0.058)
Other	0.655*** (0.042)	0.862*** (0.043)
Residence, information, and sanitation		
Rural residence	1.566*** (0.057)	1.432*** (0.039)
Mass media exposure	0.573*** (0.014)	0.944** (0.023)
Unimproved toilet	1.098 (0.065)	1.037 (0.064)
No toilet facility	1.258*** (0.031)	1.029 (0.025)
Region (ref. North)		
Central	3.504*** (0.122)	2.644*** (0.076)
East	1.515*** (0.057)	1.135*** (0.037)
Northeast	2.126*** (0.110)	1.771*** (0.079)
West	1.913*** (0.088)	0.647*** (0.027)
South	0.806*** (0.036)	0.737*** (0.028)

Notes: Entries are relative risk ratios with standard errors in parentheses. Reference categories are SC, poorest, age 15–19, no education, male household head, never in union, Hindu,

5.2 Interaction between Caste and Wealth in the Multinomial Specification

Table 4 adds caste–wealth interactions to the baseline model. The evidence for interaction is limited. Only a small number of coefficients is statistically significant, and the joint Wald test is weak at conventional levels ($F = 1.40$, $p = 0.0906$). Wealth remains the steepest gradient across caste groups, and caste differences remain visible net of wealth, but the slope of the wealth gradient does not differ sharply across caste categories in the multinomial specification.

Table 4: Multinomial Logit Model with Caste $\times$ Wealth Interaction

Variable	RRR	
	Unhygienic vs Hygienic	Use both vs Hygienic
Social group (ref. SC)		
ST	1.056 (0.056)	0.981 (0.056)
OBC	1.124** (0.052)	1.110** (0.055)
General/Other	0.834** (0.064)	0.900 (0.070)
Wealth quintile (ref. poorest)		
Poorer	0.567*** (0.027)	0.899** (0.043)
Middle	0.344*** (0.020)	0.698*** (0.036)
Richer	0.248*** (0.018)	0.532*** (0.031)
Richest	0.133*** (0.014)	0.369*** (0.026)
Caste $\times$ wealth interaction		
ST # poorer	1.102 (0.081)	0.974 (0.072)
ST # middle	1.413*** (0.129)	1.037 (0.085)
ST # richer	1.054 (0.135)	1.108 (0.112)
ST # richest	0.959 (0.216)	1.171 (0.194)
OBC # poorer	1.084 (0.066)	0.978 (0.059)
OBC # middle	1.109 (0.075)	0.960 (0.061)

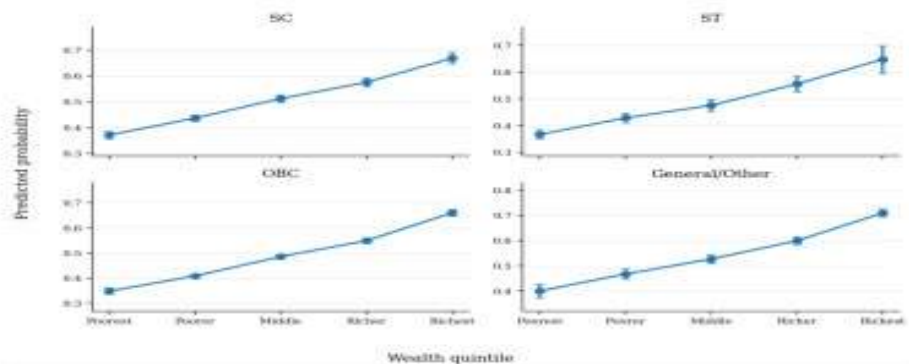
Variable	RRR	
OBC # richer	0.985 (0.082)	1.029 (0.071)
OBC # richest	0.865 (0.106)	0.965 (0.079)
General/Other # poorer	1.007 (0.098)	0.983 (0.092)
General/Other # middle	1.187* (0.122)	1.005 (0.093)
General/Other # richer	1.053 (0.119)	1.002 (0.097)
General/Other # richest	0.933 (0.135)	0.908 (0.095)
Age cohort (ref. 15–19)		
Age 20–24	1.220*** (0.026)	1.217*** (0.023)
Education (ref. no education)		
Primary education	0.770*** (0.038)	0.915* (0.046)
Secondary education	0.309*** (0.012)	0.641*** (0.025)
Higher education	0.134*** (0.006)	0.470*** (0.021)
Household characteristics		
Age of household head	1.000 (0.001)	1.002*** (0.001)
Female household head	0.953* (0.024)	0.987 (0.022)
Marital status (ref. never in union)		
Currently married/living with partner	1.094*** (0.026)	0.967 (0.020)
Widowed/divorced/separated	1.249* (0.160)	1.125 (0.135)
Religion (ref. Hindu)		
Muslim	1.421*** (0.052)	1.482*** (0.046)
Christian	0.773*** (0.058)	0.898* (0.058)
Other	0.662*** (0.043)	0.867*** (0.043)
Residence, information, and sanitation		
Rural residence	1.566*** (0.057)	1.432*** (0.039)
Mass media exposure	0.573*** (0.014)	0.944** (0.023)

Variable	RRR	
Unimproved toilet	1.102 (0.065)	1.037 (0.064)
No toilet facility	1.257*** (0.031)	1.030 (0.025)
Region (ref. North)		
Central	3.503*** (0.122)	2.640*** (0.076)
East	1.513*** (0.057)	1.131*** (0.037)
Northeast	2.114*** (0.110)	1.760*** (0.078)
West	1.906*** (0.088)	0.646*** (0.027)
South	0.810*** (0.037)	0.736*** (0.028)

Notes: Entries are relative risk ratios with standard errors in parentheses. Reference categories are the same as in Table 3. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Joint test of caste $\times$ wealth interaction: $F = 1.40$, $p = 0.091$.

Figure 1 supports the same reading. Predicted hygienic use rises steadily with wealth in every caste group. Within-wealth caste gaps remain, but they are smaller and less systematic than the overall wealth gradient. The pattern is therefore better read as cumulative stratification than as a strong multiplicative interaction between caste and wealth.

Figure 1: Adjusted Predicted Probability of Hygienic Product Use from Multinomial Model



Notes: Points denote predicted probabilities and whiskers denote 95% confidence intervals. Estimates are derived from the corresponding survey-weighted regression model with controls for age, education, household characteristics, religion, residence, media exposure, sanitation, and region.

6. 1 Robustness: Binary Model

Table 5 reports two binary logit models. The first defines any hygienic use as a combination of exclusive hygienic use and mixed use. The second uses the stricter outcome of exclusive hygienic use alone. The broad pattern remains unchanged across both specifications. Wealth remains strongly associated with hygienic use, while caste differences persist after adjustment for the full set of controls.

Table 5: Binary Logit Model of Any Hygienic Use and Exclusive Hygienic Use with Caste × Wealth Interaction

Variable	Odds ratio	Odds ratio
	Any hygienic use	Exclusive hygienic use
Social group (ref. SC)		
ST	0.925* (0.039)	0.957 (0.047)
OBC	0.951 (0.035)	0.894*** (0.038)
General/Other	1.142** (0.071)	1.159** (0.080)
Wealth quintile (ref. poorest)		
Poorer	1.648*** (0.066)	1.418*** (0.059)
Middle	2.420*** (0.121)	1.983*** (0.092)
Richer	3.079*** (0.200)	2.621*** (0.140)
Richest	5.209*** (0.552)	3.964*** (0.255)
Caste × wealth interaction		
ST # poorer	0.897* (0.056)	0.983 (0.063)
ST # middle	0.726*** (0.058)	0.878* (0.064)
ST # richer	0.997 (0.118)	0.954 (0.088)
ST # richest	1.136 (0.249)	0.950 (0.140)
OBC # poorer	0.907* (0.045)	0.975 (0.052)
OBC # middle	0.863** (0.051)	0.992 (0.056)

Variable	Odds ratio	Odds ratio
OBC # richer	0.982 (0.074)	0.985 (0.061)
OBC # richest	1.070 (0.127)	1.066 (0.078)
General/Other # poorer	0.990 (0.079)	0.986 (0.084)
General/Other # middle	0.849* (0.075)	0.921 (0.077)
General/Other # richer	0.959 (0.096)	0.964 (0.084)
General/Other # richest	1.078 (0.148)	1.072 (0.101)
Age cohort (ref. 15–19)		
Age 20–24	0.897*** (0.017)	0.820*** (0.014)
Education (ref. no education)		
Primary education	1.229*** (0.045)	1.245*** (0.056)
Secondary education	2.539*** (0.074)	2.364*** (0.083)
Higher education	5.203*** (0.211)	3.715*** (0.146)
Household characteristics		
Age of household head	1.001** (0.001)	0.999 (0.001)
Female household head	1.044* (0.023)	1.027 (0.021)
Marital status (ref. never in union)		
Currently married/living with partner	0.897*** (0.019)	0.986 (0.018)
Widowed/divorced/separated	0.840* (0.087)	0.852 (0.093)
Religion (ref. Hindu)		
Muslim	0.849*** (0.027)	0.692*** (0.020)
Christian	1.249*** (0.085)	1.176*** (0.069)
Other	1.447*** (0.088)	1.258*** (0.057)
Residence, information, and sanitation		
Rural residence	0.736*** (0.025)	0.676*** (0.017)
Mass media exposure	1.686*** (0.034)	1.361*** (0.029)
Unimproved toilet	0.921* (0.046)	0.947 (0.050)
No toilet facility	0.800*** (0.017)	0.878*** (0.019)

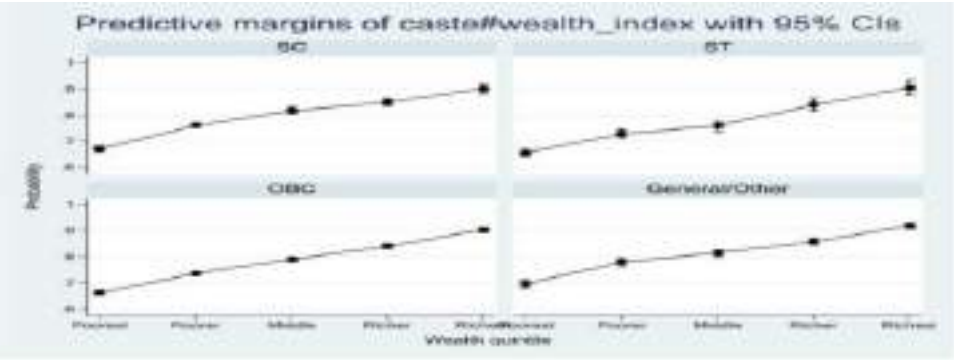
Variable	Odds ratio	Odds ratio
Region (ref. North)		
Central	0.462*** (0.015)	0.348*** (0.009)
East	0.683*** (0.024)	0.804*** (0.023)
Northeast	0.608*** (0.029)	0.542*** (0.022)
West	0.468*** (0.020)	0.999 (0.036)
South	1.135*** (0.049)	1.311*** (0.043)

Notes: Entries are odds ratios with standard errors in parentheses. Reference categories are the same as in Table 3. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Joint test of caste $\times$ wealth interaction: $F = 1.90$, $p = 0.030$.

The interaction is more visible in the model for any hygienic use than in the model for exclusive hygienic use. Figure 2 shows that the probability of any hygienic use rises across the wealth distribution for all caste groups, with wider caste gaps at lower wealth levels and narrower gaps at the top. Figure 3 shows the same upward gradient for exclusive hygienic use, but with more parallel lines across caste groups.

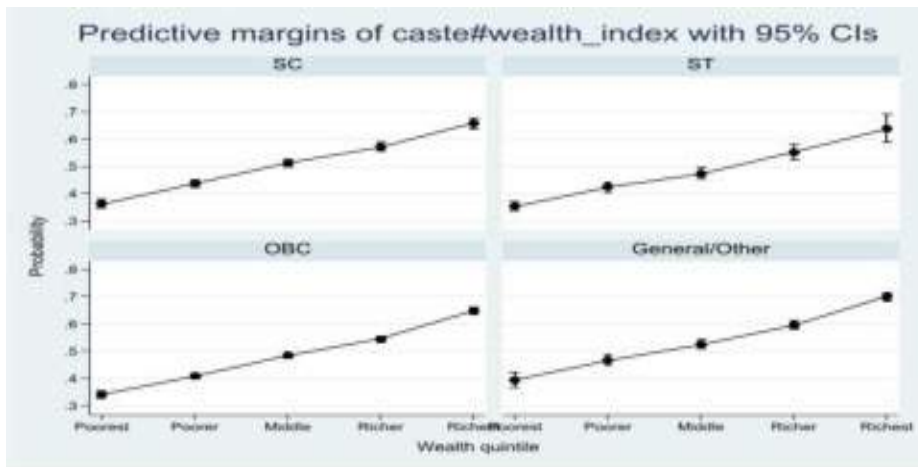
Overall, the binary models sharpen the interpretation of the multinomial results. Menstrual hygiene inequality is structured by both wealth and caste. Wealth generates the steeper gradient. Caste remains associated with use net of household economic position. But differential wealth effects across caste groups are modest and depend on how the outcome is defined.

Figure 2: Predicted Probability of Any Hygienic Use by Caste and Wealth Quintile



Notes: Points denote predicted probabilities and whiskers denote 95% confidence intervals. Estimates are based on the corresponding survey-weighted binary logit model for any hygienic use with the full set of controls.

Figure 3: Adjusted Predicted Probability of Exclusive Hygienic Use by Caste and Wealth Quintile



Notes: Points denote predicted probabilities and whiskers denote 95% confidence intervals. Estimates are based on the corresponding survey-weighted binary logit model for exclusive hygienic use with the full set of controls.

7. Concluding Observations

Using NFHS-5 data, this paper shows that menstrual hygiene practices among young women in India are structured by both household wealth and caste, though not in equal measure. Wealth is the steeper gradient. As household economic position improves, the probability of hygienic product use rises sharply, while reliance on unhygienic materials declines. However, the results also show that economic position does not fully absorb social hierarchy. Caste differences remain after adjusting for education, sanitation, residence, media exposure, and other household characteristics. Menstrual inequality in India is therefore not well described as a simple poverty effect.

The interaction results sharpen this pattern. In the multinomial specification, caste and wealth do not combine in a uniformly strong multiplicative way. In the binary model of any hygienic use, however, the interaction becomes clearer. This suggests that caste matters less as a dramatic modifier across every behavioural category than as a background structure that shapes entry into hygienic adoption. That reading is consistent with wider work on intersectional

health inequality in India, which shows that caste and class often operate as overlapping but distinct forms of disadvantage (Joe, 2015; Malhotra & Do, 2013; Pandey et al., 2017), and with stratification economics, which stresses that group hierarchy affects both access to resources and the returns derived from them (Darity & Ruiz, 2024).

The policy implication is straightforward. Affordability matters, but it is not enough. Menstrual deprivation also reflects unequal access to sanitation, privacy, information, and supportive social environments (Day, 2018; Olson et al., 2022; Babbar et al., 2022). Policies that focus only on product provision are therefore unlikely to eliminate the remaining gaps. More equitable progress requires a layered approach: reducing the recurring cost of hygienic materials for poorer households, improving water and sanitation infrastructure, and addressing stigma and menstrual misinformation through socially targeted interventions. Therefore, menstrual health must be approached not only as a matter of consumption but as a question of equitable capability.

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Self-reported Morbidity in Odisha: Positional Objectivity, Epidemiological Transition or Both

Editorial

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Abstract

The paper analyses the patterns and determinants of morbidity among over one million adult Individuals aged 15-49 in Odisha, India, using the first round of Annual Health Survey (2011-2012) data. The finding reveals that the prevalence of acute illness in the northern and southern regions is higher than the relatively developed coastal region of Odisha. Conversely, the prevalence of chronic illness is much higher in the coastal region (11.08 %) than in the northern and southern regions, indicating that the coastal region is at a higher stage of epidemiological transition than the other two areas. Furthermore, the likelihood of experiencing chronic and acute ailments is higher for those with no formal education, smokers, chewers of tobacco, widows/separated and unmarried. There is an increased odds of reporting chronic ailment, but a decline in the odds of acute ailment was observed from the poorest to the richest individuals. Acknowledging the influence of positional objectivity in explaining self-rated health cannot be ruled out and should not be viewed with scepticism. Thus, the analysis of self-reported morbidity must be contextualised within the broader phenomenon of epidemiological transition.

Keywords: Self-reported morbidity; positional objectivity; Odisha; Annual Health Survey; epidemiological transition; acute and chronic ailment.

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Introduction

Health status is measured either objectively by clinicians or subjectively through self-reports, with self-reported morbidity (SRM) being a widely used, cost-effective tool in surveys to assess illness, predict health outcomes, and analyse healthcare access and expenditure. SRM has received significant criticism and scepticism from scholars for gauging an Individual's health status, particularly in developing countries. Sen (2002) argues that SRM is an unreliable indicator of actual health status because individuals' internal assessments, shaped by education, awareness,

and social environment, often diverge sharply from objective health conditions, as illustrated by Kerala's paradox of high morbidity reporting despite excellent health outcomes and Bihar's opposite pattern. Subramanian et al. (2009) argue that once individual socio-economic factors, especially education, are accounted for, SRM becomes consistent with objective health patterns, as poorer and less educated individuals systematically report more morbidity, and age-adjusted SRM aligns with state-level life expectancy. The individual with lower education consistently reports poorer health, with only minor differences in reporting across groups and no significant underreporting among the disadvantaged (Subramanian et al., 2010). Prinja et al. (2012) show that Kerala's higher SRM and Bihar's lower levels largely reflect their different stages of epidemiological transition rather than reporting bias. The comparability of self-reported health is contested because individuals judge their health relative to differing cultural and contextual reference points, making response categories differ in meaning across populations (Jürges, 2007; Jylha et al., 1998; Quesnel Vallee, 2007).

Some research has argued that anchoring vignettes could be a viable option for the comparative measure of self-reported health (Grol-Prokopczyk et al., 2011; Hinz et al., 2020; Salomon, 2004). One of the most exciting debates is about the predictive power of self-reported health on mortality. The International Journal of Epidemiology published a special issue on the predictive power of self-rated health on mortality. The results from these studies are mixed (Dowd & Zajacova, 2007; Huisman et al., 2007; Quesnel Vallee, 2007; Singh-Manoux et al., 2007). A more recent study in Norway indicates that the impact of SRM on mortality is time-dependent. The authors suggest that it should not be

used uncritically to measure physical illness when other objective health measures are lacking (Lorem et al., 2020).

Regional disparity is one of Odisha's striking features, and the National Sample Survey of India divides the state into three regions: the northern, southern, and coastal regions. Tribal people predominantly inhabit the southern region, which comprises 8 of 12 districts and is part of the backwards KBK region (Kalahandi-Balangir-Koraput), and is referred to as the KBK+ region. It has been found that coastal districts have a longer lifespan, while the southern district has the shortest lifespan in the state (Sahu & Padhan, 2024). The SRM has been scrutinised by Sen (2002), and Subramanyam et al. (2009) argued for the reappraisal of SRM in developing countries. Some authors also suggested that the SRM should be seen through the prism of epidemiological transition. Based on the results from the previous studies, the paper analysed all of the morbidity patterns in Odisha from a regional perspective using the first updation round of Annual Health Survey (2011-12), testing the hypothesis of Sen (2002) and Subramanyam et al. (2009) and utilising secondary data to test the validity of the SRM that was not used in previous studies. The paper tested whether the SRM is a valid method for measuring Odisha's health status. Does the developed region or the districts of Odisha have a better prospect of reporting morbidity? Is the prevalence of morbidity influenced by types of morbidity, such as chronic or acute? How do positional parameters such as education, wealth, social group, place and region of residence influence the prevalence of morbidity among Individuals, controlling for their other socio-demographic and behavioural aspects?

Data and Methodology

Data

This study uses the first updation of Annual Health Survey (AHS) data conducted by the Registrar General of India, Census, in collaboration with the Ministry of Health and Family Welfare. The household is generally asked about their health status (self-reporting) and the health status of the other household members (proxy-reporting). The AHS asks about acute and chronic illness, as well as the respondent's other socio-economic characteristics, such as educational attainment, social identity, household structure, sanitation, and

possession of other household assets. Other than these variables, individuals' personal habits regarding alcohol consumption, smoking habits, and chewing of tobacco were also asked in the AHS. Household income and consumption data are not captured in the AHS. However, data on household ownership of durable and non-durable assets, household characteristics, and access to different services are captured. Principal component analysis (PCA) is widely used to construct socio-economic indicators for households and individuals, particularly in the Demographic and Health Surveys, where data on income and consumption are difficult to capture (Vyas & Kumaranayake, 2006). We have used a similar PCA methodology to construct a wealth index. Based on the PCA scores, the individuals are divided into five wealth quintiles—poorest, poorer, middle, richer and richest. The average lifespan was calculated for 65444 deceased individuals aged e"15 in Odisha's districts from 2007 to 2011. Data Availability: The data used for this article are publicly available from data.gov.in.

In addition, the study uses the National Sample Survey Organisation's 2004 (60th round), 2014 (71st round), and 2018 (75th round) datasets for SRM in Odisha. The paper analysed the 13251, 11624, and 19118 individuals from the 60th, 71st, and 75th rounds of NSSO and cross-tabulated SRM in Odisha across the NSS regions, Monthly Per-capita Consumption Expenditure (MPCE), and Education level.

Methods

The bivariate analysis measures the prevalence of SRM, both chronic and acute. The prevalence is calculated per 100 persons by using the following formula.

$$M_i = \frac{A_i}{P_i} * 100 \dots \dots \dots Eq(1)$$

Where M_i is the prevalence of morbidity

A_i is the total number of ailing persons, chronic and acute P_i is the total number of persons aged 15-49 alive in the sample household.

Following Subramanyam (2009), we used a multivariate logistic regression model to examine the independent effects of the socio-economic variables on SRM.

$$Logit (M_i) = \ln \left(\frac{q}{1 - q} \right) = \alpha + \sum_i \beta_i x_i + u_i \dots \dots \dots eq(2)$$

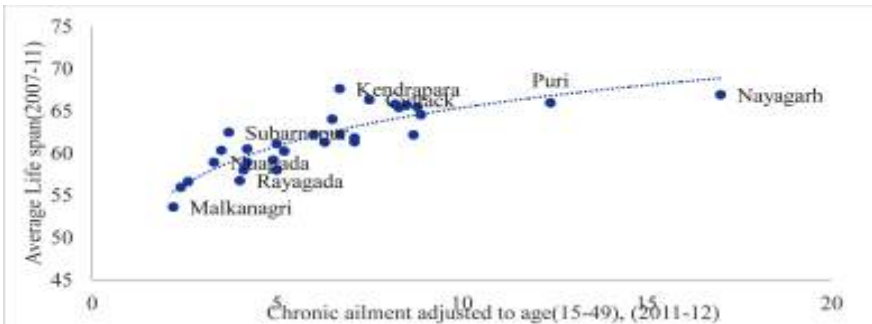
The multivariate logistic regression model(Gujrati & Porter, 2008) is applied for chronic and acute ailments in Odisha and the three NSS regions of Odisha. We have examined the odds ratios obtained from multivariate logistic regression rather than the logit coefficients. We have constructed a binary response variable for chronic and acute illness. Those with any chronic or acute disease are coded as 1; otherwise, coded as 0. The binary responses for the dependent variables are given in the following.

- 1. Whether suffering from any chronic ailment in the last one year? (Yes=1/No=0).
- 2. Whether suffering from any other Acute ailment any time during last 15 days (Yes=1/No=0).

Results

To empirically examine Sen’s (2002) observation, the district-level prevalence of chronic illness is analysed in relation to district-level average lifespan and educational attainment. The conventional wisdom holds that districts with worse health conditions have a lower lifespan; however, Figure 1 does not support this proposition, instead showing a contradictory result that aligns with Sen’s observation.

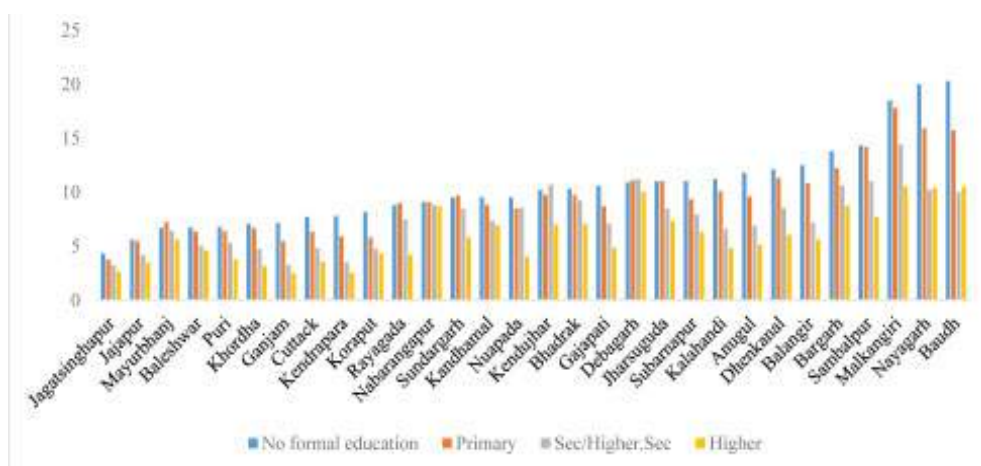
Figure 1: Districtwise Average Lifespan and Age-adjusted People Reporting Chronic Ailment



Note: The average lifespan (2007-11) is calculated from the mortality schedule of the three rounds of the AHS survey, and the Chronic ailment is estimated from the first updation round of the AHS (2011-12) survey.

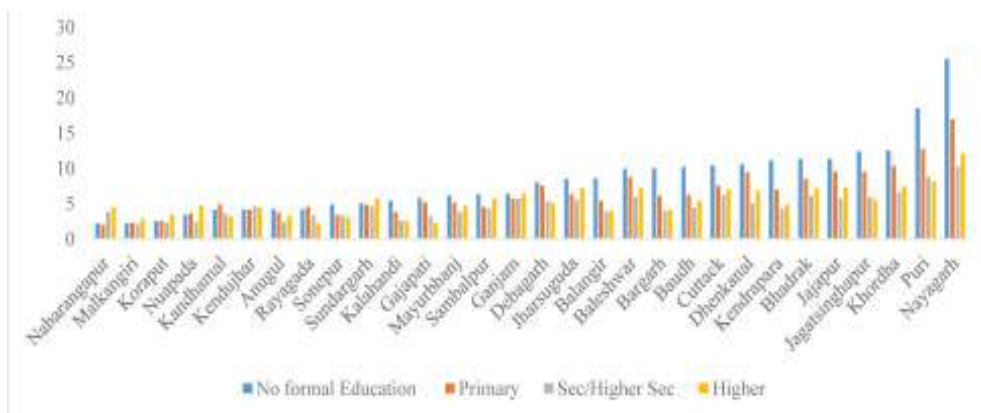
Figures 2 and 3 show that in most of the districts, the prevalence of chronic illness is higher among low-education groups. Few districts in the southern region have a higher prevalence of chronic illness among higher education groups. Interestingly, acute illness is higher among individuals with no formal education across all districts.

Figure 2: Age-Adjusted Share of People Reporting Chronic Ailment across Educational Groups in the Districts of Odisha (%)



Source: Estimated from the AHS (2011-12)

Figure 3: Age-adjusted Share of People Reporting Acute Ailment across Educational Groups in the Districts of Odisha (%)



Source: Estimated from the AHS (2011-12)

Table 1: Summary Table of AHS for Odisha and Its NSS Regions, 2011-12

Variables	Odisha		Northern		Southern		Coastal	
	N	%	N	%	N	%	N	%
Sector								
Rural	837866	80.67	267683	76.33	239176	87.85	331005	79.63
Urban	200785	19.33	83017	23.67	33075	12.15	84693	20.37
Sex								
Male	510647	49.16	171546	48.92	136981	50.31	202120	48.62
Female	528004	50.84	179156	51.08	135270	49.69	213578	51.38
Social Groups								
Scheduled Caste	194455	18.72	53257	15.19	58603	21.53	82595	19.87
Scheduled Tribe	199395	19.20	105071	29.96	78244	28.74	16080	3.87
Others	644801	62.08	192374	54.85	135404	49.73	317023	76.26
Religion								
Hindu	987703	95.09	335172	95.57	256977	94.39	395554	95.15
Others	50948	4.91	15530	4.43	15274	5.61	20144	4.85
Marital Status								
Married	349453	33.64	117646	33.55	84690	31.11	147117	35.39
Unmarried	662113	63.75	222089	63.32	179433	65.91	260600	62.69
Divorced/ separated	27085	2.61	10976	3.13	8128	2.99	7981	1.92
Education								
No Formal Education	254750	24.53	83117	23.70	108393	39.81	63240	15.21
Primary	483863	46.59	173304	49.42	103416	37.99	207143	49.83
Secondary/Higher- secondary	231151	20.33	67144	19.15	45757	16.81	98250	23.64
Higher	88877	8.56	27137	7.74	14684	5.39	47056	11.32
Chew Tobacco								
Yes	368010	35.43	140166	39.97	100250	36.82	127594	30.69
No	670641	64.57	210536	60.03	172001	63.18	288104	69.31
Alcohol								
Yes	127222	12.25	63533	18.12	38478	14.13	25211	6.06
No	931429	87.75	287169	81.88	233773	85.87	390487	93.94
Smoke								
Yes	70591	6.80	21409	6.10	18817	6.91	30365	7.30
No	968060	93.20	329293	93.90	253434	93.09	385333	92.70
Wealth Quintile								
Poorest	208193	20.04	68848	19.63	89807	32.99	49538	11.92
Poorer	208780	20.10	75840	21.63	58134	21.35	74806	18.00

Middle	206480	19.88	67075	19.13	47283	17.37	92122	22.16
Richer	207471	19.98	66085	18.84	39837	14.63	101549	24.43
Richest	207727	20.00	72854	20.77	37190	13.66	97683	23.50
Regions								
Northern	350702	33.77	350702	100	-	-	-	-
Southern	272251	26.21	-	-	272251	100	-	-
Coastal	415698	40.02	-	-	-	-	415698	100

Note: N = Number; Source: Estimated from the AHS (2011-12)

Table 2: Prevalence of Acute and Chronic Ailments in Odisha and Its NSS Regions, 2011-12

Variables	Odisha		Northern		Southern		Coastal	
	CI	AI	CI	AI	CI	AI	CI	AI
Sector								
Rural	6.5	7.7	4.7	9.7	4.1	9.2	9.6	7.0
Urban	6.9	6.3	6.1	10.2	6.6	5.1	7.5	3.7
Sex								
Male	5.8	7.4	4.3	8.9	4.1	8.1	7.9	5.7
Female	7.3	8.9	5.5	10.6	4.9	9.3	10.3	7.1
Social Group								
Scheduled Caste	6.8	9.2	5.8	12.1	4.4	10.2	8.9	6.9
Scheduled Tribe	3.6	8.8	3.2	8.6	3.1	9.5	5.0	6.0
Others	7.5	7.6	5.8	10.0	5.2	7.7	9.5	6.3
Religion								
Hindu	6.6	8.1	5.0	9.8	4.5	8.6	9.2	6.4
Others	6.4	8.4	4.2	9.4	4.7	11.3	9.1	5.4
Marital Status								
Married	2.6	6.6	1.9	8.6	1.8	6.5	3.4	5.3
Unmarried	8.4	8.8	6.3	10.2	5.6	9.6	12.2	6.9
Widow/Separated	11.4	11.6	8.8	14.0	7.8	10.8	18.1	9.6
Education								
No formal education	7.0	9.7	5.6	10.2	4.7	10.2	12.7	8.0
Primary	7.0	8.5	5.0	10.4	4.5	8.6	9.8	7.1
Secondary/Higher Secondary	5.1	6.5	4.0	8.9	3.8	6.4	6.4	5.1
Higher	6.0	4.8	4.9	6.5	4.2	4.7	7.2	3.8
Chew Tobacco								
Yes	8.3	9.8	6.0	11.1	5.3	10.4	13.1	7.7
No	5.5	7.2	4.2	8.9	4.0	7.6	7.4	5.8
Alcohol								
Yes	6.0	9.7	5.0	9.8	4.7	10.8	10.2	7.5
No	6.6	7.9	5.9	10.1	4.4	8.4	9.1	6.3
Smoke								
Yes	8.8	9.3	4.0	9.7	5.7	10.0	13.0	8.1
No	6.4	8.1	4.2	9.7	4.4	8.6	8.9	6.3
Wealth Quintile								
Poorest	5.2	9.5	5.7	10.8	3.7	10.1	9.3	7.8

Poorer	6.2	9.1	6.5	8.2	4.4	10.3	9.2	7.6
Middle	6.9	8.7	4.9	10.8	4.2	8.9	9.8	7.1
Richer	7.3	7.7	5.7	10.8	4.7	7.4	9.2	6.3
Richest	7.4	5.6	6.5	8.2	6.1	5.0	8.5	4.3
Region								
Northern	6.56	9.3						
Southern	5.65	10.1						
Coastal	11.08	6.7						

Source: Estimated from the AHS (2011-12)

Note: CI= Chronic ailment, AI= Acute ailment

The prevalence of morbidity estimated for Odisha, along with socio-economic variables of Individuals, is presented in Table 2, which shows socio-economic and individual differences in acute and chronic illness. The prevalence of chronic and acute ailments declines with increasing educational attainment, and the poorest individuals report a higher prevalence of acute ailments but a lower prevalence of chronic ailments than the richest individuals. The coastal region in Odisha has a higher prevalence of chronic illnesses and a lower prevalence of acute illnesses.

Table 3: Odds of Reporting Chronic and Acute Ailments in Odisha and Its NSS Regions, Results for Multivariate Logistic Regression Analysis

Variables	Odisha		Northern		Southern		Coastal	
	Odds ratio (Standard error)	Odds ratio (Standard error)	Odds ratio (Standard error)	Odds ratio (Standard error)	Odds ratio (Standard error)	Odds ratio (Standard error)	Odds ratio (Standard error)	Odds ratio (Standard error)
	CI	AI	CI	AI	CI	AI	CI	AI
Sector								
Urban	0.972*** (0.0108)	0.881*** (0.00952)	1.174*** (0.0212)	1.147*** (0.0170)	1.359*** (0.0409)	0.749*** (0.0199)	0.771*** (0.0124)	0.585*** (0.0124)
Sex								
Male	1.185*** (0.0110)	1.245*** (0.0102)	1.161*** (0.0205)	1.260*** (0.0169)	1.034 (0.0230)	1.191*** (0.0178)	1.249*** (0.0158)	1.304*** (0.0189)
Female®								
Social Group								
Scheduled Caste	0.900*** (0.00947)	1.084*** (0.0101)	1.022 (0.0209)	1.210*** (0.0189)	0.871*** (0.0218)	1.148*** (0.0196)	0.831*** (0.0118)	0.905*** (0.0146)
Scheduled Tribe	0.556*** (0.00792)	0.879*** (0.00894)	0.630*** (0.0129)	0.826*** (0.0122)	0.627*** (0.0166)	1.076*** (0.0177)	0.421*** (0.0158)	0.754*** (0.0267)
Others®								
Religion								
Others	1.063*** (0.0195)	1.097*** (0.0177)	0.984 (0.0373)	1.038 (0.0294)	1.224*** (0.0484)	1.357*** (0.0353)	1.025 (0.0256)	0.894*** (0.0280)
Hindu®								
Marital Status								
Married®								
Unmarried	3.138***	1.145***	2.992***	1.074***	2.878***	1.300***	3.289***	1.099***

	(0.0375)	(0.00978)	(0.0661)	(0.0144)	(0.0851)	(0.0217)	(0.0533)	(0.0165)
Widows/Separated	4.512***	1.388***	4.279***	1.399***	4.028***	1.377***	4.813***	1.422***
	(0.101)	(0.0284)	(0.164)	(0.0427)	(0.211)	(0.0523)	(0.160)	(0.0575)
Education								
Illiterate	1.400***	1.326***	1.496***	1.283***	1.383***	1.207***	1.371***	1.384***
	(0.0264)	(0.0252)	(0.0525)	(0.0389)	(0.0740)	(0.0504)	(0.0342)	(0.0435)
Primary	1.319***	1.389***	1.365***	1.420***	1.415***	1.271***	1.223***	1.371***
	(0.0219)	(0.0241)	(0.0424)	(0.0387)	(0.0713)	(0.0510)	(0.0261)	(0.0373)
Secondary/Higher Secondary	1.016	1.200***	1.038	1.263***	1.159***	1.137***	0.938***	1.116***
	(0.0179)	(0.0216)	(0.0344)	(0.0357)	(0.0607)	(0.0472)	(0.0213)	(0.0317)
Higher®								
Chew Tobacco								
Yes	1.470***	1.287***	1.509***	1.350***	1.331***	1.280***	1.491***	1.227***
	(0.0135)	(0.0109)	(0.0261)	(0.0185)	(0.0298)	(0.0197)	(0.0187)	(0.0188)
No®								
Alcohol								
Yes	0.814***	1.026**	0.846***	0.974	0.762***	1.135***	0.820***	0.998
	(0.0122)	(0.0126)	(0.0200)	(0.0178)	(0.0256)	(0.0240)	(0.0207)	(0.0297)
No®								
Smoke								
Yes	1.247***	1.057***	1.163***	1.026	1.338***	0.916***	1.260***	1.230***
	(0.0198)	(0.0159)	(0.0360)	(0.0262)	(0.0513)	(0.0250)	(0.0276)	(0.0333)
No®								
Wealth Quintile								
Poorest®								
Poorer	1.074***	0.999	1.054**	0.990	1.114***	1.035**	1.037*	0.980
	(0.0145)	(0.0106)	(0.0262)	(0.0174)	(0.0309)	(0.0178)	(0.0207)	(0.0215)
Middle	1.179***	0.988	1.192***	1.041**	1.090***	0.942***	1.133***	0.960*
	(0.0159)	(0.0110)	(0.0303)	(0.0191)	(0.0330)	(0.0185)	(0.0219)	(0.0204)
Richer	1.227***	0.944***	1.391***	1.031	1.177***	0.861***	1.113***	0.904***
	(0.0171)	(0.0112)	(0.0362)	(0.0200)	(0.0386)	(0.0197)	(0.0219)	(0.0197)
Richest	1.442***	0.771***	1.769***	0.831***	1.392***	0.689***	1.274***	0.787***
	(0.0227)	(0.0112)	(0.0502)	(0.0189)	(0.0532)	(0.0208)	(0.0283)	(0.0205)
Regions								
Northern	0.647***	1.561***						
	(0.00613)	(0.0138)						
Southern	0.454***	1.460***						
	(0.00525)	(0.0139)						
Coastal®								
Constant	0.0245***	0.0436***	0.0134***	0.0628**	0.0124***	0.0614**	0.0275***	0.0504**
	(0.000534)	(0.000881)	(0.000544)	(0.00198)	(0.000717)	(0.00262)	(0.000800)	(0.00166)
Observations	1,038,641	1,038,641	350,702	350,702	272,250	272,250	415,689	415,689

Source: Estimated from the AHS (2011-12)

Note: *** p<0.01, ** p<0.05, * p<0.1, AI: Acute Illness, CI: Chronic Illness, ®-Reference category.

Multivariate logistic regression results indicate that all the positional parameters, such as education, wealth, place of residence, and region, are significant. Households in the higher wealth quintile are more likely to report chronic ailments. In sharp contrast to chronic ailments, the wealthiest are less likely to report acute ailments than the poorest. Education is one of the most significant variables in determining the reporting of ailments. The odds of reporting both chronic and acute diseases are higher for illiterates and individuals with up to primary level education than for those highly educated. This difference in reporting is observed across all the three regions.

There is no significant difference in the reporting of chronic ailments in rural and urban areas of Odisha. However, the urban sector has a lower likelihood of reporting acute ailments. The urban areas of the three regions are more likely to report chronic and acute ailments, except in the southern region, where the odds of reporting acute ailments are higher. Besides the positional variables, other control variables, such as sex and personal behaviours, such as chewing tobacco, alcohol consumption, and smoking, are significant. Females are more likely to report chronic and acute ailments after controlling for all other variables. Scheduled Tribes (STs) are less likely to report chronic and acute ailments, except in the southern region. Scheduled Castes (SCs) are more likely to report acute ailments in Odisha’s northern and southern regions than others. Respondents with personal habits such as smoking and chewing tobacco have higher odds of reporting chronic and acute ailments.

Table 4: Marginal Effect of Chronic Illness and Acute Illness in Odisha and Its NSS Regions

Variables	Category	Odisha		Northern		Southern		Costal	
		CI	AI	CI	AI	CI	AI	CI	AI
Sector	Urban	0.070 ***	0.088 ***	0.056 ***	0.098 ***	0.041 ***	0.100 ***	0.100 ***	0.071 ***
	Rural	0.068 ***	0.078 ***	0.065 ***	0.110 ***	0.054 ***	0.077 ***	0.079 ***	0.043 ***
Sex	Male	0.064 ***	0.077 ***	0.054 ***	0.090 ***	0.042 ***	0.090 ***	0.086 ***	0.058 ***
	Female	0.074 ***	0.094 ***	0.063 ***	0.111 ***	0.043 ***	0.105 ***	0.104 ***	0.074 ***
Social Group	Scheduled Caste	0.069 ***	0.094 ***	0.067 ***	0.121 ***	0.043 ***	0.105 ***	0.086 ***	0.062 ***
	Scheduled Tribe	0.044 ***	0.077 ***	0.042 ***	0.086 ***	0.031 ***	0.099 ***	0.046 ***	0.053 ***
	Others	0.076 ***	0.087 ***	0.065 ***	0.103 ***	0.049 ***	0.093 ***	0.101 ***	0.068 ***
Religion	Hindu	0.069 ***	0.086 ***	0.059 ***	0.100 ***	0.042 ***	0.096 ***	0.096 ***	0.067 ***

	Others	0.073 ***	0.093 ***	0.058 ***	0.104 ***	0.051 ***	0.126 ***	0.098 ***	0.060 ***
Marital Status	Married	0.029 ***	0.078 ***	0.025 ***	0.095 ***	0.019 ***	0.082 ***	0.040 ***	0.062 ***
	Unmarried	0.086 ***	0.089 ***	0.072 ***	0.101 ***	0.052 ***	0.104 ***	0.120 ***	0.068 ***
	Separated/ Widowed	0.118 ***	0.105 ***	0.100 ***	0.128 ***	0.071 ***	0.109 ***	0.165 ***	0.086 ***
Education Qualification	No formal education	0.077 ***	0.087 ***	0.067 ***	0.097 ***	0.044 ***	0.097 ***	0.110 ***	0.071 ***
	Primary	0.073 ***	0.091 ***	0.061 ***	0.107 ***	0.045 ***	0.102 ***	0.100 ***	0.070 ***
	Secondary/Higher Secondary	0.057 ***	0.079 ***	0.048 ***	0.096 ***	0.037 ***	0.092 ***	0.079 ***	0.058 ***
	Higher	0.056 ***	0.067 ***	0.046 ***	0.078 ***	0.032 ***	0.082 ***	0.083 ***	0.052 ***
Chew Tobacco	Yes	0.085 ***	0.099 ***	0.072 ***	0.117 ***	0.050 ***	0.111 ***	0.118 ***	0.075 ***
	No	0.060 ***	0.079 ***	0.050 ***	0.090 ***	0.038 ***	0.089 ***	0.083 ***	0.062 ***
Alcohol	Yes	0.059 ***	0.088 ***	0.052 ***	0.099 ***	0.034 ***	0.107 ***	0.081 ***	0.066 ***
	No	0.071 ***	0.086 ***	0.061 ***	0.101 ***	0.044 ***	0.096 ***	0.097 ***	0.066 ***
Smoke Tobacco	Yes	0.083 ***	0.090 ***	0.067 ***	0.103 ***	0.054 ***	0.091 ***	0.115 ***	0.079 ***
	No	0.068 ***	0.086 ***	0.058 ***	0.100 ***	0.041 ***	0.098 ***	0.094 ***	0.065 ***
Wealth	Poorest	0.059 ***	0.090 ***	0.047 ***	0.102 ***	0.038 ***	0.103 ***	0.087 ***	0.071 ***
	Poorer	0.063 ***	0.090 ***	0.049 ***	0.102 ***	0.042 ***	0.106 ***	0.089 ***	0.071 ***
	Middle	0.069 ***	0.089 ***	0.055 ***	0.106 ***	0.041 ***	0.097 ***	0.097 ***	0.069 ***
	Richer	0.072 ***	0.086 ***	0.064 ***	0.105 ***	0.044 ***	0.090 ***	0.095 ***	0.065 ***
	Richest	0.083 ***	0.071 ***	0.079 ***	0.087 ***	0.052 ***	0.073 ***	0.107 ***	0.057 ***
NSS Regions	Coastal	0.061 ***	0.101 ***						
	Northern	0.044 ***	0.095 ***						
	Southern	0.091 ***	0.067 ***						
		Sample = 1, 38, 641		Sample = 3,50,702		Sample = 2,72,250		Sample = 4,15,689	

Note: *** p<0.01, p<0.05, p<0.1, AI: Acute Illness, CI: Chronic Illness

Source: Estimated From AHS (2011-12)

The marginal effect shows a significant divergence in the prevalence of chronic and acute ailments in Odisha and in the NSS regions of the state. The urban areas have higher chances of CI and AI in Odisha and the coastal region, while both diseases are higher in the rural areas of the Northern provinces. In the Southern region, AI is higher in the urban areas, and CI is higher in the rural areas. Compared to males, females have a higher prevalence of CI and AI in all regions of Odisha. Within the social group, OBC has a higher prevalence of the CI, and the SC has a higher prevalence of the AI. Among the religious groups, the Other have higher chances of the CI and AI compared to the Hindu religious group in Odisha.

In contrast, social and religious differences are found in the prevalence of the CI and AI in different regions. Widows/Separated have a higher prevalence, whereas Higher education has a lower prevalence of the CI and AI in Odisha, as well as in all its regions. The chewing tobacco and smoking tobacco have a higher prevalence of the CI and AI; meanwhile, the CI is higher in persons with no alcohol consumption, and AI is higher with alcohol consumption in Odisha. The richest have a higher prevalence of the CI, and the poorest have a higher prevalence of the AI in Odisha, and the coastal region has a higher AI, whereas the southern region has a higher CI.

Table 5: Distribution of Morbidities across Different Socio-economic Groups in Odisha

Variables	Categories	Infectious			CVDs			NCDs			Disability			Others		
		2004	2014	2018	2004	2014	2018	2004	2014	2018	2004	2014	2018	2004	2014	2018
Education	No formal education	18.6	41.34	20.59	1.5	7.12	14.42	8.5	4.28	13.56	7.2	31.32	19.74	36.2	48.27	40.33
	Primary	10.7	23.34	15.87	1.2	17.18	9.9	5.6	10.4	13.55	2.7	18.11	12.13	25.1	42.02	25.14
	Secondary	8.8	13.44	11.05	1.4	5.4	13.81	8.4	8.1	13.61	6.1	13.72	8.6	24.1	38.83	17.75
	Higher Secondary	0	19.75	17.9	1	21.49	6.71	2.2	9.49	14.91	0.3	1.56	7.46	30.1	29.85	19.39
	Graduate/post-graduate	11.7	5.94	11.79	4.7	12.28	11.01	12.1	2.51	24.37	0.1	1.55	7.86	6.9	7.93	11.79
MPEC	Poorest	15.7	36.11	19.86	1	2.76	10.98	6.1	8.85	7.94	5.2	25.88	13.08	44.6	33.56	29.44
	Poorer	12.4	21.72	20.19	1.1	7.92	8.61	8.8	3.58	8.91	4.5	14.37	11.88	34.3	39.13	25.53
	Middle	14.7	17.53	13.8	2.6	11.29	10	3	2.78	13.56	6	19.2	14.04	21.7	54.94	25.46

	Richer	12.5	14.71	11.87	0.6	19.63	15.46	10.2	7.44	17.12	6.1	17	12.98	23.3	44.18	28.16
	Richest	15.7	34.1	13.71	2.6	23.44	16.18	13.4	19.17	25.23	6.5	17.55	12.34	18.9	35.01	23.59
NSS Region	Coastal	15.6	27.85	13.18	2.4	13.85	10.66	11.4	8.07	10.96	7.4	26.14	9.33	35	51.53	18.81
	Southern	7.6	25.3	14.74	0.4	4.68	10.39	1.8	3.92	14.46	4.4	14.85	14.74	27.5	28.34	28.91
	Northern	15.3	22.78	20.99	0.9	14.17	16.6	5.9	10.56	18.7	3.8	16.81	15.08	25.6	42.33	33.21

Source: Author's calculation from the NSSO's 61st (2004), 71st (2014) and 75th (2018) round unit level data

The prevalence of Infectious, non-communicable diseases (NCDs) and cardiovascular diseases (CVDs), as well as disability, and other diseases changes across different education, MPCE and regions in the state (Table 5). The data from 2004, 2014, and 2018 show that the infectious disease is higher among those with no formal education as compared to the more educated. The NCDs show a rise from 2004 to 2014 to 2018 across the education level, except for the graduate/Post-graduate, where it is low in 2014. Across the MPCE, it also denotes the variabilities during 2004, 2014, and 2018. The coastal region, which is more developed, had the highest prevalence of Infectious diseases, CVDs, and Disabilities in 2004 and 2014, while in 2018 it shifted to the northern region. The NCDs were higher only in 2004 in the coastal region; in 2014 and 2018, they were higher in the northern region. The NCDs, Disabilities and Others were higher in the Northern and Southern regions in 2018. This suggests that socio-economic and environmental factors influence the distribution and burden of these diseases and disabilities in the state.

Discussion

SRM is widely used to measure health status in developing and developed countries. However, scholars have pointed out serious drawbacks to this methodology. Since the advent of Amartya Sen's critique of this methodology, the efficacy of SRM has been widely debated. This article attempted to analyse the effectiveness of SRM at the regional level using a large-scale dataset not used in previous studies. The empirical results show that the average lifespan and the prevalence of chronic morbidity in the districts of Odisha go in the same direction for chronic illness. Similarly, highly educated districts have a

higher prevalence of chronic illness. While the coastal district has a higher lifespan, the prevalence of chronic illness is higher. On the contrary, acute illness is more prominent in Odisha's northern and southern districts. As per the data collection methods of AHS, chronic illness is mostly NCDs, and acute illness is mostly CDs. We found a similar result in a multivariate logistic regression framework by looking at individual data. The southern and northern regions have a lower likelihood of reporting chronic illness but a higher likelihood of acute illness. Dilip (2002) found interesting regional differences in the prevalence of chronic and acute ailments. He observed that Southern Kerala, a relatively developed region in Kerala, witnessed a higher prevalence of chronic and acute illnesses and hospitalisations. Our present finding is relatable to Dillip's (2002) finding. What is observed at the state level, i.e., the extensive comparison of Kerala and Bihar in the literature, could also be found in Odisha. The regional disparity of access to health care may lead to lower utilisation in the peripheral districts, which may lead to lower reporting of chronic illness (Thomas et al., 2015). It has been argued that the gap between the observed and reported morbidity is smaller in developed regions. The coastal region with better development indicators may lead to greater health consciousness among individuals and better reporting (Dilip, 2002; Murray & Chen, 1992), which refers to the shift from acute to chronic illnesses as populations progress socially and economically. In the early stages of development, the society suffers from an acute disease, leading to higher mortality and lower life expectancy.

In contrast, as society progresses, health care improves, and there is a decline in acute illness. Meanwhile, chronic illnesses such as heart disease, diabetes, and cancer become more prevalent, significantly impacting morbidity and healthcare systems. This concept summarises how societies move from a stage marked by high mortality rates due to infectious diseases and a lack of medical knowledge to a stage where chronic diseases and lifestyle-related ailments become more central. Modern sanitation, vaccines, and antibiotics have greatly reduced disease in developed countries, yet infectious diseases still lead to global deaths. This continued burden stems from inadequate strategies and unexpected challenges like HIV, drug-resistant malaria, and tuberculosis (Sanders et al., 2008). The transition in Mozambique is marked by the "double burden"; it is experiencing high infectious diseases, and NCDs

are increasing. The communicable disease is major, and transitions towards NCDs are becoming more significant (Ciccacci et al., 2020). It is found that CVDs have emerged as the primary cause of death in areas like rural Vietnam, representing the transition in morbidity and mortality (Van Minh et al., 2003). Whereas India is experiencing the double burden of the disease, the burden of NCDs is rising in old age without replacing communicable diseases, and the age at which the most deaths occur (modal age at death) is rising, indicating the dominance of old age death over childhood/adult age death (Yadav & Arokiasamy, 2014).

Acute illness is higher in the northern and southern regions, but lower chronic illness, which needs a different explanation. The wealthiest individuals are reporting more chronic illness and less acute illness. The reporting of the wealthiest individuals for chronic illness is more prominent in the northern and southern regions than in the coastal areas. Further, the SCs report a higher acute illness burden in the southern part. In contrast, the prevalence of chronic illness is lower for SCs in the southern region. Previous studies from India and different states have also found a similar pattern of reporting the prevalence of morbidity, higher among the richest individuals and SCs and STs. The coastal regions of Odisha are at a higher stage of epidemiological transition relative to southern and northern regions, where the predominant cause of morbidity is NCDs. Prinja et al. (2015) found that reporting chronic illness is more prominent among the richest of Bihar than the richest of Kerala, which leads to the conclusion that Kerala is at a higher stage of epidemiological transition. It is observed in the literature that at the initial stage of epidemiological transition, affluence is associated with a higher incidence of NCDs among the richest (as in northern and southern Odisha). During the transition process, this relationship reverses, and the poor tend to bear a higher burden of NCDs, leading to the equalisation of NCDs among the poor and the rich (as in the coastal region).

Educational attainment is pivotal in validating the effectiveness of SRM, as it is widely debated in the literature. Our findings suggest that districts with better education report a more chronic but insignificant relationship for acute illness at an aggregate level. At an individual level, the illiterates report higher morbidity irrespective of region and types of morbidity. It might be due to educated districts having access to and knowledge of health care, being more

likely to report health problems, and being more knowledgeable about preventive care. Whereas the illiterate is more likely to suffer from a lack of knowledge of preventive care and access to health care. This finding corroborates previous studies on the validity of SRM (Ghosh & Arokiasamy, 2010; Paul & Singh, 2017; Srinivasan et al., 2017; Subramanian et al., 2009). Our other control variables, such as chewing tobacco and smoking, are associated with worse health outcomes for chronic and acute illnesses. Previous research on personal behaviours such as smoking also highlighted that adolescents are more likely to report poor health in different countries and contexts (Hansen et al., 2015; Heshmat et al., 2017; Nguipdop-Djomo et al., 2020). The surgeons' general report of the United States suggests that at least 20 million deaths can be attributable to smoking in the last 50 years. Smoking has a direct effect on individual health as well as on children exposed to passive smoking. It deteriorates the health status of individuals and creates diseases in all organs of the human body (U.S. Department of Health and Human Services, 2014). The findings from this study can be beneficial for framing policy and discouraging smoking and tobacco chewing behaviours, especially among adults in Odisha.

Widowhood and separation from marriage were associated with worse health outcomes for chronic and acute illness, and the relationship does not weaken even after controlling for other factors such as education and health. Previous research on marital status and health outcomes was mixed in Western society, but some studies in the Indian context documented worse health outcomes related to marital status (Perkins et al., 2016; Sudha et al., 2007). Returning to the hypotheses of Sen (2002) and Subramanian et al. (2009), we found that the relative position of different regions could partly influence the reporting of morbidity in Odisha with respect to their development indicators.

Conclusion

A district with better education and health facilities enables people to better perceive their health. However, this argument loses force as we analyse the individual-level dataset. If educational attainment is a proxy for awareness of any disease, we have consistently found an inverse relationship between educational attainment and SRM across the region. Sen's hypothesis or the validity of SRM is challenging to analyse if we are not simultaneously analysing

objective and subjective health measures and bridging the gap in both measures. Prinja et al. (2015) pointed out that the varying degree of epidemiological transition in different regions could also be responsible for SRM in Bihar and Kerala. The coastal region might be at a higher stage of epidemiological transition, hence more prevalence of chronic illness (NCDs) than southern and northern regions, where more acute illness (CDs) is observed, since most of the data collection used in developing countries is SRM due to its ease, speed, and cost-effectiveness. Our findings have important policy implications. We argued in favour of using SRM in Odisha's large-scale surveys. Finally, we conclude that SRM is a valid measure of morbidity when objective measures are lacking, even at the regional level. However, it should not be uncritically examined.

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SDG 4 and Regional Disparities in India: A Comparison of North and South Indian States

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Abstract

Recognizing its transformative potential, Sustainable Development Goal 4 (SDG 4) seeks to ensure inclusive and equitable quality education and lifelong learning opportunities for all by 2030. This study examines the status of SDG 4 achievement through a comparative analysis of North and South Indian states, highlighting structural inequalities that remain obscured within national averages. Drawing upon data from the SDG India Index 2023–24 and related national datasets, the study constructs a multidimensional analytical framework incorporating indicators of access, equity, learning outcomes, infrastructure, gender parity, teacher quality, and higher education participation for eleven representative states. The findings reveal that South Indian states demonstrate relatively higher performance on several education parameters compared to North Indian states. Variability analysis indicates greater intra-regional disparities in the North, while the South shows more standardized educational delivery systems. The composite index identifies Kerala, Himachal Pradesh, and Delhi as leading performers, whereas Uttar Pradesh and Rajasthan lag behind due to structural constraints.

Keywords: SDG 4, Quality Education, Regional Inequality, North–South Divide, NEP 2020, Human Capital Development.

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Introduction

Education is one of the most effective tools for human development, social transformation, and inclusive economic growth. Recognising its vital contribution to sustainable development, in 2015, the United Nations enlisted the Sustainable Development Goal 4 (SDG 4), which seeks to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” by 2030. Achieving inclusive and quality education for all reaffirms the belief that education can be the most potent and unfailing instrument for sustainable development. This goal envisages all girls and boys to complete primary and secondary education by 2030 and get equal access to affordable vocational training, to eliminate gender and wealth disparities, and achieve universal access to quality higher education. Additionally, it emphasizes on lifelong learning opportunities, so as to achieve substantial adult literacy and numeracy, and on building and upgrading existing education facilities that are child, disability and gender-sensitive.

India, with nearly 20% of the school-going children in the world, stands at a decisive juncture in the overall SDG framework. Since the turn of the century, the country has achieved considerable improvement in access to education through state initiatives. The notable ones include Samagra Shiksha, New India Literacy Programme, Mid-day Meal Scheme (PM POSHAN), Pre and Post matric Scholarship schemes for SCs, PM SHRI (School for Rising India), Eklavya Model Residential Schools, Rashtriya Avishkar Abhiyan (RAA), National Means-cum-Merit Scholarship, Padhe Bharat Badhe Bharat (PBBB), the Sarva Shiksha Abhiyan, the Right of Children to Free and Compulsory Education Act, and the recent policy reform through the National Education Policy (NEP) 2020. The country has noticeably improved enrollment rates, gender parity, and primary schooling expansion (World Bank, 2022). However, the current policy emphasis has shifted from schooling expansion to quality learning, equity, and outcomes, which represent the central pillars of SDG 4.

Regional inequality in education reflects broader developmental divergence within the Indian economy. Empirical studies demonstrate that learning outcomes rather than mere enrollment determine economic transformation, highlighting the importance of assessing educational quality through composite indices and multidimensional indicators (Hanushek & Woessmann, 2012). In

response to this challenge, composite measurement frameworks such as the Education Development Index (EDI) have emerged as important analytical tools to evaluate educational performance beyond conventional literacy statistics. Multidimensional indices incorporating access, equity, learning outcomes, infrastructure, and institutional quality enable comparative regional analysis aligned with SDG monitoring frameworks (UNESCO, 2015; OECD, 2019). For a country as heterogeneous as India, such indices provide a robust methodological approach to identify spatial disparities and policy priorities.

The north–south educational divide in India therefore represents not merely a statistical deviation but a developmental question central to achieving SDG 4 targets. While southern states have approached universal schooling and improved learning environments, the northern region continues to struggle with high dropout rates, teacher shortages, and uneven educational outcomes (ASER Centre, 2023; UNESCO, 2023). Understanding this regional contrast is essential for designing evidence-based policies that move beyond national averages and address localized structural challenges.

With this background, the present study examines SDG 4 Quality Education in India through a comparative analysis of north and south Indian states. By integrating multidimensional indicators and regional perspectives, the study aims to contribute to the growing literature on educational inequality, sustainable development, and human capital formation in emerging economies.

Review of Literature

With increase in education, societies enjoy higher human capital, efficiency, earnings, employability, and economic growth. The Human Capital Theory (Becker, 1993) posited that education contributed to economic development by enhancing individual productivity and societal prosperity. Becker (1964) and Schultz (1961) also held that education drove productivity and long-run growth, yet unequal access to quality education perpetuates intergenerational poverty traps and spatial inequality (Lucas, 1988; Barro, 2013). The Social Justice Theory (Young, 1990) emphasized on a framework underscoring the importance of equitable access to education as a fundamental human right. Educational equity entails fairness in resource distribution, participation, and outcomes among marginalized groups defined by gender, caste, income, language, and geography (Anderson & Smith, 2021). Sen's Capability Approach

(2000) put forth a perspective that focused on enhancing individuals' capabilities to lead fulfilling lives through education.

As regards the role of state, Bhattacharya and Narang's (2022: 64) policy analysis stressed the need for "coherent governance structures that could navigate socio-economic and linguistic complexities". Browne et al. (2023) examined changes in education attainment and found that with the government's efforts through policies and programs, inequality among various sections decreased, and quality education reached multiple sections of the society. Sain and Bozkurt (2023) argued that expenditures made on quality education yield increasing returns in the long-term.

Free elementary education, through legislative reform in 2009 in India, has turned out quite effective in reducing school dropouts (Banerjee & Mukherjee, 2017; Hoque, et al., 2022). Sharma and Khanna (2020) found that Right to Education (RTE) significantly increased enrollment rates for children from Scheduled Castes and Scheduled Tribes. Pandey (2018) concluded that India has made significant progress toward implementing the Education for All program. Kingdon (2017), in a comprehensive evaluation, found that RTE has had a positive effect on school enrollment in rural India. However, the study also pointed to challenges in maintaining quality education standards, especially in government schools.

There are a number of grey areas in the Indian school education that slow down its pace to attain the SDG 4. Agarwal & Taneja (2020) reported improvements in school infrastructure in recent times, particularly in urban areas. However, the study highlighted disparities between rural and urban regions, with rural schools still lacking basic amenities such as toilets and clean drinking water. Mukherjee & Sen (2019) conducted a qualitative study on marginalized students, suggesting that while enrollment rates improved, issues of school infrastructure, teacher absenteeism, and insufficient pedagogical methods continue to hamper quality education. Bandyopadhyay & Sahoo (2021) argued that inadequate sanitation facilities, especially for girls, remain a barrier to achieving equitable access to education. However, by improving infrastructure technology and fostering an inclusive and supportive learning environment, academic institutions can contribute to the achievement of SDG 4 (Bhatt, et al., 2026).

Quality education requires curriculum relevance, effective pedagogy, and measurable learning achievements (Kumar & Singh, 2023). Gupta (2016) argued that merely increasing enrollment does not guarantee quality learning outcomes. Quality of teachers is a crucial factor influencing educational outcomes. Banerjee and Duflo (2014) reported that while student enrollment in rural India surged due to RTE, learning outcomes did not improve at a commensurate rate. And, they attributed this gap to poor teacher training, inadequate curriculum, and lack of accountability. Kumar & Taneja (2018) examined teacher training programs in rural India and found significant gaps in both pre-service and in-service training. The study highlighted that teachers were often unprepared to handle large class sizes or to employ child-centric pedagogies, a core requirement of RTE. Muralidharan (2016) concluded that inadequate teacher incentives and training programs have contributed to suboptimal learning outcomes. With varying degrees of state intervention in the increasing access and improving quality of education, the outcome may vary from state to state in India.

As Bhattacharya and Narang (2022: 60) noted, state-level adaptations and infrastructural disparities significantly influenced the success of national frameworks like NEP 2020. Patel and Desai (2021: 5) demonstrated that “the digital divide remained a critical constraint, as rural schools report markedly less access to infrastructure needed for blended learning modalities promoted by NEP”. “Infrastructure disparities between urban and rural schools limit equitable access to learning opportunities” (Bhattacharya & Narang, 2022: 67). Anderson and Smith (2021: 3) argued that improvements in education quality cannot be sustained without addressing intersectional inequities deeply embedded in education systems. Pradhan (2019) noted that social and cultural factors continue to impede girls’ access to quality education. For achieving the SDG 4, gender disparities in education continues to be a pressing concern particularly for the north Indian states.

Despite comprehensive national advancement, India’s educational development remains remarkably uneven across regions. Apparent disparities, though got narrowed during the last decade, between north and south India are observed in literacy outcomes, learning achievement, infrastructure availability, teacher quality, and higher education participation (Kingdon, 2007; Drèze & Sen, 2013

& Garg, et al., 2022). Southern states such as Kerala, Tamil Nadu, and Karnataka demonstrate stronger educational indicators due to historical investments in social development, decentralised governance, and human capital formation. In contrast, several northern states continue to face structural constraints related to poverty, demographic pressures, gender inequality, and governance capacity (Tilak, 2015; NITI Aayog, 2024).

Status of SDG 4 in Indian States

The *Sustainable Development Report 2025*¹ puts forth an overview of the progress of India in SDG 4 pointing out that between 2018 and 2023 only a moderate improvement from a score of 50 to 61 could occur. Pre-primary participation rate (aged 4 to 6 years) at 94.4% (2022) is low compared to universal target and has not improved much. However, net primary enrollment reached 99.9% (2024), indicating near-complete universalization of elementary education. But, the secondary completion rate, 85.5% (2023) indicates poor retention beyond primary schooling. Meanwhile, youth literacy improved to 97% (2023), reflecting strengthened human capital outcomes. The tertiary gross enrolment ratio rose from 23.7% to 29.5% between 2015-16 and 2023-24. In short, whereas access to education has markedly bettered, secondary completion (aged 15 to 24 years) remains an essential logjam in realising the goal.

India has neared to its SDG 4 through improving several vital physical facilities in academic institutions since 2015-16 (*SDG National Indicator Framework Progress Report 2025*²). For instance, school electricity access surged from 58.55% to 91.80% and pedagogical computer availability more than doubled to 57.20%. Additionally, basic facilities including drinking water (98.30%) and gender-segregated sanitation (97.20% for girls) have reached near universality. But a critical gap remains in disability inclusion as only one third of the schools have disabled-friendly toilets despite improvements in ramp access (77%). In a nutshell, the basic school amenities in Indian schools have reached near-universal coverage.

¹<https://dashboards.sdginde.org/static/profiles/pdfs/SDR-2025-india.pdf>

²[https://www.mospi.gov.in/sites/default/files/publication_reports/Sustainable% 20 Development %20Goals%20N 20National%20Indicator%20Frame work%20Progress%20 Report%2C%202025.pdf](https://www.mospi.gov.in/sites/default/files/publication_reports/Sustainable%20Development%20Goals%20N20National%20Indicator%20Framework%20Progress%20Report%202025.pdf)

In order to evaluate India’s performance towards SDG 4, the Government of India has identified 12 national level indicators that capture six out of 10 SDGs. These indicators based on data at the subnational level allow for comparability across states and Union Territories in India. The Indian states range from 32 to 86 on the SDG index score (Table 1). Based on their performance, the states are ranked in a descending order, and are grouped as Achievers, Front Runners, Performers and Aspirants. No state has been able to reach in the club of Achievers. Overall, Delhi (86) and Kerala (82) are the top performers among the states. About one third of states stood both as Front Runners and Performers in each category. But, six states scored less than 50 and were categorized as Aspirants. Therefore, it can be safely concluded that no single factor including area, population and location of a state, have led to performance of a state in reaching its SDG.

Table 1: Status of Indian States based on SDG India Index 2023-24

Category	States
Achiever	No state has fallen in this category yet
Front Runner	Delhi (86), Kerala (82), Haryana (77), Himachal Pradesh (77), Tamil Nadu (76), Punjab (75), Uttarakhand (73), Goa (72), Maharashtra (67), Sikkim (67), Manipur (65) and Mizoram (65).
Performer	Telangana (64), Chhattisgarh (63), Karnataka (63), Rajasthan (63), Jharkhand (61), West Bengal (60), Gujarat (58), Uttar Pradesh (54), Andhra Pradesh (52), Arunachal Pradesh (52), Tripura (52).
Aspirant	Madhya Pradesh (49), Nagaland (46), Assam (41), Meghalaya (40), Odisha (40) and Bihar (32).

Table 2 shows that the top performers are much better than the national average on almost all SDG-4 indicators. This means that there are strong educational leads in the region. India has an Adjusted Net Enrolment Rate (ANER) of 96.5%, but states like Delhi, Kerala, Himachal Pradesh, and Uttarakhand have already reached universal elementary enrollment (100%), which shows that schools are accessible. Dropout rates show that the system works very well: Himachal Pradesh (1.5%), Tamil Nadu (4.5%), Delhi (4.8%), and Kerala (5.5%) all do much better than the national average of 12.6%. The national Gross Enrollment Ratio (GER) in higher education is only 28.4%, but Delhi (49%), Tamil Nadu (47%), and Himachal Pradesh (43.1%) are close to the SDG target of 50%. This shows that there are better ways for students to

move from school to college. Learning outcomes are still not consistent. Punjab has the highest proficiency level (91.5%), which is much higher than the national average of 77.23%. On the other hand, Tamil Nadu has a lower proficiency level (67%), which shows that expanding access does not always mean better learning. Inclusion indicators set leaders apart even more: Delhi has 41% of people with disabilities in school, while India has 19.3%. Kerala has the highest gender parity (GPI 1.44), which means that women have an advantage in higher education. Institutional capacity indicators strongly support performance differences. For example, most top states have almost universal school infrastructure (around 100%), high teacher training levels (above 95%), and good pupil-teacher ratios, such as Himachal Pradesh (6) and Punjab (11), compared to the national PTR of 18. As a result, SDG-4 scores range from 86 in Delhi to 67 in Maharashtra and Sikkim. This shows that educational success in India is not just about more students enrolling, but also about a mix of low dropout rates, good learning outcomes, inclusive participation, and well-developed educational infrastructure.

Table 2: Top Ten States on the SDG India Index 2023-24

States	ANER [®]	Dropout ²	GER ³	Proficiency ⁴	GER ⁵	PwD Edu ⁶	GPI HE ⁷	Lit Rat e ⁸	Infr a ⁹	Comp @@@	Train ed ¹⁰	PT R ¹¹	SDG 4 Score
Target	100	7.67	100	100	50	100	1	100	100	100	100	30	100
India	96.5	12.6	57.6	77.23	28.4	19.3	1.01	76.7	88.65	47.5	92.2	18	61
Delhi	100	4.8	94.9	80	49	41	1.03	86.2	100	100	97.7	28	86
Kerala	100	5.5	85	77	41.3	24.3	1.44	94.8	99.51	98.3	96.6	15	82
Haryana	97.7	5.9	75.5	87	33.3	25.1	1.22	80.6	99.04	93.2	95.7	12	77
HP	100	1.5	94.1	79.5	43.1	25.6	1.33	86.5	98.64	40.5	97.1	6	77
TN	99.5	4.5	81.5	67	47	19.1	1.01	83.9	100	78.4	99.9	13	76
Punjab	99.2	17.2	82.1	91.5	27.4	23.4	1.19	81.4	99.98	99.6	97.7	11	75
Uttarakhand	100	5	78.8	77.5	41.8	24.7	1.09	83.5	84.06	58.3	96.9	11	73
Goa	86.9	9	73.7	78	35.8	32.4	0.99	94.4	100	55.3	98	9	72
Maharashtra	100	10.7	71.5	78.5	35.3	25.7	0.9	85.1	94.61	81.4	98	21	67
Sikkim	85.2	11.9	64.2	75	38.6	20.4	1.21	85.4	99.13	89.9	83.2	9	67

Notes: @ Adjusted Net Enrolment Rate in elementary education (class 1-8),

Average annual dropout rate at secondary level (class 9-10),

% Gross Enrolment Ratio in higher secondary (class 11-12),

^ Percentage of students in grade VIII achieving minimum proficiency in learning outcomes, * Gross Enrolment Ratio in higher education (18-23 years), & % persons with disability (15+ years) who completed at least secondary education,**

Gender Parity Index for higher education (18-23 years), ^^ Literacy level among persons 15 years and above,

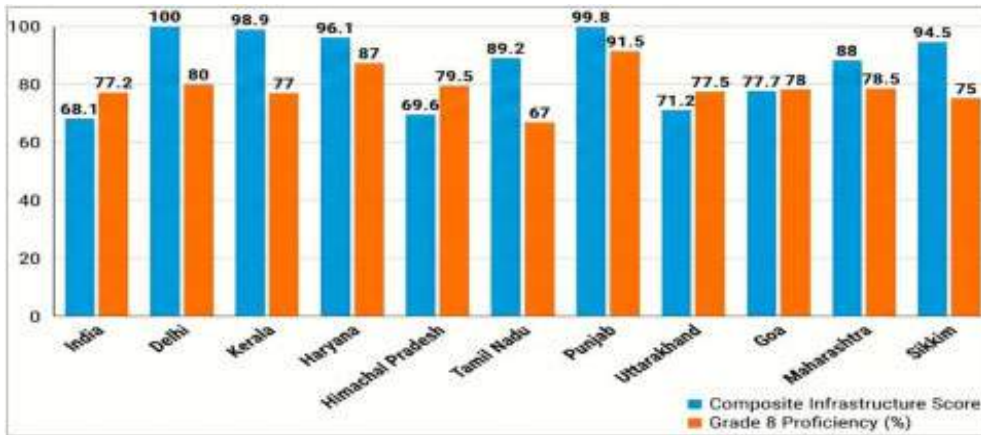
*** Percentage of schools with access to electricity and drinking water,

@@ Percentage of schools with computers,

\$\$ Percentage of trained teachers at secondary level (class 9-10),\$\$\$ Pupil-teacher Ratio at secondary level (class 9-10)

The Infrastructure-Output Gap (Figure 1) shows that while having access to both physical and digital facilities is a big part of reaching SDG 4, having a lot of infrastructure does not always mean better learning outcomes. For example, Delhi and Punjab both have almost perfect composite infrastructure scores, but their proficiency levels show different levels of system efficiency. Punjab has the best learning outcomes (91.5%), while Tamil Nadu has a big “efficiency gap” where high infrastructure (89.2% composite) meets lower foundational proficiency (67%). These contrasts highlight the “north-south divide,” which, although has been shrinking in the high-performing zones of Himachal Pradesh and Uttarakhand, still reflects the reality that the south consistently sustains a more uniform “structural floor” for quality education, wherein average basic infrastructural facilities across the board stand at 97.8%. In contrast, the north, specifically Uttar Pradesh and Rajasthan, faces issues with greater regional inequalities and structural barriers that impede the transformation of increased schooling into improved educational outcomes. The fulfilment of SDG 4 in India cannot merely be achieved through enrollment and infrastructural facilities.

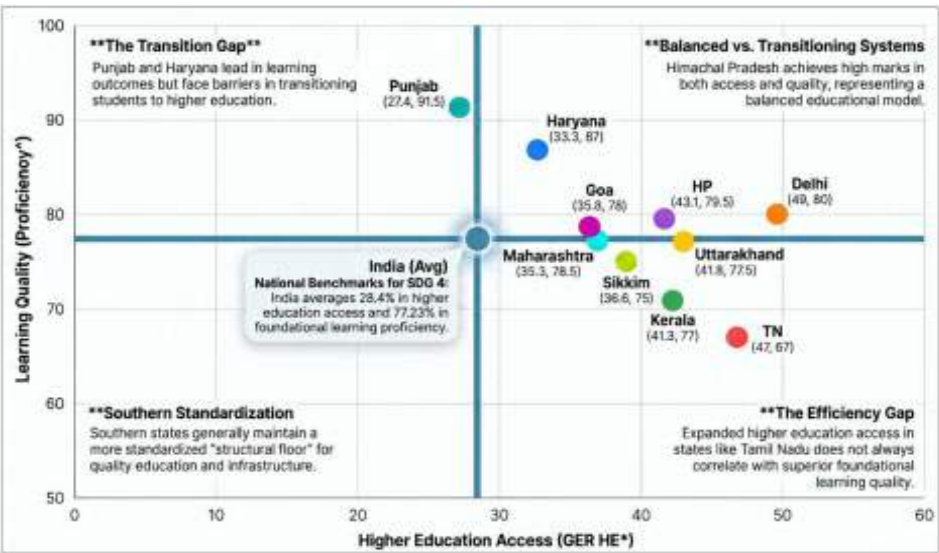
Figure 1: India's Education Paradox: Infrastructure vs. Learning Output, 2023-24



Source: Prepared by authors using data gleaned from https://www.niti.gov.in/sites/default/files/2024-07/SDG_India_Index_2023-24.pdf

Figure 2 presents the quadrant analysis of the states with respect to their progress towards SDG 4 as determined through the proficiency levels of Grade VIII students against GER. Himachal Pradesh (Grade VIII proficiency of 79.5% and GER HE of 43.1%) has achieved an equilibrium between both parameters and thus has efficient systems in place. However, the case of Tamil Nadu (Grade VIII proficiency of 67% and GER HE of 47%), on the other hand, indicates that there is an “efficiency gap” where a high GER level does not indicate better outcomes in foundational skills. Whereas Punjab (Grade VIII proficiency of 91.5%) and Haryana (Grade VIII proficiency of 87%) represent a “transition gap” where despite achieving high performance within schools, they do not seem to transition to higher education levels as effectively as required. This demonstrates that national development can mask significant variations in the level of development among different regions, requiring policy interventions to match the specific needs of the region in terms of structural and socio-economic challenges. The differences between the north and south regions act as an obstacle to India’s development towards achieving SDG 4 by creating an environment in which national development masks deep regional variations. While the SDG 4 rating for the country has increased from 50 in 2018 to 61 in 2023-24, it should be noted that southern states have been ranked as “Front Runner” while the northern states belong to “Aspirant” category.

Figure 2: Learning Quality verses Higher Education Access



SDG 4 and the North-South States Divide

This empirical study analyzes the education outcomes of north and south Indian states using indicators under SDG 4. Cross-sectional data are employed in this analysis for conducting regional comparison and inequality measurement. The dataset comprises 11 states that have been further classified into two broad regions. North India comprises Haryana, Himachal Pradesh, Punjab, Rajasthan, Uttar Pradesh, Uttarakhand, and Delhi, while south India includes Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, and Telangana. The main indicators mentioned in Table 3 are same as in Table 2. It is evident that south India exhibits higher mean performance in ANER, Higher Education GER, and Basic Infrastructure (Table 3). North India shows lower secondary dropout rates on average but higher variability in infrastructure quality. The coefficient of variation (CV) indicates that infrastructure and enrollment are more standardized in the south, while the north shows higher internal consistency in literacy rates.

While the south maintains a higher lead in elementary enrollment (99.4%), the north (specifically in this sample) shows a lower average dropout rate at the secondary level (7.6% vs 11.0%) (Table 3). The south exhibits significantly higher gender parity in Kerala (1.44), whereas the north is more centralized

around the target ratio of 1.0, with Rajasthan slightly below at 0.97. The south shows more consistent “Universal Infrastructure” (97.8% average) compared to the north, where states like Uttar Pradesh (89.43%) pull down the regional average.

Table 3: SDG 4 Parameters and North-South Indian States

State	AN ER	Dropou t (Sec)	GE R (H Sec)	Proficien t Ge VII	Highe r Ed GER	Disabi lity Sec Comp	GPE	Litera cy (13+)	Basic Infra	Schoo l Comp	Teache r Trainin g	PTR	SDG 4 Scor e
HP	100	1.5	94.1	79.5	43.1	25.6	1.31	86.5	98.64	40.5	97.1	6	73
Punjab	93.7	11.2	82.1	91.5	27.4	23.4	1.19	81.4	99.98	98.6	96.0	11	75
Haryana	97.7	5.9	75.5	87.0	33.3	25.1	1.22	80.8	99.01	93.2	95.7	12	77
BJ	95.7	9.7	70.4	89.0	28.6	14.9	0.97	68.3	96.78	52.0	98.0	11	63
UP	94.5	9.7	58.7	66.0	24.1	17.6	1.02	72.0	89.43	27.0	98.0	27	54
Delhi	100	4.8	94.9	80	49	41	1.03	85.2	100	100	97.7	28	86
UK	100	3	78.8	77.5	41.8	24.7	1.09	83.5	84.06	58.3	96.9	11	73
Average of NI	97.4	6.8	77.4	81.5	35.3	24.6	1.1	80.1	95.4	67.1	97.1	15.1	71.6
Kerala	100	5.6	95.0	77.0	41.9	24.3	1.44	94.9	99.51	98.3	96.6	13	82
TN	100	4.7	81.5	67.0	47.0	19.1	1.01	83.9	100.0	78.4	99.6	10	76
TG	100	13.7	64.8	69.5	40.0	20.8	1.01	75.7	90.81	42.9	97.8	10	64
KA	100	14.7	56.6	76.0	30.2	20.9	1.01	77.8	99.86	58.4	92.9	19	63
AP	96.9	16.3	56.7	73.3	35.8	15.4	0.93	66.0	98.80	51.6	82.3	11	53
Average of SI	99.4	11.0	70.9	72.6	39.0	20.1	1.08	79.7	97.9	65.9	93.9	13	67.6

Source: Prepared by the authors based on data gleaned from https://www.niti.gov.in/sites/default/files/2024-07/SDG_India_Index_2023-24.pdf

Notes: RJ – Rajasthan; UK – Uttarakhand; NI - North India; TG – Telangana; KA- Karnataka; SI- South India

Table 4 provides a concise regional comparison of educational performance under SDG 4 across north and south Indian states using descriptive statistics. The findings reveal that south India demonstrates stronger overall educational preparedness, reflected in higher elementary enrolment (ANER: 99.4%), greater participation in higher education (GER: 39.0%), and better availability of basic school infrastructure (97.8%). Moreover, lower standard deviation and CV values in these indicators suggest that southern states have achieved relatively more uniform educational outcomes. In contrast, north India records a lower secondary dropout rate (6.8%), indicating comparatively better student retention at this stage, although greater variation in higher education access

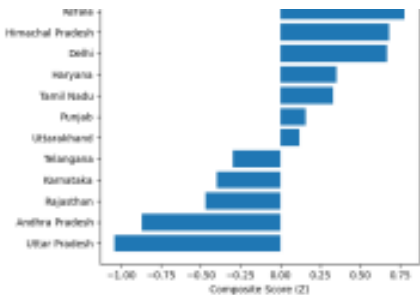
and infrastructure points to uneven development across states. Literacy levels remain almost similar between the two regions, but variability is slightly higher in the south. Overall, Table 4 highlights a pattern where south India combines higher educational access with institutional consistency, while north India reflects mixed progress marked by regional disparities in achieving the SDG 4.

Table 4: Descriptive Statistics and Regional Comparison

Indicator	Mean		SD		CV (%)	
	North	South	North	South	North	South
ANER (%)	97.4	99.4	2.7	1.4	2.8	1.4
Dropout (Secondary)	6.8	11.0	3.5	5.5	50.8	50.1
GER (Higher Secondary)	78.1	70.9	15.1	16.9	19.4	23.8
Higher Education GER (%)	35.3	39.0	9.4	6.4	26.5	16.3
Literacy Rate (15+)	79.8	79.7	7.0	10.7	8.8	13.4
Basic Infrastructure (%)	94.0	97.8	7.0	3.9	7.4	4.0

Figure 3 shows that differences in SDG-4 outcomes across Indian states are shaped less by geography and more by the effectiveness of educational governance and policy implementation. Although the southern states generally display more uniform educational progress, the northern region presents a mixed picture, where strong performers exist alongside states facing persistent educational constraints. States such as Kerala, Himachal Pradesh, and Delhi illustrate how sustained investment in infrastructure, learning quality, and higher education expansion can translate into better outcomes, while lower-ranked states continue to struggle with student retention and equitable access. These findings highlight the importance of state-specific policy interventions aimed

Figure 3: State Rankings based on Composite Score



Source: Prepared by the authors based on data gleaned from https://www.niti.gov.in/sites/default/files/2024-07/SDG_India_Index_2023-24.pdf

at narrowing educational gaps and promoting balanced progress toward SDG 4 across the country.

Conclusion

This study set out to examine regional disparities in India's progress toward SDG 4 by comparing educational outcomes across selected north and south Indian states. The analysis demonstrates that while India has largely succeeded in expanding educational access and improving basic infrastructure, significant differences persist in the quality, continuity, and inclusiveness of education across regions. The findings indicate that educational performance is shaped less by geographical location and more by governance effectiveness, historical investment in human development, and institutional capacity at the state level.

Southern states exhibit relatively stable and uniform educational systems, characterized by high enrolment levels, stronger higher education participation, and consistent infrastructure availability. Their lower variability across indicators demonstrates institutional maturity and sustained policy continuity. In contrast, the northern region reflects a dual reality: alongside high-performing states such as Himachal Pradesh and Delhi, several states continue to experience structural constraints related to socio-economic inequality, demographic pressures, and uneven educational delivery. The higher intra-regional variation observed in the north highlights the challenge of translating access expansion into sustained learning outcomes and educational equity.

The study further shows that improvements in infrastructure or enrolment alone are insufficient to achieve SDG 4 targets. The persistence of learning gaps, transition barriers to higher education, and inclusion challenges underscores the need for integrated policy approaches linking quality teaching, governance reforms, and social inclusion. India's advancement toward SDG 4, therefore, depends on moving beyond uniform national policies toward regionally responsive strategies that address localized educational deficits.

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Understanding Financial Literacy Inequalities among Scheduled Caste Women: Insights from Rural and Urban Karnataka

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Abstract

This study investigates the financial literacy gap between Scheduled Caste (SC) women in urban and rural areas of Karnataka, India, using regression analysis and the Oaxaca-Blinder decomposition method. The study reveals a significant disparity in financial literacy, with urban women scoring higher than rural women. The gap is almost entirely due to the endowment effect driven by factors such as education, income, access to information, and financial resources. The coefficient effect does not significantly impact the gap, suggesting that variations in the returns to these attributes do not contribute meaningfully. Key contributors to the gap include access to financial information, proximity to a bank, and education. While Self-Help Group (SHG) membership shows a slight positive association with financial literacy, the effect is statistically insignificant. This insignificance could be attributed to the limited scope of SHGs, which primarily focus on microfinance rather than comprehensive financial education. The study underscores the importance of targeted interventions to improve financial education and access to resources for rural SC women.

Keywords: Social and economic inequality, Financial inclusion, Financial literacy, Scheduled Caste.

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1. Introduction

Inequality in India is deeply structured by caste, gender, and region. While vertical inequality refers to disparities across income groups, horizontal inequality reflects disparities between social groups such as caste and gender (Deshpande, 2012; Darity & Ruiz, 2024).

Caste-based inequality operates as a structural mechanism through which resources are systematically transferred from historically marginalised groups to socially dominant groups (Gupta & Kothe, 2022). Beyond reinforcing social hierarchy, the caste system intersects with gender norms to restrict access to education, religious privileges, and economic opportunities (Deshpande, 2012). These structural inequalities are further compounded by the rural–urban divide, which limits access to institutions, employment, and financial services in rural areas.

Social Network Theory suggests that individuals primarily interact within geographically and socially proximate networks, reinforcing existing inequalities and restricting information flows (Granovetter, 1983). Consequently, disparities in access to financial resources, such as income opportunities and financial knowledge, persist more strongly in rural regions than in urban centres. In this context, financial literacy becomes more than an individual capability; it functions as a mechanism of social justice. By enhancing knowledge, skills, and confidence in financial decision-making (Aprea et al., 2016; Henchoz, 2016), financial literacy can reduce regional and income disparities (Xu et al., 2023), promote inclusive growth (Batsaikhan & Demertzis, 2018), and support the economic empowerment of marginalised communities in India (Bönte & Filipiak, 2012).

Financial literacy refers to the ability to understand and apply financial knowledge and skills for effective financial decision-making (Hung et al., 2011). This study adopts the measurement framework developed by the National Centre for Financial Education (NCFE), which evaluates financial literacy across three dimensions: knowledge, attitudes, and behaviour. Each dimension is scored separately, and a respondent is classified as financially literate if she obtains a minimum of 15 out of 22 overall, including at least 6 in knowledge, 3 in attitudes, and 6 in behaviour. Findings from the NCFE Financial Literacy and

Inclusion Survey (2019) indicate persistent disparities across social groups. Scheduled Castes (SCs) score lower than the general category and Other Economically Backward Castes across all components, particularly in financial knowledge and behaviour. Gender gaps are also evident, with women consistently scoring lower than men (NCFE, 2019). SC women, especially in rural areas, emerge as one of the most financially vulnerable groups, reflecting the intersection of caste, gender, and regional disadvantages.

Karnataka is one of India's economically advanced states, with a Gross State Domestic Product (GSDP) of approximately \$240 billion and a growth rate of 9.5% in 2021–22, largely driven by Bengaluru's industrial and technological expansion (Malleshappa, 2023). The state contributes nearly 8.8% to India's GDP and about 40% of national IT exports. However, significant intra-state disparities persist, particularly between the more developed southern region and the relatively lagging northern districts (Chandrakala, 2022). Karnataka faces a significant digital divide, with urban areas far ahead of rural regions in internet access. Urban penetration reaches 71.5% among men and 50.1% among women, while rural connectivity remains much lower (Praveen, 2023). Despite efforts to expand rural access (Afzal et al., 2023), disparities persist. In contrast, Kerala's near-universal digital literacy highlights how sustained public investment can enhance digital and financial inclusion.

This study primarily explores the factors influencing financial literacy among SC women from rural and urban areas of Karnataka, India. It also aims to identify the financial literacy gap between urban and rural SC women to determine the regional and socio-economic factors that contribute to these differences. Using comprehensive regression techniques and the Oaxaca-Blinder decomposition technique, this study examines various factors, including region, education, income, employment, bank proximity, digital access, financial resilience, unpaid care work, and decision-making ability.

This study supports the theory of economic inequality by demonstrating how disparities in access to education, stable income, and financial resources perpetuate social and economic inequality. Additionally, it complements social network theory by highlighting how restricted social interactions within the same caste and geographical region can hinder access to financial information and resources, thereby intensifying inequality (Granovetter, 1983).

The next part of this article is structured as follows: Section 2 reviews the literature. The third section discusses the research design and methodology, which describes the study's data collection and methodological approach. The fourth section presents results and discussion, presents key findings, and the article concludes with insights and policy recommendations to address financial literacy disparities in Section 5.

2. Literature Review

This section discusses the theory and literature on the significance of financial literacy and the influence of caste, gender, and region on financial literacy. This study draws upon three theoretical frameworks to study the financial literacy disparities among SC women. The first framework, Social Network Theory, examines how social interactions within a community shape access to information, including financial knowledge. In rural regions, where social networks are typically more insular, the dissemination of financial information is frequently restricted, hence intensifying literacy disparities (Granovetter, 1983). The second framework is Economic Inequality Theory, which explains how disparities in income and social stratification influence access to resources (Piketty, 2014). This theory highlights that financial literacy is closely tied to economic status, with lower-income groups often facing barriers to financial education and services, particularly in rural, marginalised populations. Finally, the study employs Intersectionality Theory (Crenshaw, 1989), which allows for a nuanced exploration of how caste, gender, and region intersect to create compounded disadvantages. SC women, especially those in rural areas, experience a unique set of challenges related to their socio-economic status, gender roles, and geographical location, which together restrict their access to financial knowledge and opportunities.

2.1 Importance of Financial Literacy

Financial literacy can be defined as an individual's ability to comprehend financial concepts and use such knowledge effectively to manage funds and secure long-term financial stability (Hung et al., 2011). Numerous studies have highlighted micro-level factors such as gender, age, race, education, and household wealth that influence financial literacy (Grohmann & Menkhoff, 2021). At the macro level, factors like economic policies, financial education,

and social interactions also shape financial literacy (Biswas & Gupta, 2021). Studies have shown that financial literacy can help optimise the use of household assets and investments, thereby reducing poverty and improving financial resilience (Tang & Jiang, 2021). In the Indian context, the caste-based social structure influences financial literacy, where marginalised castes are often accompanied by less financial literacy than other forward castes (Dhara, 2019). If knowledge, attitudes, and behaviours are recognised as socially determined, then bridging the financial literacy gap within marginalised castes and between the marginalised and other forward castes would serve as a tool for social justice (Henchoz, 2016).

However, while these studies emphasise the role of socio-economic factors in shaping financial literacy, they tend to overlook how structural inequalities, such as caste-based discrimination, directly hinder financial knowledge among marginalised communities, particularly those in rural areas. Although caste is frequently cited as a determinant of financial literacy (Dhara, 2019; Kumar, 2019), many studies lack a nuanced exploration of how caste intersects with gender and region to create compounded barriers to financial literacy. For instance, while gender and economic status are acknowledged, their intersection with caste is often assumed but not deeply explored in empirical research.

2.2 Financial Literacy and Caste

Caste remains a deeply entrenched social institution that has historically impeded access to resources, including education, income, and financial services (Deshpande & Newman, 2007; Gupta & Kothe, 2022). Marginalised castes, particularly in rural areas, are often subject to restrictive social norms that limit their access to financial tools and knowledge (Ahuja & Ostermann, 2016). Financial interactions within these communities are confined mainly to intra-caste networks, limiting the flow of financial knowledge (Sangwan, 2018). As such, individuals from these castes often have lower levels of financial literacy, which exacerbates socio-economic inequalities (Bönte & Filipiak, 2012).

Although an increasing amount of research underscores caste as a significant determinant of financial literacy (Dhara, 2019), there remains an insufficient focus on the gendered dimensions of this disparity. Many studies approach caste as a homogeneous component, ignoring the specific experiences of SC

women, who endure caste-based discrimination and gendered power dynamics (Keerthikadevi & Sujatha, 2023). This gap in the literature highlights the necessity for an intersectional analysis of the effects of caste and gender on financial literacy and access.

2.3 Financial Literacy and Region

Region plays a crucial role in shaping financial literacy, with geographical proximity often determining access to financial information (Bönte & Filipiak, 2012). Rural residents, particularly those in isolated areas, face significant challenges due to limited infrastructure and financial services (Atkinson & Messy, 2012; Gaiha et al., 2007). The NCFE Financial Literacy and Inclusion Survey reveals substantial financial literacy disparities across caste groups in India, with rural populations, especially those in lower-caste communities, being disproportionately affected by financial illiteracy (NCFE, 2019). However, while many studies focus on the rural-urban divide, they often oversimplify the complexities involved by not adequately addressing caste and gender as critical factors in financial literacy. Studies also demonstrate that financial literacy programs are urban-centric, neglecting rural difficulties and caste and gender factors.

To address these gaps, the present study focuses on financial literacy among SC women in the Koppal district, with a specific emphasis on the regional context. This study contributes to the existing body of knowledge in three ways: first, by collecting finance and decision making specific primary data from SC women in both rural and urban settings; second, by incorporating regional comparisons to explore how place-based access to various endowments affects financial knowledge and behavior; and third, by employing a quantitative approach using OLS regression and Blinder-Oaxaca decomposition for examining the structural determinants of financial literacy. By including additional variables such as SHG membership, financial information exposure, bank proximity, and digital access, the study provides a more nuanced and evidence-based understanding of the barriers and enablers of financial literacy.

3. Research Design, Variables, and Methodology

3.1 Research Design

The data for this study were collected through a structured survey administered to 924 SC women in the Koppal district of Karnataka, an underbanked area facing high poverty and low literacy rates, with limited access to financial services and economic opportunities (Nanjundappa, 2002; Reserve Bank of India, 2016). The sample size was calculated using Yamane's formula (Memon et al., 2020) with the sample divided into rural and urban subgroups. Data were collected proportionately across seven taluks using a multi-stage random sampling design.

3.2 Variables

The study considers variables related to socio-economic background, financial resources and stability features, and financial behaviour, as detailed in Table 1.

Descriptive statistics of these variables by region are presented in Table 2.

Table 1. Variable Description

Variables		Description
Financial Literacy Score		Outcome Variable
		Raw financial literacy score
		Explanatory Variables
Socio-Economic Background	Region	0 = Urban, 1 = Rural (Urban as Reference Group)
	Age	Age of SC women 0 = 18-24, 1 = 25-49, 2 = 50-64 and 3 = 65-80 (18-24 as Reference Group)
	Education	Education of SC women: 0 = No formal education, 1 = Up to 5th class, 2 = High school education, 3 = Pre-university education, 4 = Post graduation & above. (No formal education as Reference Group).
	Marital Status	Marital status of SC women: 0 = Married, 1 = Unmarried, 2 = Widowed. (Married as the reference group).
	Household Structure	Household structure of SC women 0=Single, 1= Nuclear, and 2= Joint-family. (Nuclear Family as reference group)
Financial Resources and Stability	Income	Income of SC women. 0 =Up to Rs 10,000, 1 = Rs 10,001 to 50,000, 2 = Rs 50,001 to 2,00,000 3 = Rs 2,00,001 to 5,00,000 and 4 = Rs 5,00,001 to Rs 10,00,000, (Income Up to Rs 10,000 as the reference group)
	Employment Status	Employment status of SC women. 0 = Unemployed, 1 = Employed (Employed as the reference group).
	Assets	The aggregate worth of the individual's top five most valuable assets (in Rs.).
	Financial Resilience	Measures the availability of a financial cushion. = 1 if an individual has savings for over three months, 0 otherwise.
Financial Behaviour and Management	Membership in SHG	SHG membership of SC women. 0 = Member of SHG, 1= Non-Member of SHG. (Member of SHG as the reference group).
	Bank Proximity	Measures the proximity of a bank to the respondent's residence = 1 if it is above 4 km, 0 otherwise
	Digital Access	Digital access status of SC women. 0 = No access to digital devices, and 1= Access to digital devices. (Having access to digital devices as the reference group)
	Unpaid Care Work	The number of hours that an individual spends on unpaid care work activities within her home and community.
	Decision Making	Measures the respondents' household financial decision-making ability. = 1 if she makes the decisions, 0 otherwise.
	Access to financial information	Financial information accessibility of SC. 1 = If SC women can access financial information through friends, family members and other financial consultants, zero otherwise.

Table 2. Descriptive Statistics of Predictor Variables

Variables	Entire Sample		Urban		Rural	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Financial Literacy Score	13.135	4.835	15.439	4.372	10.896	4.171
Region	0.7178	0.450				
Age	1.901	0.575	1.824	0.534	1.976	0.605
Education	2.236	1.861	3.123	1.646	1.373	1.638
Household Structure	2.424	0.526	2.368	0.483	2.479	0.561
Income	2.650	1.532	2.439	1.894	2.855	0.994
Employment Status	0.751	0.432	0.632	0.483	0.868	0.339
Asset	0.511	0.512	0.614	0.487	0.409	0.492
Financial Resilience	1.428	0.495	1.263	0.441	1.588	0.493
Membership in SHG	0.399	0.494	0.368	0.483	0.429	0.495
Bank Proximity	0.482	0.512	0.667	0.472	0.303	0.461
Digital Access	1.533	0.499	1.368	0.483	1.693	0.462
Unpaid Care Work	6.488	1.587	6.702	1.739	6.279	1.394
Decision Making	3.017	1.735	3.105	1.776	2.932	1.692
Access to Fin. Info	0.416	0.589	0.649	0.663	0.191	0.393
No. of Respondents	924		456		468	

Source: Authors' computations based on the primary data

Data were collected from 924 SC women in Koppal district using a structured survey based on the OECD/NCFE framework. The instrument was reviewed by subject experts and pilot-tested. Cronbach's alpha ranged between 0.78 and 0.85, indicating satisfactory reliability.

3.1 Empirical Model

3.1.1 Linear Regression Model

This study examines the determinants of financial literacy among rural and urban SC women in Karnataka using a linear regression framework. Based on the literature, the explanatory variables are grouped into three categories: socio-economic background (SE), financial resources and stability (FRS), and financial behaviour and management (FBM). The financial literacy score (FLS), measured using the NCFE framework, is specified as the dependent variable. The general regression model can be mathematically stated as follows (Frank & Harrell, 2015).

The financial literacy score (FLS) is the response variable, modelled as:

$$FLS = \beta_0 + \beta_1 SE + \beta_2 FRS + \beta_3 FBM + \varepsilon \quad (1)$$

In Equation 1, FLS is a response variable denoting the financial literacy score obtained by SC women on questions formulated within the OECD/NCFE financial literacy

framework. SE, FRS, and FBM denote a list or vectors of predictor or independent variables. β_0 an intercept parameter. $\beta_1, \beta_2, \beta_3$ are vectors or regression coefficients corresponding to SE, FRS, FBM respectively.

3.1.2 Oaxaca-Blinder Decomposition Technique

To decompose the rural–urban financial literacy gap, the Oaxaca–Blinder method (Oaxaca, 1973; Blinder, 1973) is employed. The mean difference (D),

$$D = E(FLS_U) - E(FLS_R),$$

Using a linear specification, the gap can be expressed as:

$$= E(X_U)' \beta_U - E(X_R)' \beta_R \quad (2)$$

Rearranging yields the threefold decomposition:

$$D = E + C + I \quad (3)$$

The first part, (E) represents the portion of the differentials because of group differences in the predictors, known as the “endowments effect.” It represents the portion of the gap explained by differences in characteristics between urban and rural SC women. The Second component (C) along with the differences in the intercept, it captures the effect of differences in the coefficients, including the differences in the intercept, and is known as the “coefficient effect.” In the context of this study, it captures differences in returns to those characteristics, including differences in intercepts. The third component (I) is an interaction term. It captures the combined effect of simultaneous differences in both endowments and the coefficients (Sen, 2014).

3. Results and Discussion

4.1 Determinants of Financial Literacy among SC Women

To ensure the robustness of the regression results, multicollinearity among the explanatory variables was examined using Variance Inflation Factors (VIF). The VIF values ranged from 1.277 to 3.097, with a mean of 1.92, indicating low collinearity. Since all values are well below the conventional threshold of 10, multicollinearity does not pose a concern in the model.

Potential endogeneity of income was addressed using a Two-Stage Least Squares (2SLS) approach, with education, household structure, region, and bank

proximity employed as instruments. The instruments were selected based on theoretical relevance and empirical justification. The over-identification test ($p > 0.05$) supports instrument validity, while Shea's partial R^2 (> 0.1) indicates adequate instrument strength. The Durbin–Wu–Hausman test yields a non-significant result ($p > 0.05$), suggesting that endogeneity does not materially affect the estimates.

Table 3 indicates that financial literacy among SC women is significantly influenced by region, age, education, marital status, income, employment status, assets, financial resilience, bank proximity, digital access, unpaid care work, and decision-making ability. The positive and significant coefficient for region confirms that urban SC women exhibit substantially higher financial literacy than their rural counterparts. This finding reflects the advantages associated with urban residence, including greater access to educational institutions, financial services, and information networks, consistent with prior studies (Banerjee et al., 2021; Hogarth & Hilgert, 2002).

Table 3. Regression Results

Variables	Entire Sample	Urban	Rural
	Coefficient	Coefficient	Coefficient
Region	5.751*** (0.307)	-	-
Age (18-24)			
25-49	-0.458 (0.318)	-0.776*** (0.233)	-0.642** (0.298)
50-64	-1.391*** (0.444)	-0.126** (0.425)	-1.462*** (0.661)
65-80	-2.224*** (0.462)	-2.102** (0.525)	-2.363*** (0.663)
Education (No Formal Education)			
Primary Education	1.912*** (0.376)	-1.261*** (0.301)	2.548*** (0.335)
High School	1.606*** (0.341)	0.017*** (0.303)	1.565*** (0.293)
Pre-University Education	3.594*** (0.458)	1.475*** (0.307)	4.246*** (0.452)
University/Postgraduate	2.608*** (0.668)	2.848*** (0.355)	6.659*** (0.262)
Household Structure (Nuclear)			
Joint Family	0.097 (0.734)	0.146 (0.362)	0.168 (0.562)
Single Women	0.334 (0.724)	0.358 (0.335)	0.688 (0.554)
Income (Below Rs 10,000)			
Rs 10,000 to Rs 50,000	-3.053** (1.197)	-0.616** (0.295)	-2.471** (0.982)
Rs 50,001 to Rs 2,00,000	0.211 (0.499)	2.068*** (0.327)	1.586*** (0.554)
Rs 2,00,001 to Rs 5,00,000	1.861*** (0.555)	2.411*** (0.343)	2.763*** (0.619)
Rs 5,00,001 to Rs 10,00,000	2.303*** (0.768)	4.658*** (0.442)	5.264*** (0.552)

Employment Status (Employed)	0.933** (0.436)	1.384*** (0.217)	1.064** (0.424)
Assets	1.206*** (0.321)	0.017*** (0.313)	1.564*** (0.278)
Membership in SHG (Member)	0.117 (0.249)	0.258 (0.337)	0.179 (0.238)
Bank Proximity (Within 4 Kms)	1.094*** (0.265)	0.641*** (0.214)	1.306*** (0.258)
Digital User (User)	1.723*** (0.302)	1.616*** (0.217)	0.924*** (0.287)
Marriage (Unmarried)			
Married	0.396 (0.471)	0.265 (0.233)	0.418*** (0.546)
Widowed	3.086*** (0.772)	0.131 (0.598)	3.496*** (0.308)
Unpaid Care Work	-0.033*** (0.083)	-0.215*** (0.072)	-0.054*** (0.743)
Decision Making (Maker)	0.821*** (0.071)	0.621*** (0.052)	0.913*** (0.064)
Access to Fin.Info (With Access)	3.041*** (0.267)	1.908*** (0.144)	3.338*** (0.267)
Constant	9.093*** (1.255)	13.919*** (0.867)	11.113*** (0.967)
Number of observations	924	456	468
F-test	325.152	242.823	95.929
Prob > F	0.000	0.000	0.000
R-squared	0.497	0.431	0.440

Source: Authors’ computations based on the primary data

Standard deviations are in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$

Age exhibits a negative and significant association with financial literacy, particularly among older SC women. Relative to younger cohorts, women in the higher age groups demonstrate lower financial literacy levels. Financial literacy is not static across the life cycle; rather, it typically follows a hump-shaped pattern rising with experience, peaking in middle adulthood, and declining at older ages. The observed decline among older SC women likely reflects cumulative socio-economic disadvantages, limited access to formal education, and reduced familiarity with modern financial technologies. Prior research similarly documents lower financial literacy among older individuals in marginalised communities (Bhushan & Mohinder, 2023; Goyal & Kumar, 2021; Jappelli, 2009).

Education exhibits a strong positive association with financial literacy among SC women, with higher levels of educational attainment corresponding to greater financial capability. The effect is particularly pronounced at the tertiary level, indicating that advanced education substantially enhances financial competence. These findings align with Human Capital Theory, which posits that education strengthens cognitive skills and decision-making capacity (Becker, 1975). However, the comparatively smaller gains at lower educational levels suggest that foundational schooling alone may be insufficient to develop complex financial skills. From a policy perspective, financial literacy programmes targeting the least educated may yield limited behavioural change

unless delivery mechanisms reduce participation costs, including time and comprehension constraints. A more sustainable strategy would involve mandating structured financial education at the high school level, thereby building financial capability early in the life cycle and reducing the need for remedial interventions in adulthood.

Household structure does not appear to significantly affect financial literacy, as indicated by the statistically insignificant coefficients for both joint family and single women. However, single women show a slight positive relationship with financial literacy, suggesting that financial independence may lead to better financial knowledge. On the other hand, joint family structures show no clear impact, potentially because collective financial decision-making reduces individual agency.

Income exhibits a positive and significant association with financial literacy, indicating that women in higher income groups demonstrate greater financial capability. This finding is consistent with prior studies showing that income enhances engagement with formal financial systems and improves exposure to financial products and services (Azeez & Akhtar, 2022; Choudhary & Kamboj, 2017). Higher-income individuals are more likely to interact with diverse financial instruments, thereby strengthening their financial knowledge and decision-making skills. These results suggest that financial education must be context-sensitive. For individuals who rely primarily on transfer payments or subsistence-level income for long-term security, advanced financial training such as detailed stock market strategies may generate limited practical returns. In such cases, programmes focusing on budgeting, savings management, social security literacy, and risk protection may yield greater marginal benefits than complex investment-oriented modules.

Employment and asset ownership are positively associated with financial literacy. Stable income enhances exposure to financial decision-making, while asset ownership strengthens financial resilience and engagement with formal financial systems. Together, these factors improve women's capacity to manage economic risks and plan for the future. However, the lack of both employment and assets increases vulnerability, particularly in rural or marginalised communities, where these factors are less accessible (Yatheen Ishwara 2024).

SHG membership shows a positive but statistically insignificant association with financial literacy across the full sample and within both urban and rural subgroups. While SHGs contribute to income generation and financial inclusion, their impact on financial literacy appears limited. This may reflect the operational focus of many SHGs on microfinance activities rather than structured financial education (Roodman & Morduch, 2014; Suganya et al., 2016).

Bank proximity is positively associated with financial literacy, with stronger effects observed in rural areas. Living closer to a bank appears to enhance engagement with formal financial services, particularly where access is otherwise limited. Similarly, digital access exhibits a significant positive relationship with financial literacy across both regions. Women with access to digital devices are more likely to interact with financial services and information platforms. While digital access benefits both rural and urban women, its impact is relatively stronger in urban settings where digital infrastructure is more developed. These results highlight the importance of physical and digital infrastructure in enhancing financial literacy, with bank proximity having a more pronounced impact in rural areas and digital access being more influential in urban areas.

Unpaid care work exhibits a negative association with financial literacy, consistent with feminist economic critiques that emphasise the gendered allocation of time and labour (Figart, 2006). Feminist theory argues that unpaid domestic responsibilities reduce women's economic agency by limiting time available for market participation, skill development, and financial engagement. The stronger negative effect observed in urban areas may reflect the dual burden faced by women who combine informal care responsibilities with emerging labour market participation. Overall, the findings suggest that time poverty, rather than lack of ability alone, constrains financial capability among SC women.

Access to financial information significantly improves financial literacy, with rural women benefiting more compared to urban women. This aligns with information asymmetry, where rural women, facing limited access to formal financial resources, gain more from accessing financial information. In urban areas, the impact is smaller due to better existing access to financial services.

The participants in this study were divided into two groups: urban and rural. Table 4 presents the mean values for each predictor variable for the overall sample and for urban and rural women separately. SC women in urban areas regularly exhibited higher averages for financial literacy (41.69%), bank proximity (120.13%), income (17.06%), digital access (23.76%), financial resilience (25.73%), assets (50.12%), and education (127.46%). Access to financial information is 241.58% greater in urban areas than in rural areas, indicating that urban residents have far more access to financial advice and information from peers and professionals than their rural counterparts. Conversely, rural women exhibited higher levels of debt (28.94%), suggesting potential obstacles to maintaining financial stability and a reliance on borrowing. The observed statistically significant disparities indicate a clear distinction between the determinants of financial literacy between urban and rural women in the SCs.

Table 4. Mean Values of Predictor Variables by Region

Variables	Overall	Urban	Rural	Difference
Financial Literacy Score	13.135 (4.835)	15.439 (4.371)	10.896 (4.171)	4.543***
Age	1.9016 (0.575)	1.825 (0.4522)	1.977 (0.476)	-0.152***
Education	2.236 (1.861)	3.123 (1.646)	1.373 (1.638)	1.751***
Household Structure	2.4248 (0.526)	2.369 (0.483)	2.481 (0.499)	-0.112***
Income	2.65 (1.521)	2.855 (0.994)	2.439 (1.894)	0.416***
Employment Status	0.751 (0.432)	0.868 (0.483)	0.632 (0.339)	0.236***
Assets	0.511 (0.501)	0.614 (0.614)	0.409 (0.492)	0.205***
Financial Resilience	1.428 (0.495)	1.588 (0.493)	1.263 (0.441)	0.325***
Membership in SHG	0.399 (0.491)	0.368 (0.483)	0.429 (0.495)	-0.061
Bank Proximity	0.482 (0.501)	0.667 (0.472)	0.303 (0.461)	0.364***
Digital Access	1.533 (0.499)	1.693 (0.483)	1.368 (0.462)	0.325***
Unpaid Care Work	6.488 (1.587)	6.702 (1.739)	6.279 (1.394)	0.423***
Decision Making	3.017 (1.735)	3.105 (1.776)	2.932 (1.692)	0.173
Access to Financial Information	0.416 (0.589)	0.649 (0.663)	0.19 (0.393)	0.458***
Interaction Effect $\{E(X_U) - E(X_R)\}(\beta_U - \beta_R)$		0.600	0.127 (12.83%)	0.893
Total Observations		924		

Source: Authors' computations based on the primary data

Note: *** $p < .01$, ** $p < .05$, * p

4.1 Financial Literacy Gap among Rural and Urban SC Women

Based on the robust statistical evidence from the regression results and the significant differences observed in the descriptive statistics, there are substantial grounds for arguing that there is a significant disparity in financial literacy levels between SC women living in urban and rural areas. For the Oaxaca-Blinder decomposition analysis, all variables were standardised. This standardisation allows consistent comparisons across variables with different scales and ensures comparable results.

Table 5 displays the breakdown outcomes obtained using the Oaxaca-Blinder approach (Equation (3)). The difference in financial literacy scores between urban and rural women in the SCs was 0.990 standard deviations. This difference is almost entirely due to the endowment effect, which accounts for 67.78% of the total difference, contributing 0.990 out of the 0.949 standard deviations. The results suggest that the difference can be solely ascribed to differences in endowments, i.e., characteristics or resources, such as education, income, access to information, and other pertinent factors, between the two groups. The coefficient effect does not substantially influence, indicating that variations in returns on these attributes (e.g., how effectively education translates into financial literacy) do not contribute to the observed disparity. The findings suggest that if the overall average characteristics of both groups were similar to those of urban women, rural women’s financial literacy would have improved by 4.672 points. This emphasises the need to prioritise advancing the resources and abilities of SC rural women to narrow the gap in financial knowledge and promote greater equality across different demographics.

Table 5. Results of Oaxaca-Blinder Decomposition Analysis

Financial Literacy Score	Coefficients		P Value
	Raw Financial Literacy Score	Standardised Financial Literacy Score	
Urban	15.393	3.263	.000
Rural	10.721	2.273	.000
Difference	4.672	0.990	.000
Endowment Effect $\{E(X_U) - E(X_R)\}'\beta_R$	3.164	0.671 (67.78%)	.000***
Coefficient Effect $E(X_R)'(\beta_U - \beta_R)$	0.908	0.192 (19.39%)	0.826
Interaction Effect $\{E(X_U) - E(X_R)\}'(\beta_U - \beta_R)$	0.600	0.127 (12.83%)	0.893
Total Observations	924		

Source: Authors’ computations based on the primary data

Note: *** p<.01, ** p<.05, * p

The results of the detailed Oaxaca-Blinder decomposition are presented in Table 6. As previously established, the coefficient and interaction effects in our analysis were not statistically significant. However, the endowment effect was found to be statistically significant at the 1% level. The most substantial contributions to financial literacy come from endowment effects, such as financial decision-making influences, education, and planned financial behaviours. This suggests that possessing or improving these characteristics can lead to higher financial literacy. The Endowment Effect decomposition shows the relative contribution of each variable to the total difference in financial literacy scores, which is 0.671 standard deviations. Access to Financial Information accounts for the largest share, at 34.72% (0.233 standard deviations), followed by Bank Proximity at 36.96% (0.248 standard deviations). Education also plays a significant role, contributing 27.12% (0.182 standard deviations), and Financial Resilience accounts for 25.19% (0.169 standard deviations). Income contributes 4.77% (0.032 standard deviations), while Age contributes 5.66% (0.038 standard deviations). Digital Access has a contribution of 5.51% (0.037 standard deviations). On the other hand, Unpaid Care Work (-3.73%, -0.025 standard deviations) and Household Structure (0.89%, 0.006 standard deviations) also have a relatively small impact. These findings underscore the need for targeted interventions that address both the availability of financial information and structural barriers that disproportionately affect rural and underprivileged populations, ultimately fostering a more inclusive financial literacy environment.

Table 6. Oaxaca-Blinder Decomposition- Detailed Analysis

Variables	Financial Literacy Score					
	Endowment Effect		Coefficient Effect		Interaction Effect	
	Coef.	P Value	Coef.	P Value	Coef.	P Value
Age	0.038	0.151	-0.066	0.017	-0.183	0.042
Education	0.182	0.000	-0.052	0.017	0.876	0.017
Household Structure	0.006	0.705	-0.018	0.000	-0.312	0.007
Income	0.032	0.046	0.044	0.607	0.090	0.610
Employment Status	-0.296	0.004	0.033	0.666	0.110	0.666
Assets	0.026	0.627	0.149	0.403	-0.125	0.407
Financial Resilience	0.169	0.034	0.156	0.005	-0.717	0.007
Membership in SHG	-0.009	0.490	-0.156	0.096	-0.060	0.216
Bank Proximity	0.248	0.001	0.119	0.451	0.166	0.451
Digital Access	0.037	0.618	-0.098	0.801	-0.056	0.801
Marital Status	0.007	0.706	-0.046	0.000	-0.269	0.007

Unpaid Care Work	-0.025	0.002	0.028	0.000	-0.495	0.001
Decision Making	0.023	0.285	-0.114	0.348	-0.043	0.411
Access to Financial Information	0.233	0.000	0.213	0.000	1.145	0.000

Source: Authors’ computations based on the primary data

Note: *** $p<.01$, ** $p<.05$, * $p<.1$

3. Conclusion

This study contributes to the understanding of economic inequality by demonstrating how disparities in resource access perpetuate financial literacy gaps among SC women in both urban and rural Karnataka. The findings reveal that these disparities are driven primarily by differences in endowments, particularly education, income, access to financial information, and infrastructure, rather than differential returns. Targeted improvements in these structural factors, especially in rural areas, are therefore critical for narrowing the financial literacy gap.

The results also suggest that financial literacy interventions must be context-sensitive. For the least educated women and those relying primarily on transfer payments or low, unstable incomes, advanced investment-oriented training may yield limited practical returns. In such contexts, programmes focused on basic budgeting, social protection awareness, savings discipline, and risk management are likely to yield higher marginal benefits than complex instruction in financial markets. Mandating structured financial education at the high school level could further strengthen foundational capabilities and reduce the need for costly remedial interventions later in life. Policymakers should prioritise tailored financial literacy programmes delivered in vernacular languages and supported through digital and mobile platforms. Collaborations with local institutions, state initiatives such as Karnataka’s Sakhi scheme, banking outreach models like Business Correspondents, and trusted grassroots actors such as ASHA workers can enhance community-level engagement. Such targeted and structurally informed strategies are essential for advancing financial inclusion, strengthening economic agency, and promoting more equitable growth.

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Maximising Returns from Irrigation

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This article is based on the data collected by the Odisha Government's Bureau of Economics and Statistics since 1981. Soon after the abolition of zamindaries in early 1950s and the integration of the princely states before that, the collection of agricultural statistics in Odisha was entrusted to an officer, with two assistants, in a subdivision. I remember my days in the Hirakud survey in 1954-56. The concerned officer at Cuttack Collectorate told me that with his charge being for all the villages in the sub-division – about 80 or more, it was clear that the data reported by him every year relating to area under crops and yield rates, irrigation, etc., can be nothing better than guess works. It took the state government a long time to carry out cadastral survey operations in all villages of the state. To collect proper information, the Ministry of Agriculture of the Government of India provided complete funds to the State Statistical Bureau to conduct detailed fact-finding inquiry in 20 per cent random sample villages of the state every year. The data were to be collected relating to every plot in the surveyed villages in every season of the agricultural year and the estimated all-Odisha figures based on these sample data were to be published every year by the Bureau. The Bureau has been doing this since 1981. I have tabulated the published data since 1881 to 2022 to understand the trends in the state's agriculture.

The data show that, the share of cultivated land in the state's geographical area has decreased in the last 40 years; only land under paddy and, along with it, *moong* (green gram) has increased. Now, 83 per cent of the total cultivated land in Odisha is cultivated with paddy. It has increased from 73 per cent in the past 40 years. *Moong* is the only crop whose area has grown slightly. All

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other crops have declined. Especially, the area under pulses, like *biri* (black gram), *kolatha* (horse gram) and oilseed crops like *til* (sesame seeds), mustard and groundnut has declined so much that they have become insignificant.

Today, the total irrigated area is about one-third of the total cultivated land. And, almost all of that is under paddy. Only the cultivation of summer *moong* has increased under flow irrigation. What is the reason for this situation?

Looking at the 25-year account from the end of the twentieth century to 2023, the selling prices of all pulses and oilseeds have not increased compared to the farm harvest price (that is, the average selling price of three months after the harvest) of paddy, but have started to decrease slightly. The price of *mandia* (ragi) alone has increased slightly compared to paddy. The reason for the decline of area under *mandia* is probably different. *Mandia* is grown in hilly areas, especially in the tribal-dominated areas of south Odisha. But a researcher who was conducting research in that area a few years ago spoke about his experience. While he was conducting research in a tribal village in Rayagada district, a farmer in the village told him, “Now that the government is providing us with our required rice for free or at a nominal price, we no longer grow paddy or *mandia*. Instead, we grow maize and sell it.” The per-hectare yield of paddy has started to increase during this entire period. The main reason for this is that farmers started using new high-yielding (HYV) seeds instead of local varieties of rice from the early 1980s. Its per hectare yield is higher than that of indigenous seeds. This did not happen overnight: the use of local seeds decreased every year and the use of HYV seeds increased steadily. Now, the use of local seeds has become only nominal. Since the early 1980s, as the irrigated area increased, farmers cultivated rice on that land. The area under pulses and oilseeds steadily declined. The prices of such crops did not increase, but rather went down. For the last 40 years, the Indian government has been importing pulses, edible oils and oilseeds in large quantities from abroad. Often, these are sold to people at a cheaper price from fair-price shops. The market prices of such crops could not increase.

In Odisha (indeed in the whole country) water for irrigation is the shortest among the factors of production required for agriculture. Therefore, water needs to be used in such a way that maximum value production is obtained from every acre-inch (or hectare-centimetre) of water. The irrigation department

does not have an estimate of water required to irrigate various crops. The information is available from experiments by the Agronomy Department of the Agricultural University. A lot of such information is available in the book *Irrigation and Drainage* (Third Edition, 2017) by (late) Dr. Damodar Lenka, who originally worked in the Agronomy Department of the Agricultural University in Bhubaneswar. I am using it. In a state like Odisha, which receives good rainfall during the rainy season, 63 centimetres (cm) of groundwater is required per hectare for Sharad paddy (Kharif); 103 cm for *Dalua* (summer) paddy. Except for sugarcane, no other crop requires so much irrigation water. For maize, 40 cm, for cotton 56 cm, for wheat in Rabi, 45 cm, for oilseeds, 33 cm in Rabi, 61 cm in summer, 19.44 cm in Rabi for mustard, etc., 55 cm in summer for sesame, 15 cm in Kharif for millet, 20-25 cm in Rabi, 35 cm in summer, only 7 cm in Rabi for sorghum, 25 cm in Rabi for *biri*, 30 cm in summer, 18 cm for potato.

From this it can be seen that rice consumes the most water: two or three times that of all other pulses or oilseeds. But the production of paddy per centimetre of water is the lowest. Taking Dr. Lenka's statements about irrigation water needs of various crops in different seasons and the Statistical Bureau's figures about yields and the farm harvest prices of various crops, it is seen that the price of paddy produced per centimetre of water is 1168 rupees for kharif and 910 rupees for summer. But, on the other hand, the production value per cm of water for all pulses and oilseeds is much higher than this: Moong Rs. 6157 in Kharif, Rs. 3700 in Rabi, Rs. 2700 in summer, *biri* Rs. 1528 in Rabi and Rs. 930 in summer, Rs. 3500 for *kolatha* in Rabi, Rs. 2930 in summer, among oilseeds, groundnut Rs. 2400 in Rabi, Rs. 1920 in summer, Til Rs. 1300 in Rabi, Rs. 2000 in summer. The highest was potato, with a production of Rs. 9110 per cm of water. All these productions are based on current survey data. If water is given to each crop according to its requirement, then the production per unit of water would be even higher.

If all the current crops of Odisha other than rice get so much more per acre-centimetre of water, then why don't the farmers do use the available irrigation water for those crops? The answer to this question depends on the way canal water is provided to crops in Odisha. In Odisha, water from the canal is provided to fields by opening the side bund of minor or distributary to the field, which

is called the flooding method. The bund between the minor or distributary and the field is cut to release water to the fields, and water flows from field to field. Water flows till the breach in the bund is closed. This is the flooding method of irrigation. In this, it is impossible to decide when and how much water to give to which crop. However, this is not the only method of irrigation in India. The design of the irrigation system in the Punjab (including Haryana) and in western Maharashtra laid out more than a century ago is another method that is more suitable.

In that method, a water course is cut from the distributary to the field area. This water course is designed to irrigate about 20 acres of land on its side. If there is one watercourse for more land, the measurement of water supplied to the fields will not be correct. The outlet of the watercourse from the distributary is such that as soon as the outlet is opened, one cubic foot of water will flow out every second. So, how much water has passed through that water course can be easily calculated. As soon as the water is released, the person whose land is on the fag end of the watercourse (he is called the end irrigator) first closes that watercourse and cuts a breach to his field by the side for the water to flow in to the field. Now-a-days, since large plastic pipes are available, instead of cutting a breach, people take three or four pipes from the watercourse to the field. Since he knows the size of the field and the amount of water required for the crop, the farmer will close the breach when the required minutes (or hours) have passed. In fact, the farmer whose plot is just before his, would be waiting for his time to be over, when he will close the watercourse and start irrigating his field. In this way, starting from the end and working up to the first farmer at the head of the water course, the flow of water from the distributary to the water tank is stopped. This system has been in operation in that area for one hundred and twenty-five years. Each field can be given water according to its size and the need of the crop. (I had proposed implementation of such a system in our canal area in a newspaper article many years ago. A few years ago, when I was in Sambalpur, a professor friend of mine visited the canal area of Atabira and told me that such work had been done in a very inadequate manner, with no useful result.)

A Ph.D. student of the Agricultural Research Institute, Delhi, calculated many years ago that if such water-courses were constructed in the place of the present

flooding system in the Hirakud canal area, the total canal water of the Hirakud scheme can irrigate an additional thirty per cent of the current command area. (He later became the President of the Agricultural Economics Society.) It would have irrigated the fertile land further from Dungaripali in the west and the somewhat drier land in the north. Such design should be made for irrigation of not only from the Hirakud Dam, but also Tel, Indravati, Bansadhara, lower Salandi, Rusikulya, upper Brahmani, Subarnarekha, etc.

This would facilitate one more useful step, which can further increase the command area. Due to the sloping landscape of the cultivated region of Hirakud command, only the At, Mal and Borna lands could have been provided flow irrigation through the water-courses. The lowest, Bhal, lands could have been spared. Because, since the day the present canal system was built, this best Bhal land has been receiving too much water (not only from the canal, but from the water seeping underground from the irrigation of the upper At, Mal and Borna lands) and its rice crop has been affected by pests. Its productivity has decreased. When the Hirakud scheme was implemented, Shri Madan Pradhan of Bargarh (who was living in his village after retiring from the State Vidyadharpur farm near Cuttack) strongly opposed the irrigation of Bhal lands. He was right. Now if new water courses are built, there will be no problem in stopping irrigating the bhal lands. If for some reason it is necessary to irrigate the fields (for summer, for example), a well or a shallow tube well can be sunk in the bhal field. This will be beneficial, because it will use groundwater to maintain the moisture of the land. If water currently supplied to the bhal lands can be used for irrigating additional areas. The command area of Hirakud can be increased by about 50 per cent.

By making such arrangements, water, by design, should be made available to seasonal crops. Farmers, many more farmers on larger command area will grow pulses and oilseeds instead of rice. One very useful seasonal crop is sweet sorghum. Its stem contains sweet water, like sugarcane, which extracted like in case of sugarcane, can be boiled to the point of syrup that can be a very adequate substitute to sugar in many uses. Of course, for crops like potatoes, proper water supply is not enough. Therefore, a cold storage system is required. Solar energy can be used for this. Some products cannot be stored for a long time due to their moisture content. For example, onions, potatoes

and tubers. Now the government's Atomic Energy Department is making arrangements for radiation to preserve onion, potato, etc., crops for a long time. Its cost per kilogram is very low, only about fifty paise per kg. If government can make that arrangement, the farmers will be greatly benefited.

A final point about advantages resulting from the redesigned water distribution system. It is applying fertilizers and manure to the crops for better production. It is clear from the data reported by the Statistical Bureau that there is not much difference in the application of chemical fertilizers and manures. One reason for this is that due to the flooding method, there is no way to know how much fertilizer and manure given in the field remains in that field and how much is washed away. Therefore, farmers tend to minimise application. If water-courses are arranged, this problem can be solved. Application of fertilizer and manure might improve, leading to greater production.

The farmers and the government should recognize this possibility of making Odisha's irrigated agriculture more productive and better distributed benefits. By making such arrangements, the area of land irrigated by canals would increase by 50 per cent, the total production from that amount of water would have doubled, the distribution of this higher income would become more equitable, and more people would find work in agriculture.

Rethinking Traditional Knowledge Protection: Kerala's IPR Policy, 'Knowledge Commons' and Future of Governance

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Introduction

The protection of Traditional Knowledge has emerged as one of the most contested issues within global intellectual property (IP) governance. Across the world, indigenous communities have long held knowledge system relating to biodiversity, medicine, agriculture, and ecological management. However, the modern intellectual property (IP) regime, built primarily around individual authorship, novelty, and commercialization, often fails to recognize the collective, intergenerational and context- specific nature of the traditional knowledge (Dutfield 2004; Posey and Dutfield 1996).

Developing countries have historically been the strongest advocates for TK protection within international negotiations, particularly in forums such as the world intellectual property organization (WIPO). Their concern stems from repeated instances of biopiracy, where knowledge originating from indigenous communities has been patented by external actors without recognition or benefit

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sharing. Well-known examples include the patents on Neem derivatives and Turmeric wound-healing properties, both of which were eventually revoked after legal challenges from India (Shiva, 2001). These cases illustrate the structural tension between global IP frameworks and community-based knowledge systems. Much of traditional knowledge has historically been treated as part of the ‘public domain’, making it vulnerable to appropriation (Drahos, 2014).

The noted example of the introduction of traditional Knowledge Digital Library (TKDL) in India has introduced to work as a bridge to connect the Indian traditional medicinal system and the International Patent Classification System (Fredriksson, 2021). Consequently, many countries have begun exploring sui generis frameworks for TK protection that move beyond conventional intellectual property rights. Javed et al (2020) proposed a comprehensive national policy and sui-generis mode of protection is the need of the hour for the protection of TK in the context of international debates.

Within this broader debate, the state of Kerala in India introduced one of the earliest policy experiments in TK governance through the Kerala Intellectual Property Rights Policy in 2008, which presents an alternative approach to the dominant commercialization-oriented model of knowledge protection.

Kerala’s IPR Policy: A ‘Knowledge Commons’ Approach

The Kerala IPR policy was introduced in the year of 2008, nearly a decade before the National IPR policy (2016) of the Government of India. While both policies acknowledge the importance of protecting traditional knowledge, their philosophical foundations differ significantly.

The National IPR policy largely frames TK within the broader agenda of innovation, commercialization and knowledge based economic growth. In contrast, the Kerala policy adopts a non-IPR protection framework grounded in the concept of ‘knowledge commons’”. The idea of knowledge commons recognizes that traditional knowledge is: (a) Collectively owned, (b) inter-generationally transmitted and c) embedded within social and ecological systems. The main aim of the Kerala IPR Policy in 2008 was to create property rights on traditional knowledge, all the rights should be upheld with the

custodians of the knowledge, and they have the right to permit others to use the knowledge for non-commercial purposes. However, the revised draft of Kerala IPR Policy 2025 envisaged an innovation perspective of TK through widening the scope of extensive TK related education in the schools and academic institutions. It emphasises a favourable environment of patent rights like IPR cells in institutions, IP professionals and researchers giving high importance on innovation (patent facilitation) and branding under Geographical Indications (GIs). The policy that focuses on market-oriented innovation, IP and open for suggestions in the very IPR sensitive environment in Kerala (Spicy IP, 2025), at the same time it has to be noted that the policy does not subsume TK under patents. Rather than treating knowledge as commodifiable asset, the Kerala policy emphasizes community custodianship and non-commercial use. This approach reflects broader scholarship on commons governance, particularly the work of Elinor Ostrom, which demonstrates that community-managed resources can be sustainably governed through collective institutions (Ostrom, 1990). From policy perspective, this framework represents an attempt to shift the focus from the knowledge extraction to knowledge stewardship.

Positive and Defensive Protection: Limits if Conventional Approaches

International TK policy debates often distinguishes between positive protection and defensive protection (WIPO, 2017). Positive protection allows communities to claim rights over their knowledge and benefit from its use, while defensive protection aims to prevent outsiders from patenting existing traditional knowledge. India's most prominent defensive mechanism is Traditional Knowledge Digital Library (TKDL), which documents thousands of formulations from Ayurveda, Unani, and Siddha texts to prevent wrongful patents abroad. The TKDL has been widely recognized for successfully challenging patents in international patent offices. However, scholars and policy commentators and researchers (Gaudilliere 2014), including discussions on legal platforms, have pointed out several limitations: (a) codifications risks exposing knowledge to wider commercial exploitation (b) documentation may detach knowledge from its cultural context and (c) communities rarely control access to the documented knowledge. In effect, while TKDL prevents biopiracy, it may also contribute to the global circulation of traditional

knowledge without ensuring meaningful community control or benefit sharing (Chandrasekharan and Kumar 2018).

Kerala's IPR policy attempts to address this challenge through a structured documentation and governance system for TK namely Traditional Knowledge Docketing System (TKDS). Instead of simply collecting and publishing knowledge or creating an open repository, TKDS proposes to docket knowledge in a formal system and tag it with community and associate it with local trusts, thereby maintaining a link between knowledge and its custodians. Considering the richness of Kerala's vast traditional knowledge TKDS, the policy work as a facilitative repository as in the case of People's Biodiversity Registers (PBRs). It would facilitate the docketing and also help to recognize the community owned TK and traditional protected plant resources.

The TKDS comprises the information related to the location of the knowledge, the custodian of the community, nature and type of knowledge and the community rules and regulations. This reflects a change from the earlier defensive mechanism by creating a controlled access and embed the ownership and custodianship metadata. This policy gave importance to the prior informed consent and the community involvement to be take care of under this initiative.

Community-led knowledge governance: Lessons and Practice

Several community initiatives across India and the Global south illustrate how collective management of traditional knowledge can function in practice. One example is Gram Mooligai Limited Company in Tamil Nadu. This initiative involves networks of local herbal gatherers, primarily women, who collectively harvest medicinal plants, produce herbal medicines, and market them through a community enterprise. The initiative demonstrates how traditional medicinal knowledge can generate livelihoods while remaining embedded within community institutions. This example shows how decentralized networks of primary knowledge holders- particularly women herbal gatherers can be organized into a community-owned enterprise structure that integrates harvesting, value addition, and market participation while local ecological and epistemic contexts in the context if its strong social and cultural foundations.

These initiatives involve documenting plant properties, harvesting methods and therapeutic uses while maintaining community control over knowledge

dissemination. Similarly in Kerala's Wayanad district, indigenous communities such as Kurichya and Mullu Kuruma have engaged in documentation of traditional medicinal knowledge. In the year of 2002, tribal healers took a decision to register a society named Indian Indigenous Peoples Service Society (IIPSS) with an objective to promote education, research and development activities of tribal medicinal knowledge. IIPSS also received the fund from the state government to run the three-year certificate course (2003-2006). The main objective of this society was the digital documentation of tribal medicinal knowledge to prevent losing them with the demise of the tribal healers. This was one of the major problems that TK faces, i.e., the extinction of knowledge within 20-30 years with the demise of the knowledge holders as there is very less possibility of responsible inter-generational transfer. Moreover, the Bio assay research revealed that the medicinal plants used by the tribal healers are very useful to cure chronic diseases. One of the significant features of this documentation process is its comprehensive coverage of healers, the tribes they belong to and the specific details of their practice, including the locational details of the plants and their availability in various seasons (Field data, 2011).

International experiences also demonstrate the potential of community-driven TK governance. The Kukula traditional health practitioners from South Africa are also known as the traditional practitioners of Bushbuckridge, spread across parts of two provinces (Mpumalanga and Limpopo in North Eastern South Africa), has registered as a biosphere reserve, holding various forms of traditional knowledge related to local medicinal plants (Cocchiato et al., 2013). This community-led group (TK commons pool) aimed a participatory approach for the recognition and support for a customary and sustainable use of biodiversity. The executive committee of the healers and the knowledge to community management committee tried to collaborate with a local cosmetic company, Godding and Godding (G&G) in the year of 2011. After the negotiations and discussions in between the entities, they decided to put forward two sets of agreements. First is a confidentiality and use-restriction agreement, and the other is benefit-sharing agreement on the product which G&G company wished to develop. These agreements include confidentiality clauses and benefit-sharing arrangements, illustrating how communities can negotiate equitable partnerships with private enterprises.

The Kani Case: A Critical Lesson from Kerala

Any discussion of traditional knowledge governance in India inevitably intersects with the famous case involving the Kani tribe and the development of the herbal drug Jeevani. Researchers from the Tropical Botanic Garden and Research Institute developed the drug based on the Kani community's knowledge of the plant *Arogyapacha*. Although the project eventually included a benefit-sharing arrangement with the community, it also revealed institutional gaps in recognizing collective knowledge rights (Anuradha, 2001). The Kani has become a global reference point in debates on access and benefit sharing (ABS) and illustrates the need for policies that go beyond conventional patent frameworks to incorporate community governance.

While community-based knowledge governance is promising, it also raises several internal challenges. Kerala is home to diverse tribal communities that often coexist within the same ecological regions. In such contexts, overlapping knowledge systems are common, raising questions about ownership and representation. There is also the possibility that dominant groups within tribal communities may capture institutional structures, marginalizing smaller or less politically organized groups. Factors such as education, social hierarchy and proximity to administrative systems may influence participation in TK documentation and governance. Moreover, many indigenous communities remain unaware of the legal implications of intellectual property regimes. Without adequate institutional support and legal literacy, they may remain excluded from decision-making process regarding their own knowledge.

Emerging Policy Directions: Globalizations, AI, and the Future of TK

Recent policy developments indicate a growing interest in integrating traditional knowledge into global innovation systems. For instance, during the G20 Johannesburg summit, India proposed the creation of a global traditional knowledge repository aimed at addressing challenges such as climate change and food security. Similarly, initiatives supported by the World Health Organization and India's Ministry of Ayush are exploring the integration of traditional medicine with emerging technologies such as artificial intelligence. Programs like 'eSanjeevani' and the research field of Ayurgenomics illustrate attempts to connect traditional medicine with digital health ecosystems. While

these developments offer new possibilities for research and innovation, they also raise important concerns.

Traditional knowledge is inherently tacit, experiential and context-dependent. It evolves through long-term interaction between communities and eco-systems. Codifying such knowledge within algorithmic systems risks reducing it to data points detached from its cultural and ecological foundations. AI may assist in analyzing or reorganizing knowledge, but it cannot substitute the living knowledge systems sustained by indigenous practitioners. Without safeguarding community authority and ecological contexts, digitization may inadvertently accelerate knowledge extraction rather than preservation.

The central argument here is that, although it is highly important to make use of various forms of knowledge in the context of AI, traditional knowledge (TK) presents unique challenges due to its tacit nature, which makes it difficult to formalize, practice, or develop within such frameworks. Moreover, every form of knowledge requires its own space and conditions to grow and flourish. Traditional knowledge, in particular, has evolved over long periods through experience, trial, and error. Therefore, before attempting to elevate TK to more advanced platforms, it is essential to adopt measures to preserve and sustain it within the communities that nurture it.

The custodians of this knowledge are best equipped to manage, protect, and promote it, and they should be granted full authority to do so in accordance with their values and practices. TK should be allowed to evolve organically within its natural context, while also engaging with other knowledge systems in a supportive and conducive environment. Although AI may assist in utilizing and adapting this knowledge in new ways, it cannot guarantee its continued existence or sustainability without potentially altering its intrinsic nature and undermining the role of its custodians. Any kind of digitalization process arguably ignores the intangible properties of the practices, like context-specific association of plants within local ecosystems, the culturally embedded timing and methods of collection, and the performative dimensions such as rituals and other embodied practices that accompany preparation. Even though some of these elements may be disregarded as ‘unscientific’, they are often believed to be inseparable embodiment of practices that often have claims of efficacy and dropping them may form a cultural loss to these communities.

The Kerala IPR policy offers three important lessons for future TK governance: First, it challenges the assumption that commercialization is the primary goal of knowledge protection. By framing TK as a ‘knowledge commons’, the policy recognizes the ethical and cultural dimensions of indigenous knowledge. Second, it emphasizes community custodianship rather than external ownership, aligning with merging global debates on indigenous data sovereignty. Third, it highlights the importance of localized governance structures, particularly in culturally diverse regions where knowledge systems overlap. Joining together, these elements suggest that protecting traditional knowledge requires institutional innovation beyond conventional intellectual property frameworks.

One of the major concerns that can be raised here is the issue of inter-tribal disparities. In Kerala, many tribal communities live in close proximity and may share similar traditional knowledge systems. However, an important aspect that requires careful attention is the existing power structure, which continues to play a crucial role within these communities. It is therefore essential to ensure their meaningful participation in the process, along with the protection of equal rights for all groups. There is a risk that certain tribal communities may dominate others, potentially leading to reduced or even absent participation from some groups. Furthermore, some communities that have lived deep within forest interiors for long periods possess valuable knowledge, yet they often remain hesitant to communicate with other tribal groups as well as with non-tribal communities.

Inferences

Traditional knowledge protection is not merely a legal question but a broader issue of epistemic justice, community rights, and ecological sustainability. Kerala’s IPR policy represents an important attempt to rethink knowledge governance by centering communities rather than markets. One of the important concerns while considering the states like Kerala, comprises heterogeneous tribal communities having vast knowledge. The decay of our traditional resources can lead to huge loss of biodiversity and also the community knowledge that has the power to protect the resources. The continuous interference without any proper rules and regulations from the side of the community itself will be a threat to the life of the indigenous communities and their knowledge. As India continues to position TK within global innovation and digital ecosystems,

the challenge will be to ensure that indigenous communities remain active custodians rather than passive sources of data. Future policy frameworks must therefore combine legal protection, community empowerment, and ethical governance to sustain traditional knowledge systems in the twenty-first century.

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*A Sixth of Humanity:
Independent India's
Development Odyssey*

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Odisha Economic Association



Sandhya Krishnan

This book is an audacious and largely successful attempt to empirically reinterpret India's post-independence development trajectory. Bringing together two inherently complex subjects—development and India—is no small intellectual undertaking. Development itself is a deeply contested and multidimensional concept; India, with its vast scale, diversity, and institutional intricacies, is even more challenging to analyse comprehensively. Yet, the authors succeed in producing a novel, rigorous, and compelling work that will likely remain a key reference for students, scholars, and policy practitioners interested in India's development story.

The book has several strengths, three of which stand out. First, it provides a remarkably comprehensive account of post-independence India, integrating both political and economic dimensions that have influenced the country's development story. Second, it situates India's trajectory within a comparative global framework, allowing readers to contextualize its achievements and shortcomings relative to other nations. Third, the arguments are grounded in

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extensive empirical evidence, lending structure, credibility, and analytical clarity to the narrative.

At the heart of the book lies the concept of India's "precocious" development—a trajectory shaped by early institutional and political choices that produced both anticipated and unforeseen outcomes. The authors argue that India's developmental path is the result of interactions among four central entities: the state, society, nation, and markets. Accordingly, the book is divided into four parts, each devoted to examining one of these actors.

The first section explores the role of democracy, emphasizing how foundational decisions taken at independence continue to shape India's development. The early adoption of universal franchise and affirmative action, for instance, are presented as progressive and developmentally consequential choices. However, the delayed prioritization of universal education and insufficient attention to women's participation in nation-building are identified as missed opportunities that constrained long-term outcomes.

The second part focuses on markets and the economy, dividing India's economic history into four phases: the planning era (1950–1980), import substitution and early liberalization (1980–1991), the neoliberal reform period (1991–2010), and the welfarist phase (2010 onwards). The authors challenge conventional interpretations of these phases, arguing that both the magnitude and drivers of growth during these periods have often been misunderstood.

Part three turns to the state, contending that public administration has been one of India's principal developmental bottlenecks. Contrary to popular perception, the Indian bureaucracy is not excessively large by international standards but is structurally imbalanced. Public employment is concentrated at the state level, with local governments relatively understaffed leading to weak grassroots governance. Policy priorities, such as emphasizing physical infrastructure over social infrastructure and privileging education over health, have also contributed to uneven developmental outcomes. Although technological advancements and digitization have improved state capacity in recent years, substantial gaps remain.

The final part surveys the "many Indias" within India, examining diversity across religion, caste, gender, and especially across states. From Kerala's

distinctive development model to West Bengal's economic stagnation, the authors highlight stark inter-state disparities that complicate any singular narrative of national progress.

Despite its usefulness in many ways, the fundamental limitation of the book is its lack of a nuanced and interdisciplinary analysis.

While the book paints a broad picture of India's economic and political development, it misses on the nuances of why certain measures were taken and how they resulted in specific outcomes. In other words, the book focuses more on the what, but little on the why and how. For instance, in the second part on markets, the book offers little analysis on why specific policies like import substitution or welfarism were prioritised during different phases and how they led to the economic outcomes that are discussed. Similarly, the analysis on states offers little on why states like Kerala adopted a specific model or what factors influenced Punjab and Haryana to adopt the policies they did and how these policies translated into different development outcomes for these states.

At the outset of the book the authors acknowledge that development occurs at the intersection of economics, politics, and society and that they want to draw from across disciplines to look at development. In spite of this, the book largely focuses on two disciplines- political science and economics. Moreover, the structure of the book treats the political and economic actors somewhat discretely. The four-part division risks analytically separating forces that, in practice, are deeply intertwined. Development is rarely the product of isolated actors; it is the outcome of their interaction. For example, how did early democratic mobilization, socialist economic policies, and evolving state capacity collectively shape India's initial developmental path? In more recent years, how have welfare expansion, demographic change, private investment, and geopolitical pressures interacted to influence growth? A chronological structure organized around distinct developmental phases—showing how political, economic, and social forces interacted within each period—might have yielded a more explicitly interdisciplinary narrative. As it stands, the book is best characterized as multidisciplinary rather than fully interdisciplinary.

The book also leaves certain critical issues underexplored. First, while it

documents India's aggregate economic growth, it does not sufficiently engage with rising economic and social inequality. Even when India is celebrated as the fourth-largest economy in the world, its per capita income is starkly lower than other major economies and income inequality is a major impediment to sustainable growth. The book also treats social inequalities in the form of caste, gender and religion quite superficially, without any in-depth analysis of how these have resulted in specific developmental trajectories. For example, India's labour market outcomes are characterised by declining female labour force participation, an important issue, which gets completely ignored. Even if affirmative action is discussed in the book as a political decision, the issue of how caste continues to influence economic and political choices and development trajectory of the country is completely missed. Any comprehensive assessment of India's development must grapple with the structural drivers of socio-economic inequality and its impact on development.

Second, environmental sustainability receives limited attention. In an era defined by climate change and global warming, India's development trajectory cannot be meaningfully assessed without a deeper analysis of its environmental history, carbon footprint, and climate vulnerabilities.

Third, the treatment of diversity remains largely inter-state in focus. A more granular examination of intra-state inequalities would have enriched the analysis. For example, while the book highlights the service-driven growth of cities such as Mumbai, Bengaluru, and Hyderabad, it pays less attention to the underdeveloped regions within the states where these cities are situated—Maharashtra, Karnataka, and Telangana, respectively. In discussing state-wide differences in development and policies, a deeper discussion on the role of local governments in both rural and urban areas, would have explained the reasons for the high intra-state inequalities in the country. Such analysis would have been useful especially from a policy and action perspective.

Fourth, the book conspicuously avoids any policy prescriptions and the way forward for India's development. The authors explain in the beginning of the book that one of the reasons for them to write this book is because of the critical juncture that India is in with respect to its standing in global economy and politics. Given that, it would have been useful to lay out some actions and

policies that can enable the country sustain its position in the world economy and polity.

Nonetheless, these critiques do not diminish the book's overall contribution. Kapur and Subramanian offer an ambitious, data-rich reinterpretation of India's post-independence trajectory. By challenging conventional knowledge about independent India's development and reassessing the institutional foundations of growth, *this volume* significantly advances scholarly debates on India's development and provides a macro-institutional lens through which to reconsider its past and present.

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