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Time, Tasks and Tradeoffs: Women's Agricultural Time Use, Crop Choice, and Household Welfare in Semi-Arid India

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Abstract— **Women play a central yet often underrecognized role in agricultural production in semi-arid regions of India, where farming systems are shaped by climatic uncertainty, labor scarcity, and resource constraints. This study examines how women's allocation of time across agricultural tasks influences crop choice decisions and household welfare outcomes. Drawing on the concept of time as a scarce and gendered resource, the paper analyzes the trade-offs women face between farm labor, domestic responsibilities, and income-generating activities. It explores how labor-intensive versus less time-demanding crops affect women's workloads, decision-making power, and the stability of household livelihoods. The study highlights that women's time burdens significantly shape cropping patterns, often limiting diversification and adoption of climate-resilient practices despite their potential welfare benefits. At the household level, unequal time demands are linked to nutritional outcomes, income variability, and women's well-being. By foregrounding women's time use in agricultural decision-making, the paper contributes to a more nuanced understanding of productivity and welfare in semi-arid farming contexts. The findings underscore the need for gender-responsive agricultural policies, labor-saving technologies, and support systems that recognize women's time constraints as a critical factor in enhancing both agricultural sustainability and household welfare.**

Keywords— ***Women's time use; Agricultural labor; Crop choice; Household welfare; Gender and agriculture; Semi-arid India***

Introduction

Agriculture in semi-arid regions of India is characterized by climatic uncertainty, limited water availability, and a high dependence on household labor. Within this context, women contribute substantially to agricultural production, performing a wide range of tasks that span sowing, weeding, harvesting, post-harvest processing, and livestock management. Alongside these responsibilities, women also shoulder the primary burden of unpaid domestic and care work. Despite their central role, women's labor and time constraints remain insufficiently reflected in agricultural planning, policy design, and household-level decision-making analyses.

Time is a finite resource, and its allocation involves constant trade-offs, particularly for rural women. In semi-arid farming systems, where labor demands fluctuate sharply across seasons, women often adjust their time use to accommodate both farm and household needs. These adjustments directly influence crop choice, as different crops require varying levels of labor intensity, supervision, and timing. Labor-demanding crops may offer higher returns or greater food security, yet they can impose heavy time burdens on women, affecting their health, rest, and ability to engage in income diversification or community activities. Conversely, crops that are less demanding in terms of labor may reduce women's workload but may also limit household income or nutritional diversity.

Understanding crop choice without considering women's time use risks oversimplifying agricultural decision-making processes. Crop selection in semi-arid regions is not determined solely by market prices, rainfall patterns, or access to inputs; it is also shaped by who performs the labor and how time is distributed within the household. Women's limited control over productive resources, combined with socially embedded gender norms, often constrains their ability to influence cropping decisions, even when they bear a disproportionate share of the labor costs. As a result, household welfare outcomes—such as food security, income stability, and nutritional well-being—are closely linked to gendered patterns of time allocation.

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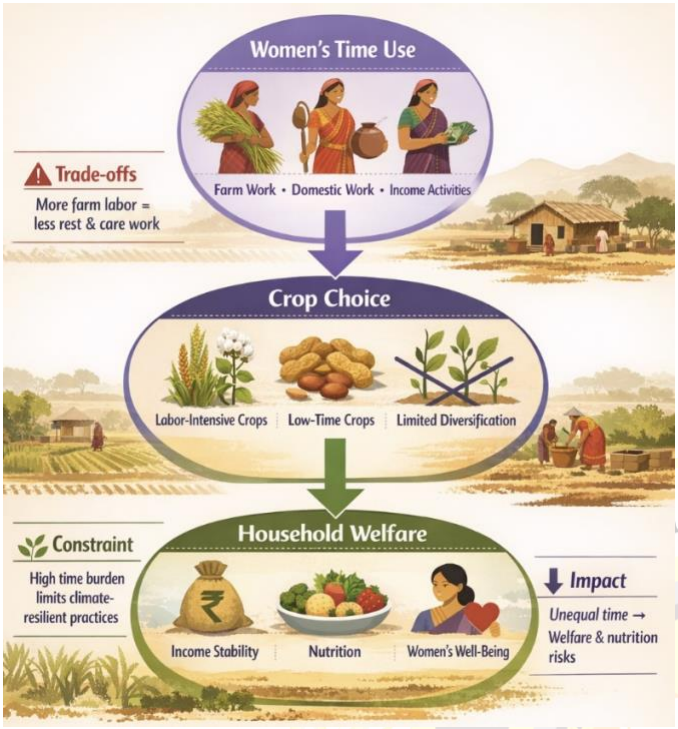

Fig. 1: Women, Time and Farm Decisions in Semi-Arid India

Household welfare extends beyond income measures to include health, nutrition, education, and overall quality of life. Excessive time burdens on women can have cascading effects on these dimensions. Long working hours and competing responsibilities may reduce time available for childcare, food preparation, rest, and participation in social networks. In semi-arid contexts, where environmental stress already heightens vulnerability, these time-related constraints can intensify welfare risks for both women and their households. At the same time, women's agricultural labor remains critical for sustaining production and managing risk, particularly under conditions of rainfall variability and resource scarcity.

This study situates women's agricultural time use at the center of analysis to examine its relationship with crop choice and household welfare in semi-arid India. By focusing on time as both an economic and social constraint, the paper aims to highlight how gendered labor dynamics shape agricultural outcomes and well-being. Recognizing women's time constraints is essential for designing more inclusive agricultural strategies, promoting sustainable livelihoods, and improving household welfare in regions where ecological and social pressures intersect.

Conceptual Framework and Theoretical Background

The conceptual framework of this study is built on the premise that time is a critical yet undervalued input in agricultural production, particularly in gendered rural economies. In semi-arid India, women's time allocation across agricultural, domestic, and care-related activities forms a complex system of trade-offs that directly and indirectly influence crop choice and household welfare. The framework links three core components: women's time use, agricultural decision-making (with specific emphasis on crop choice), and household welfare outcomes. These components interact within a broader environment shaped by ecological conditions, socio-cultural norms, and institutional constraints.

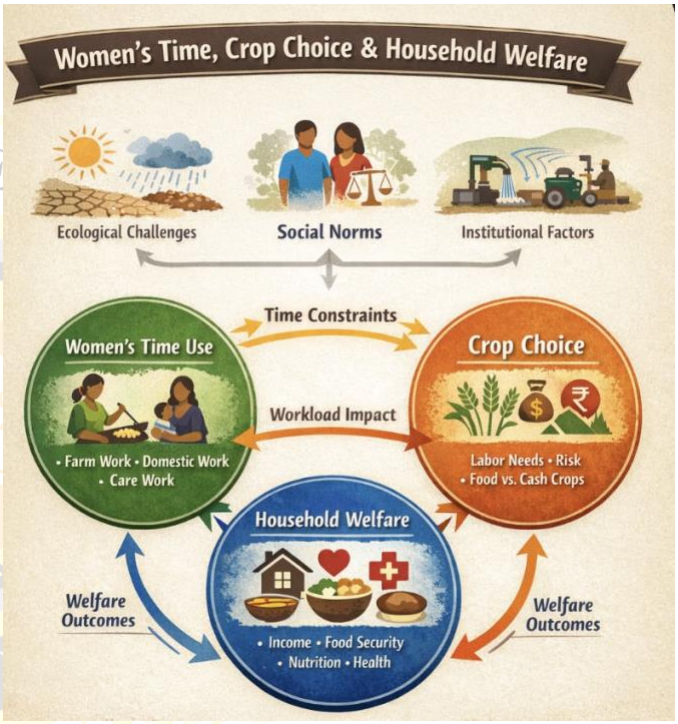

Fig. 2: Women's Time, Crop Choice and Household Welfare

At the theoretical level, the study draws on time allocation theory, which views households as decision-making units that distribute time among competing activities to maximize overall welfare under constraints. In agrarian households, time allocation decisions are influenced not only by economic returns but also by social norms and gender roles. Women's time is often treated as flexible and infinitely adjustable, allowing households to absorb labor shortages or seasonal peaks without explicit recognition of the associated costs. This assumption obscures the opportunity costs of women's labor, such as reduced leisure, compromised health, and limited participation in education or off-farm employment.

The framework also incorporates insights from gender economics, which emphasizes intra-household bargaining and unequal access to resources. Crop choice decisions are rarely gender-neutral. Although men often hold formal authority over

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land and market transactions, women contribute substantial labor and possess context-specific knowledge of crops, soil conditions, and food needs. However, their influence over crop selection is mediated by their time burdens and limited bargaining power. When women face severe time constraints, households may favor crops that minimize peak labor demands, even if alternative crops could improve income stability or nutritional outcomes. Thus, women's time scarcity becomes a structural factor shaping production choices.

From an agricultural household model perspective, production and consumption decisions are closely linked, particularly in subsistence-oriented and semi-commercial farming systems. Crop choice affects not only income but also food availability, dietary diversity, and risk exposure. Women's time use mediates this relationship by determining how much labor can be allocated to specific crops and post-harvest activities. Labor-intensive crops may enhance food security or income but can increase women's workload, leading to adverse welfare effects. Conversely, reduced labor demands may ease time pressure but constrain livelihood options. The conceptual framework captures this bidirectional relationship, where crop choice both responds to and reinforces women's time allocation patterns.

The framework further acknowledges the role of ecological and climatic uncertainty characteristic of semi-arid regions. Rainfall variability, drought risk, and soil constraints intensify labor requirements during critical periods, amplifying time trade-offs for women. Under such conditions, women's adaptive strategies—such as prioritizing certain crops, reallocating labor within the household, or reducing time spent on care activities—have significant implications for household welfare. These adaptive responses are shaped by institutional factors, including access to irrigation, labor-saving technologies, extension services, and social support systems, which can either alleviate or exacerbate time burdens.

Literature Review

Research on agriculture in India has consistently highlighted the central role of women in farm production, particularly in rain-fed and semi-arid regions. Studies document that women contribute a substantial share of labor in activities such as sowing, weeding, harvesting, post-harvest processing, and livestock care. Despite this, early agricultural literature largely treated farm labor as a homogeneous input, overlooking gender differences in task allocation and time burdens. More recent scholarship has shifted attention toward gender-disaggregated analysis, revealing that women's labor is often concentrated in time-intensive and low-visibility tasks that are critical for farm productivity but undervalued in economic assessments.

A growing body of literature focuses on time use as an important dimension of gender inequality in rural households. Time-use studies demonstrate that women in agrarian settings face "time poverty," resulting from the simultaneous demands of agricultural work, domestic responsibilities, and care activities. In semi-arid regions, where agricultural labor demands fluctuate seasonally and coping strategies are essential for survival, women's time burdens intensify during peak agricultural periods. Scholars argue that excessive time pressure reduces women's capacity to rest, seek education, engage in paid employment, or participate in community decision-making, thereby reinforcing cycles of disadvantage.

The relationship between women's time use and crop choice has received increasing attention in agricultural economics and gender studies. Research suggests that crop selection is not driven solely by agro-climatic suitability or market incentives but is also shaped by labor availability within the household. Labor-intensive crops, such as certain food grains, pulses, or commercial crops, often rely heavily on women's unpaid labor. While these crops may enhance food security or income, they can impose significant physical and temporal costs on women. Conversely, households may opt for crops requiring less labor during peak seasons to manage time constraints, even when such choices limit income diversification or nutritional outcomes. This literature highlights that women's time scarcity can act as a hidden constraint on agricultural innovation and diversification.

Studies grounded in intra-household bargaining frameworks further reveal that women's limited control over resources affects how their time is allocated and valued. Although women bear a disproportionate share of agricultural and domestic labor, their influence over crop choice and technology adoption is often constrained by social norms and unequal access to land, credit, and extension services. Empirical research indicates that when women have greater decision-making power, households are more likely to adopt crops and practices that improve food security and dietary diversity. However, without supportive interventions, increased responsibilities can also translate into heavier workloads, suggesting that empowerment without attention to time burdens may have mixed welfare effects.

The literature on household welfare emphasizes that agricultural outcomes must be assessed beyond income measures. Researchers link women's time allocation to broader welfare indicators, including nutrition, health, education, and overall well-being. High labor demands on women are associated with reduced time for childcare and food preparation, which can negatively affect child nutrition and health outcomes. In semi-arid contexts, environmental stress amplifies these effects, as households rely more heavily on women's labor to manage risk and ensure subsistence. Scholars

increasingly argue for integrated approaches that consider production, time use, and welfare simultaneously.

Recent policy-oriented studies stress the importance of labor-saving technologies, improved access to water, and gender-sensitive extension services in reducing women's time burdens. Evidence suggests that interventions such as mechanized tools, improved crop varieties, and community support systems can ease labor constraints and enable women to participate more actively in decision-making. However, gaps remain in understanding how these interventions interact with crop choice and long-term household welfare, particularly in semi-arid regions.

Research Questions and Hypotheses

This study is guided by the overarching objective of understanding how women's agricultural time use influences crop choice decisions and household welfare in semi-arid regions of India. Recognizing time as a scarce and gendered resource, the research seeks to uncover the linkages between labor allocation, agricultural decision-making, and well-being outcomes at the household level. The following research questions and hypotheses are formulated to address these relationships in a systematic and analytical manner.

Research Questions

1. How is women's time allocated across agricultural, domestic, and care-related activities in semi-arid farming households?
2. In what ways does women's agricultural time use influence household crop choice decisions?
3. How do labor-intensive and less labor-demanding crops affect women's overall time burden during different agricultural seasons?
4. What is the relationship between women's time constraints and key household welfare indicators such as income stability, food security, and nutritional outcomes?
5. How do socio-economic and institutional factors, such as access to resources, technology, and decision-making power, mediate the relationship between women's time use, crop choice, and household welfare?

Hypotheses

H1: Women in semi-arid agricultural households spend a disproportionate amount of time on labor-intensive farm activities in addition to unpaid domestic and care work, resulting in significant time constraints.

H2: Households with higher women's agricultural time burdens are more likely to choose crops that reduce peak labor demands, even when such crops offer lower economic or nutritional returns.

H3: The cultivation of labor-intensive crops is associated with increased time pressure on women, which negatively affects their health, rest, and participation in non-farm activities.

H4: Greater women's time constraints are negatively associated with household welfare outcomes, including food security, dietary diversity, and income stability.

H5: Access to labor-saving technologies, institutional support, and greater women's participation in decision-making moderates the negative effects of time burdens on crop choice and household welfare.

These research questions and hypotheses provide a structured foundation for empirical analysis, enabling the study to examine how gendered time allocation shapes agricultural practices and welfare outcomes in semi-arid India.

Study Area and Socio-Economic Context

The study is situated in selected semi-arid regions of India, characterized by low and erratic rainfall, frequent droughts, and a heavy dependence on rain-fed agriculture. These regions typically experience annual rainfall that is both spatially and temporally uneven, resulting in high production risk and uncertain yields. Agriculture in such areas is dominated by small and marginal farmers, with limited access to irrigation, modern inputs, and formal credit. Cropping systems commonly include coarse cereals, pulses, oilseeds, and drought-tolerant cash crops, chosen primarily for their resilience rather than high productivity.

The socio-economic structure of semi-arid rural households is shaped by land fragmentation, seasonal employment, and livelihood diversification. Farming households often rely on a combination of crop cultivation, livestock rearing, wage labor, and migration to manage risk and income variability. Women play a critical role in sustaining these livelihood strategies. Their responsibilities extend beyond farm production to include household management, fuel and water collection, childcare, and care of the elderly. This multiplicity of roles intensifies women's time burdens, particularly during peak agricultural seasons.

Gender norms strongly influence labor allocation and decision-making processes within households. While men typically control land ownership, market transactions, and major financial decisions, women contribute a substantial share of

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unpaid agricultural labor. Their participation is especially pronounced in labor-intensive and repetitive tasks that require sustained time investment but yield limited recognition or remuneration. Limited access to education, extension services, and labor-saving technologies further constrains women's capacity to reduce their workload or influence crop-related decisions.

Household welfare in semi-arid regions is closely tied to women's labor and time availability. Food security and nutritional outcomes often depend on women's involvement in crop production, food processing, and meal preparation. However, high time pressure can reduce the quality of care and nutrition within households, with implications for health and well-being across generations. Environmental stress, combined with socio-economic vulnerability, amplifies these challenges, making women's time allocation a critical factor in both agricultural sustainability and household welfare.

Within this context, the study examines how women navigate competing demands on their time and how these trade-offs shape crop choice and welfare outcomes. By situating the analysis in the lived realities of semi-arid rural households, the study seeks to capture the intersection of ecological constraints, gender norms, and economic pressures that define women's agricultural labor.

Hypotheses

H1: Women in semi-arid regions experience higher cumulative time burdens due to the combined demands of agricultural labor, domestic work, and care responsibilities.

H2: In households facing acute labor and time constraints, crop choices tend to favor less labor-intensive or traditional crops over potentially more profitable or nutritionally beneficial alternatives.

H3: Increased women's time burdens are associated with lower household welfare outcomes, particularly in terms of food security, dietary diversity, and women's health.

H4: Socio-economic factors such as landholding size, access to irrigation, and availability of labor-saving technologies significantly influence the relationship between women's time use and crop choice.

H5: Greater involvement of women in agricultural decision-making mitigates the negative welfare effects of high time burdens by enabling more balanced crop and labor strategies.

Together, the study area context and hypotheses provide a grounded framework for analyzing how gendered time allocation interacts with agricultural decision-making and household welfare in semi-arid India.

Data Sources and Methodology

This study adopts a mixed-methods approach to examine the relationship between women's agricultural time use, crop choice, and household welfare in semi-arid regions of India. Combining quantitative and qualitative data allows for a comprehensive understanding of both measurable outcomes and the lived experiences underlying time allocation decisions. The methodology is designed to capture seasonal variation, intra-household labor dynamics, and socio-economic heterogeneity across farming households.

Data Sources

Primary data form the core of the analysis. Household-level data are collected through structured surveys administered to farming households across selected semi-arid districts. The survey captures detailed information on demographic characteristics, landholding size, cropping patterns, access to irrigation and inputs, income sources, and household assets. A time-use module records women's daily and seasonal allocation of time across agricultural activities, domestic work, care responsibilities, and income-generating tasks. To ensure accuracy, time-use data are gathered using recall-based daily schedules supplemented by seasonal calendars that reflect peak and lean agricultural periods.

In addition to surveys, qualitative data are collected through focus group discussions and in-depth interviews with women farmers. These methods provide insights into decision-making processes, perceptions of time pressure, and coping strategies adopted during periods of labor scarcity or environmental stress. Key informant interviews with extension workers, local leaders, and representatives of self-help groups help contextualize household-level findings and shed light on institutional factors affecting women's labor and crop choices.

Secondary data complement the primary dataset. Agricultural statistics, rainfall records, and regional socio-economic indicators are sourced from government publications, census reports, and agricultural departments. These data provide background information on agro-climatic conditions, cropping trends, and infrastructural availability in the study area, supporting the interpretation of primary findings.

Methodology

The analytical framework integrates descriptive, econometric, and qualitative techniques. Descriptive analysis is used to summarize women's time allocation patterns, cropping

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systems, and household welfare indicators such as income, food security, and dietary diversity. Time-use profiles are constructed to highlight variations across seasons, farm sizes, and socio-economic groups.

Econometric analysis examines the relationship between women's time use and crop choice decisions. Crop choice models incorporate women's agricultural labor hours as key explanatory variables, along with controls for land size, rainfall variability, access to irrigation, and household characteristics. To assess welfare outcomes, regression models link women's time burdens and crop choices to indicators of household welfare, including food consumption patterns and income stability. Interaction terms are used to explore how access to labor-saving technologies and women's participation in decision-making moderate these relationships.

Qualitative data are analyzed thematically to complement quantitative findings. Narratives from interviews and focus groups are used to interpret observed patterns, particularly where numerical data may not fully capture social norms, power relations, or subjective experiences of time scarcity. This triangulation strengthens the validity of the results and ensures that women's perspectives remain central to the analysis.

Overall, the data sources and methodology are designed to capture the complex interplay between time, tasks, and trade-offs faced by women in semi-arid agriculture. By integrating multiple data types and analytical approaches, the study provides a robust foundation for understanding how gendered time allocation shapes crop choice and household welfare outcomes.

Empirical Results and Analysis

This section presents the empirical findings on women's agricultural time use, crop choice, and household welfare in semi-arid India. The analysis integrates descriptive statistics with econometric insights to illustrate how gendered time allocation shapes agricultural decisions and welfare outcomes.

Women's Time Use Patterns

The results indicate that women devote a substantial share of their daily time to agricultural activities alongside domestic and care work. On average, women spend longer hours on farm-related tasks during peak seasons such as sowing and harvesting, while domestic responsibilities remain constant throughout the year. This dual burden results in extended working days and limited rest, particularly during periods of climatic stress.

Table 1: Average Daily Time Allocation of Women (Hours)

Activity Type	Lean Season	Peak Season
Agricultural labor	3.2	6.1
Domestic work	4.5	4.6
Care responsibilities	1.8	1.9
Income-related activities	0.9	0.6
Leisure and rest	1.6	0.8

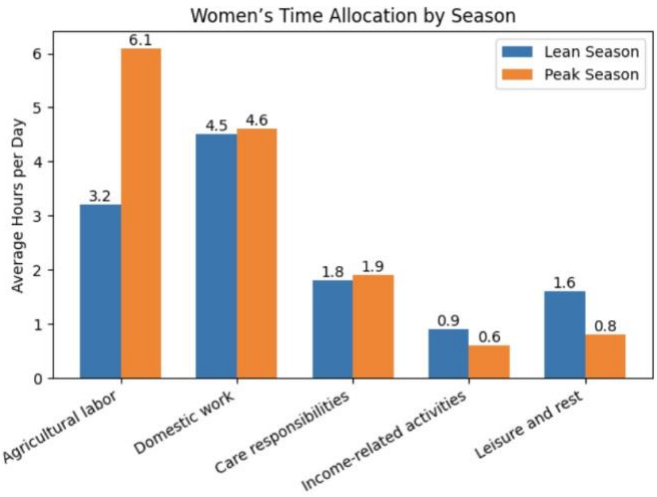

Fig. 3: Average Daily Time Allocation of Women (Hours)

The table highlights a sharp reduction in leisure and rest during peak agricultural periods, underscoring the intensity of women's time constraints.

Time Use and Crop Choice

Empirical analysis reveals a strong association between women's time burdens and household crop selection. Households where women report higher peak-season labor hours tend to favor crops with lower labor requirements, even when such crops yield lower economic returns. Regression results suggest that women's agricultural time use is a significant predictor of crop choice, independent of land size and rainfall conditions.

Labor-intensive crops are more prevalent in households with additional adult labor or access to basic mechanization. In contrast, time-constrained households often rely on traditional or less diverse cropping patterns, indicating that time scarcity limits agricultural flexibility and innovation.

Impact on Household Welfare

The analysis further shows that women's time burdens are closely linked to household welfare indicators. Higher

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cumulative work hours are associated with lower dietary diversity and increased food insecurity, particularly in households dependent on rain-fed agriculture. Income stability is also affected, as limited time availability restricts women's participation in supplementary income activities.

Table 2: Relationship Between Women's Time Burden and Welfare Indicators

Welfare Indicator	Low Time Burden	High Time Burden
Average household income	Higher	Lower
Dietary diversity score	Higher	Lower
Food security status	More secure	More vulnerable
Women's self-reported health	Better	Poorer

The results suggest that excessive time demands on women generate trade-offs that extend beyond labor allocation, influencing nutrition, income, and well-being at the household level.

Moderating Role of Resources and Decision-Making

Further analysis indicates that access to labor-saving technologies, irrigation, and women's participation in decision-making moderates the negative effects of time burdens. Households where women have greater influence over crop decisions demonstrate better alignment between crop choice and welfare outcomes, even under time constraints. These findings highlight the importance of institutional and social factors in shaping how time scarcity translates into welfare impacts.

Women's Time Use and Household Welfare Outcomes

Women's time allocation plays a decisive role in shaping household welfare in semi-arid agricultural contexts, where livelihoods depend heavily on family labor and careful management of scarce resources. The findings of this study show that women's extended working hours—spread across agricultural production, domestic responsibilities, and care work—create significant trade-offs that directly affect multiple dimensions of household well-being. Time scarcity emerges not merely as a labor issue, but as a welfare constraint with long-term implications.

One of the most visible links between women's time use and household welfare is food security and nutrition. Women are central to food production, processing, and preparation, and their time availability strongly influences the quality and diversity of household diets. When agricultural labor demands intensify during peak seasons, women often reduce the time spent on meal planning, food processing, and childcare. This adjustment does not necessarily reduce caloric intake, but it frequently affects dietary diversity and nutritional quality. Households with highly time-constrained women tend to rely more on easily prepared staples, limiting the consumption of pulses, vegetables, and nutrient-rich foods.

Health and well-being outcomes are also closely associated with women's time burdens. Prolonged working days, inadequate rest, and physically demanding agricultural tasks contribute to fatigue, stress, and declining self-reported health among women. Over time, these conditions can reduce women's productive capacity and resilience, increasing vulnerability during periods of climatic or economic shock. The cumulative effect of time pressure often remains invisible in household welfare assessments that focus solely on income or output, yet it has profound implications for sustainability and intergenerational well-being.

Income stability represents another important welfare dimension influenced by women's time use. While women's agricultural labor is essential for sustaining farm production, heavy time demands limit their ability to engage in supplementary income-generating activities such as wage labor, home-based enterprises, or participation in self-help groups. As a result, households with highly constrained women may experience greater income volatility, especially in rain-fed systems where crop yields are uncertain. In contrast, households where women have more balanced time allocations are better positioned to diversify livelihoods and manage risk.

Women's time use also affects social and educational outcomes within the household. Limited time availability reduces women's participation in community networks, training programs, and extension activities that could enhance agricultural knowledge and social capital. For children, reduced maternal time for care and supervision can influence schooling and health outcomes, particularly in resource-constrained environments. These indirect effects illustrate how women's time scarcity extends beyond individual well-being to shape broader household and community outcomes.

Policy Implications

The findings of this study have important implications for agricultural, social, and gender-focused policy in semi-arid regions of India. By demonstrating that women's time use is a critical determinant of crop choice and household welfare, the analysis highlights the need for policies that move beyond yield- and income-centric approaches and explicitly recognize time as a scarce and gendered resource.

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First, agricultural policies should prioritize the reduction of women's time burdens through the promotion of labor-saving technologies and infrastructure. Access to appropriate mechanization, improved tools for weeding and harvesting, reliable water supply, and nearby fuel and water sources can significantly reduce the physical and temporal demands placed on women. Technology adoption programs must be designed with women's needs in mind, ensuring affordability, ease of use, and access through women's groups rather than assuming male ownership or control.

Second, crop planning and extension services should incorporate gender-sensitive assessments of labor and time requirements. Extension recommendations often emphasize productivity or market returns without accounting for who performs the labor. Integrating women's time constraints into advisory services can help households select crop combinations that balance economic returns with manageable workloads. Seasonal labor calendars and time-use awareness tools can support more informed and equitable crop choice decisions.

Third, strengthening women's participation in agricultural decision-making is essential. Policies that enhance women's access to land rights, credit, training, and producer organizations can increase their bargaining power within households and communities. However, empowerment initiatives must be accompanied by measures that prevent the unintended consequence of increased workloads. Supporting collective action through self-help groups and cooperatives can help redistribute labor and improve access to shared resources.

Fourth, social protection and rural development programs should address the intersection of care responsibilities and agricultural labor. Investments in childcare facilities, health services, and community-based support systems can ease women's care-related time burdens, particularly during peak agricultural seasons. Public employment and welfare schemes can be designed to complement women's agricultural schedules rather than compete with them for time.

Finally, policy evaluation frameworks should adopt broader measures of success that include time use and well-being outcomes alongside production and income indicators. Incorporating time-use data into agricultural and rural development monitoring can reveal hidden costs and trade-offs that are otherwise overlooked. Such an approach would enable policymakers to design more holistic interventions that promote both agricultural sustainability and household welfare.

Limitations of the Study

Despite its contributions, this study has certain limitations that should be acknowledged when interpreting the findings. First, the analysis relies partly on self-reported time-use data, which may be subject to recall bias or measurement error. Although seasonal calendars and cross-checking methods were used to improve accuracy, some underreporting or overreporting of specific activities may persist, particularly for multitasking and care-related work that is often taken for granted.

Second, the study is confined to selected semi-arid regions of India, and the results may not be fully generalizable to other agro-climatic zones or socio-cultural contexts. Farming systems, gender norms, and labor arrangements vary widely across regions, and the relationships observed in this study may differ in irrigated or more commercially oriented agricultural settings.

Third, while the study examines associations between women's time use, crop choice, and household welfare, establishing strict causal relationships remains challenging. Time allocation, crop decisions, and welfare outcomes influence one another simultaneously, making it difficult to isolate the direction of causality using cross-sectional data. Longitudinal data would provide deeper insights into how changes in time use and crop choice affect welfare over time.

Fourth, the study focuses primarily on women's time use and does not provide an equally detailed analysis of men's time allocation. A more comprehensive comparison of intra-household labor dynamics could further illuminate how responsibilities are negotiated and shared within households. Additionally, variations across age groups, marital status, and household structure could not be explored in depth due to data constraints.

Finally, certain qualitative dimensions, such as intra-household power relations and social norms influencing time allocation, are complex and context-specific. While qualitative methods were used to capture these aspects, they cannot fully represent the diversity of experiences across all households. These limitations suggest areas for future research and highlight the need for continued investigation into the gendered dimensions of agricultural time use and welfare.

Conclusion

This study has examined the interconnections between women's agricultural time use, crop choice, and household welfare in semi-arid regions of India, bringing attention to time as a critical yet often overlooked resource in rural livelihoods. The analysis demonstrates that women's labor extends far beyond visible farm activities to include substantial domestic and care responsibilities, resulting in persistent time constraints, particularly during peak agricultural seasons. These constraints

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shape not only women's well-being but also the broader economic and nutritional outcomes of farming households.

The findings reveal that crop choice in semi-arid agriculture is closely linked to women's time burdens. Households facing acute labor and time pressures tend to favor less labor-intensive cropping patterns, even when alternative crops could improve income stability or dietary diversity. This highlights that agricultural decision-making is embedded within gendered labor arrangements and cannot be fully understood through agronomic or market considerations alone. Women's time scarcity acts as a hidden constraint on diversification, innovation, and the adoption of potentially beneficial practices.

At the household level, excessive time demands on women are associated with lower welfare outcomes, including reduced dietary diversity, heightened food insecurity, and poorer health and well-being. These effects extend beyond individual women to influence child care, nutrition, and household resilience in environments already marked by ecological uncertainty. The study underscores that productivity gains achieved through intensified labor may come at the cost of diminished welfare if women's time constraints remain unaddressed.

Overall, the study emphasizes the need to reframe agricultural and rural development strategies to explicitly account for women's time use. Policies and interventions that reduce time burdens, promote equitable decision-making, and support women's access to resources are essential for achieving sustainable and inclusive development in semi-arid regions. By recognizing time as a central element of agricultural systems, this research contributes to a more holistic understanding of how gender, labor, and welfare intersect in rural India and points toward pathways for more resilient and equitable agricultural futures.

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