ISSN ONLINE: 3021-9604

INTERNATIONAL SOCIOECONOMIC REVIEW

VOLUME II, ISSUE 1, 2024

Institute of Socioeconomic Research and Development

www.isrd.org.np

Institute of Socioeconomic Research and Development

ISSN Online: 3021-9604

International Socioeconomic Review (ISER)

Vol II, Issue I, 2024

Message from Editor in Chief

Dear Esteemed Readers,

It is with great pride and a deep sense of responsibility that I present to you the latest issue of International Socioeconomic Review (ISER). As we continue to navigate an ever-evolving academic and professional landscape, our journal remains steadfast in its commitment to fostering high-quality research and meaningful dialogue that addresses the complexities of our world.

This issue brings together an exceptional collection of articles that reflect the intellectual rigor, creativity, and diversity of thought that our journal aims to champion. From groundbreaking studies on analyzing the Mediating Role of Financial Well-Being in “Ginhawa" and Young Adult’s Desire to Have Children to in-depth analyses of Economic Development and Changing Women Lives: Evidence from Women Employment Participation in India, each piece offers unique insights into issues of global significance.

The contributions in this issue are a testament to the dedication of our authors and the invaluable efforts of our peer reviewers. It is their commitment to excellence that ensures our journal remains a trusted source of knowledge and a catalyst for transformative ideas. I extend my heartfelt gratitude to each of them for their unwavering support.

As we look ahead, we recognize the importance of fostering inclusive and interdisciplinary perspectives. We encourage submissions that challenge conventional thinking, explore uncharted territories, and propose solutions that drive social impact and innovation.

To our readers, your engagement is at the heart of what we do. We invite you to explore the articles in this issue, share your feedback, and contribute to the ongoing conversations that shape our fields of inquiry. Together, we can continue to build a vibrant and dynamic scholarly community.

Thank you for your continued support, and we look forward to your contributions and reflections on future issues.

Warm regards,

Shyam Kumar Thapa

Editor-in-Chief

International Socioeconomic Review

Institute of Socioeconomic Research and Development

ISSN Online: 3021-9604

Contentment to Commitment: Analyzing the Mediating Role of Financial Well-Being in Ginhawa and Young Adult's Desire to Have Children

Clarissa Mae Cruz, Nikkaella Mae Reyes, Ivan Railey Robiso, and Dr. Darwin Rungduin

Philippine Normal University

Corresponding email: reyes.nm@pnu.edu.ph

How to cite this paper: Cruz, C. M., Reyes, N. M., Robiso, I. R., & Rungduin, D. (2024). Contentment to Commitment: Analyzing the Mediating Role of Financial Well-Being in "Ginhawa" and Young Adult's Desire to Have Children. *International Socioeconomic Review*, *2*(1), 4–16. www.isrd.org.np

Received: August 05, 2024

Revised: October 25, 2024

Accepted: December 15, 2024

Published: December 24, 2024

Abstract

Financial status, well-being, and efforts are the pillars considered when building a family of their own. Understanding how these aspects are essential in building a family in the future can be beneficial in the growth of one's life stability. The researchers found knowledge gaps about the influence of "Ginhawa" on the desires of young adults to have children, and how financial well-being mediates or influences the relationship between young adults' desire to have children and their level of "Ginhawa". The main objective of the study is to examine the relationship between the desire to have children and "Ginhawa", while also considering the potential mediating effect of financial well-being on this relationship, which allows for a more nuanced understanding of the factors influencing the well-being of Filipino young adults in the context of their family planning desires. Data were collected through surveys and analyzed utilizing mediation analysis. The analysis revealed that with a p-value of 0.039, "Ginhawa" and the desire to have children have a significant relationship. However, with a p-value of 0.058, financial well-being does not mediate this relationship. These findings suggest that although "Ginhawa" is evident to be a strong predictor of the childbearing intentions of young adults, financial well-being does not mediate the relationship significantly. This reflects that family planning among young adults is more a concern for their overall well-being than for their financial stability. Subsequently, plans for having children are dictated largely by their sense of well-being, regardless of their financial stability.

Keywords: Financial Well-Being, Desire to have children, Ginhawa

1. Introduction

In establishing one's own family, it is crucial to have concrete planning and full commitment to being parents to children since it costs a lot. Financial status, time, state of well-being, and efforts are the pillars being

considered to build a family of their own. Numerous studies have demonstrated that both men and women believe that having a job, a stable income, a completed education, and decent housing are crucial factors when deciding whether to have children (Statistics Sweden, 2001; Morin et al., 2003). Furthermore, Lampic et. al (2005) found out that in Sweden and other Western nations, delaying parenthood is a trend that is becoming more widespread, particularly among more educated populations. It infers that many people are concerned about the practical issues that come with parenthood, one of which is the population of young adults. The decisions and the desire to have children among young adults are still present for further discussions in society. Hoffower (2022) mentioned that one of the main reasons millennials and Gen Zs are either not having children at all or are having fewer than they thought was desirable is financial hardship which emphasizes that some can't afford to or at the very least, they'd prefer to wait until they feel financially caught up, in addition to managing daily allowances spent and overall cost of living. Along with that, larger economic and social forces are also having an impact on birth rates (Grabmeier, 2023). With that, in a study conducted by Rackin and Gibson-Davis (2017), the narratives used by the respondents implied that having a child without sufficient financial security would eventually lead to sentiments of regret and failure, possibly even in silence. However, they lack a focus on cultural and emotional factors, particularly in non-Western settings like the Philippines. The present study builds on this existing research by investigating the Filipino concept of "Ginhawa" and its role in young adults' aspirations for parenthood. In the Philippines, "Ginhawa" is an integral part of life satisfaction and personal well-being, making it essential to examine how it interacts with financial well-being in the context of family planning (Bernardo & Resurreccion, 2018).

Moreover, the drop in millennial and Generation Z birth rates is caused by an intricate series of events such as the rising costs of housing, rent, healthcare, and other essentials are causing these generations great concern about their capacity to give their kids the kind of life they picture for them. The researchers also found knowledge gaps regarding the influence of "Ginhawa" on the desires of young adults to have children, and how financial well-being mediates or influences the relationship between young adults' desire to have children and their level of "Ginhawa". With that, it is essential to examine the relationship between the desire to have children and "Ginhawa", while also considering the potential mediating effect of financial well-being on this relationship, which allows for a more nuanced understanding of the factors influencing the well-being of Filipino young adults in the context of their family planning desires.

This study hypothesizes that (H0) financial well-being does not mediate the relationship between "Ginhawa" and young adults' desire to have children, and (H1) financial well-being significantly mediates the relationship between "Ginhawa" and young adults' desire to have children. By analyzing these relationships, this research contributes to a deeper understanding of the intersection between well-being, financial stability, and family planning in the context of the Philippines.

The desire to have children is influenced by different factors, including cultural, emotional, and financial aspects. Knowing these aspects in the context of young adults might help them make informed decisions about

family planning. The purpose of this study is to explore whether "Ginhawa" is a significant factor and predictor of young adults' desire to have children.

Specifically, this research aims to answer the following questions:

1. Does the '"Ginhawa"' significantly predict Young Adults' desire to have children?
2. Does financial well-being significantly mediate the relationship between '"Ginhawa"' and the Desire to have children?

Conceptual Framework

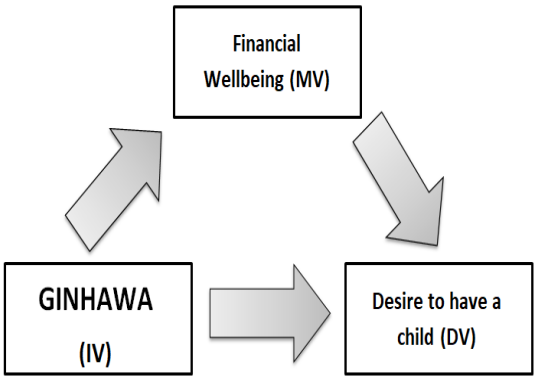


Fig. 1 Conceptual Framework of the study

The framework above indicates the presumed relationship between "Ginhawa" and young adults' desire to have children and the mediating effects of financial well-being on the two variables. It looks at how financial well-being plays a part in this relationship and whether having a stable financial status can enhance or diminish the impact of "Ginhawa" on the decision to have children.

2. Literature Review

The childbearing desires of young adults are complexly related to sociocultural, economic, and individual factors. In this respect, "Ginhawa" sets the basis for an entwined discussion; it is a Filipino term that denotes quality of life, ease, and comfort. This literature review examines the association of "Ginhawa" and financial well-being with the childbearing desires of young adults.

This paper examines how the concept of "Ginhawa"—a sense of well-being—predicts childbearing desire among young adults, investigating the moderating role of financial well-being. Literature gaps have been identified considering this perspective, while areas of specific inquiry have been determined through the review of relevant studies emanating from comparable socio-economic and cultural settings.

2.1 Financial Stability and Reproductive Decisions

Financial stability in family planning has been echoed in various research, mainly as a pre-condition for marriage and childbearing. For instance, young adults, especially in settings with economic pressure, consider financial readiness a moral duty before starting a family. However, there are inconsistent findings on the extent to which financial well-being acts as a critical determinant. While financial stability can often be held up in Western contexts as the benchmark, the Filipino notion of "Ginhawa" does complicate this relationship, suggesting perhaps that overall life satisfaction may outweigh concerns purely financial in nature. This research question addresses a large gap in the literature, at least in that most studies focused predominantly on economic factors, such as those by She et al. (2022) and Riitsalu et al. (2023), and did not expound on their interaction with culturally specific notions of well-being. The current study remedies this by incorporating "Ginhawa" as a possible overarching determinant even in the face of financial constraints.

2.2 Cultural-Specific Determinants of Family Planning

While global trends may entertain the idea that financial considerations are a critical factor in family planning decisions, an emphasis on "Ginhawa" taps into culturally specific dynamics in the Philippines. In the current setting, discussion within the literature about family planning in the Philippines remains underdeveloped concerning the exploration of intrinsic cultural concepts, such as "Ginhawa", concerning reproductive choices. Most of the related studies are focused on the more general contexts of Southeast Asia specifically without regard for these nuanced dimensions of culture. This study tries to fill this gap by incorporating both economic and cultural variables into its analysis of young adults' reproductive aspirations. Furthermore, it attempts to question the universalistic assumptions that financial well-being universally dictates family planning decisions.

2.3 The Decline in Birth Rates and Its Underlying Causes

One of the major debating points in the literature relates to the causes of falling birth rates in countries such as the Philippines. Whereas some, like Hoffower (2022), have related these trends to increasing economic burdens, others point to shifts in social values, such as career and personal freedom over more traditional family roles. While decreasing fertility rates are well-documented, there is a comparative dearth of research that would investigate how cultural factors—in this case, "Ginhawa"—and socio-economic realities, such as financial instability, interactively bear on these trends. Consequently, the study embarks directly upon investigating how both economic and cultural factors combine in shaping the family planning decisions of Filipino youth.

2.4 Childhood Experiences and Family Planning

Available literature indicates that there is a high level of proof that adverse experiences in childhood, such as emotional abuse or bad parental dynamics, bear strongly on one's motivation to procreate. However, only a

few studies have been conducted in Southeast Asia regarding how such psychological factors interact with economic or cultural drivers of reproductive decision-making. Parker et al. (2004) have posed that these parental statuses and marital satisfaction are also important factors in people's desire for children; again, most of these studies have been confined to the Western population. This omission highlights the requirement for culturally cognizant research in non-Western contexts where the influence of gnarled childhood psychopathology might express itself differently in family-building behavior.

2.5 The Influence of Social Media and Advertising on the Enhancement of Reproductive Desires

The other rising area of interest in family planning literature deals with the role of media (particularly social media) in shaping childbearing desires among individuals. Nelson-Coffey et al. (2022) found that situational cues, such as positive portrayals of parenthood on social media, can drive reproductive intentions. This, however, remains an underexplored area in the context of the Philippines and Southeast Asia. This study tries to fill that gap by investigating how social perceptions, influenced by online platforms, combined with economic and cultural factors to influence childbearing choices among young adults.

To further enhance this discussion, Riitsalu et al. (2023) clarify the various aspects that encompass the notion of financial well-being for a range of age groups. Their findings shed light on the priorities and viewpoints of different generations concerning financial stability. The terms "maintaining current living standards," "realizing aspirational lifestyles," and "achieving eventual economic independence" are commonly used by younger people to describe financial well-being. On the other hand, She et al. (2022) found that young adults' lower financial well-being cannot be entirely explained by their lower income and net wealth; instead, efforts should be directed toward examining other age-specific factors, such as their increased financial burden due to their lack of experience and knowledge in managing money, their tendency to buy impulsively due to consumerism, their improper use of credit cards, and the high cost of education. The findings highlight the crucial role that these socioeconomic factors play and urge practitioners to investigate the root causes that underlie them as well as in improving present and future financial well-being.

This present study attempts to fill this gap by examining how a feeling of well-being, in a non-Western context, may moderate—even override—the perceived need for financial security to start a family. Considering that economic concerns are also thought to be central, the results of this research will point out how irrelevant financial security is when compared to the cultural drivers in the quality of life. This can open a whole new perspective on a research investigation that considers both the material and non-material factors in reproductive decisions, particularly in a culturally bound atmosphere such as in the Philippines. This paper takes off by underlining these knowledge gaps and an emerging debate to frame an understanding of the complex relationship between cultural well-being, financial security, and family planning aspirations. This study would transcend economic reductionism by acknowledging the relevance of cultural and psychological factors to reproductive

choices. By doing so, it responds to a critical gap in the discourses on family planning at both the global and local levels and provides insights relevant to other socio-economically similar contexts across Southeast Asia.

In conclusion, young adults envision and have their own basis on the aspect of family aspirations. There is still a gradual decline in birth rates in the Philippine context and various contributing factors such as experienced parental styles and dynamics, parental status, reproductive planning, financial stability, and personal reasons. Socioeconomic factors do play a pivotal role in the desire of individuals to have children and young adults need to make critical decisions as well as be prepared mentally and financially for them to establish their own family.

3. Materials and Methods

Participants

A total of 317 participants, aged 18 to 26, were recruited through purposive sampling, specifically targeting young adults who are single and without children. This sample size's dataset allows researchers to examine the complex relationship between "Ginhawa", financial stability, and the desire to have children. This approach ensured that the participants were relevant to the study's objective of understanding family planning intentions. However, while purposive sampling was effective for this specific focus, it introduces limitations in generalizability, as it may only partially represent the broader population of young adults.

Procedure

Upon the completion of data gathering approval from the research adviser, the researcher began with the data collection. Data collection began with posting publication material on social media to persuade the possible participants in the study. In this way, a broader scope attracted more participants to answer the survey questionnaires. Included in the publication material is the relevant information regarding the study, and the criteria for eligible participants. The researcher used Google Forms as a tool to answer the survey questions. Included in the Forms are informed consent, the data privacy act, the demographics of the participants, and the questionnaires/research instruments for the study.

In selecting the target population, the researcher utilized purposive sampling. According to Nikolopoulou (2022), purposive sampling refers to a group of non-probability sampling techniques in which units are selected because they have characteristics that the researcher needs in their sample. This sampling technique depends on the researcher's criteria/judgment to determine which people, situations, or events will yield the most information to meet the goals of the study. Consequently, in using purposive sampling, the limitations include limiting the generalizability and reliability of study findings by preventing the data from being extended to a larger population whereas potential biases and other errors in the sampling process may also arise because there can be too few or too many participants from the population. Along with that, to conform to perceived expectations, participants may intentionally or inadvertently alter their answers, which could skew the authenticity and correctness of the

data gathered (Voxco, n.d.). The target number of participants is 300 to ensure a 95% confidence interval and a 5% margin of error for the validity and reliability of the results.

After data collection, the researchers ensured that the personal data collected were kept private and secured in the discussion part of the paper. Besides, the data gathered from the Google forms are deleted after the analysis. This will satisfy the ethical standards of research promoting informed consent, confidentiality, and respect for participants.

Research Instrument

Three scales were used to investigate the research questions. The Desire to Have a Family Scale (Rholes et al., 1997) measures the extent to which an individual expresses their desire to have children. The CFPB Financial Well-Being Scale developed by the Consumer Financial Protection Bureau (2015) evaluates an individual's financial well-being, financial stability, and ability to manage financial obligations. Lastly, the "Ginhawa" Scale measures the level of "Ginhawa" (quality of life) particularly, the "Ginhawang Panloob" (happens within the individual) and "Ginhawang Panlabas" (relationship to others) of an Individual.

Analysis technique

Data cleaning is the first stage after data collection, during which the dataset is examined to find and fix any errors, outliers, or missing values. The measures used in the study are then subjected to reliability testing using JASP, a software program used to conduct statistical analyses and which, for this study, uses methods like Cronbach's alpha to evaluate internal consistency. Determining reliability strengthens the validity of the study's conclusions by ensuring that the measures used are reliable and consistent. Following validation, mediation analysis was applied to examine the relationships between "Ginhawa," financial well-being, and young adults' desire to have children. In addition, mediation analysis was used because it involves three variables and describes several possible forms of interrelationship from causal hypotheses. With that, it was chosen to explore whether financial well-being mediates the effect of "Ginhawa" on the desire to have children and explains how external events take on the internal psychological significance of the participants of the study. This method helps determine if financial well-being serves as a significant factor explaining how "Ginhawa" influences family planning intentions. Using the JASP software, the mediation analysis was conducted in three steps: testing the direct effect of "Ginhawa" on the desire to have children, introducing financial well-being as a potential mediator, and analyzing the total effect, which includes both direct and indirect effects.

By applying mediation analysis, this study offers a comprehensive view of how well-being and financial factors interplay in shaping family planning decisions, contributing to a deeper understanding of the cultural and economic influences on young adults' aspirations to have children.

Reliability Test

To ensure the reliability of the scales utilized in this study, the researchers ran each of the questionnaires on the JASP Application, obtaining the Cronbach Alpha (α) result and confirming that each of them is valid and reliable for data collection.

Table 1: "Ginhawa" Reliability Scale

	Cronbach's α
scale	0.739

[3]

Table 1 presents the reliability coefficient for the "Ginhawa" Scale, which is used to measure life satisfaction and well-being. The Cronbach's alpha for this scale is 0.739, indicating acceptable internal consistency and reliability for the data collected. A reliable scale ensures that the responses accurately capture the construct of "Ginhawa" without random error, which is crucial for assessing its role as a predictor in family planning intentions.

Table 2: Financial Well-Being Reliability Scale

	Cronbach's α
scale	0.061

[3]

Table 2 shows the reliability coefficient for the CFPB Financial Well-Being Scale, which assesses participants' financial stability and ability to manage financial obligations. The Cronbach's alpha score for this scale is 0.061, which falls below the typical threshold for acceptable reliability. This lower reliability score indicates some limitations in measuring financial well-being consistently within this study. Despite this limitation, the Financial Well-Being Scale provides useful, despite limited insights into participants' financial status, and this measure is still included in the mediation analysis.

ISSN Online: 3021-9604

Table 3: Desire to Have a Children Reliability Scale

	Cronbach's α
scale	0.748

[3]

Table 3 displays the reliability coefficient for the Desire to Have Children Scale, which measures participants' intention and desire to start a family. The Cronbach's alpha for this scale is 0.748, indicating a moderate level of internal consistency. This reliability score suggests that the scale is a reliable tool for assessing family planning intentions in the context of this study.

4. Results and Discussion

Table 4. Direct Effects

Direct effects								
							95% Confidence Interval	
			Estimate	Std. Error	z-value	p	Lower	Upper
GINHAWA	-	DESIRE	0.224	0.109	2.062	0.039	0.011	0.437

Table 4 shows that "Ginhawa" and the desire to have children have a statistically significant relationship. The p-value of 0.039 suggests that young adults who feel a sense of "Ginhawa" are more likely to express a desire to have children. The relationship highlights how young adults' desires for family planning are shaped by their subjective well-being and contentment in life. The fact that the two variables were positively correlated suggests that improving "Ginhawa" might increase young adults' desire to begin a family.

This indicates that higher levels of life satisfaction and well-being, as captured by the concept of "Ginhawa", are positively associated with young adults' desire to start a family. This result supports previous literature, emphasizing the importance of emotional well-being and contentment when making family planning decisions (Hoffower, 2022; Grabmeier, 2023). It suggests that, for Filipino young adults, their sense of well-being plays a crucial role in shaping their decision to have children. The findings highlight that the role of "Ginhawa" on the

family aspirations of young adults is pivotal for their preparations and planning in having a family of their own wherein there is a potential to develop their understanding and capability of being parents in the future.

Table 5. Mediation Analysis

Mediation								
							95%Confidence Interval	
			Estimate	Std. Error	z-value	p	Lower	Upper
GINHAWA	SCORING	DESIRE	0.071	0.038	1.893	0.058	-0.003	0.145

Table 5 shows that financial well-being does not seem to be a statistically significant mediator in the relationship between "Ginhawa" and the desire to have children. The indirect effect between "Ginhawa", financial well-being, and the desire to have children has a p-value of 0.058. "Ginhawa" significantly predicts young adults' desire to have children. However, financial well-being is not a statistically significant mediator in this relationship.

While prior research (Rackin & Gibson-Davis, 2017) has highlighted financial stability as a key determinant of family planning, the results of this study suggest that in the Filipino context, well-being, as represented by "Ginhawa," may take precedence over financial considerations. One possible explanation for this finding is that "Ginhawa," deeply rooted in Filipino culture, represents a holistic sense of life satisfaction that transcends financial factors. In a collectivist society like the Philippines, where family ties, emotional support, and communal values are emphasized, financial well-being may not carry the same weight in family planning as it does in more individualistic societies. This result challenges the prevailing notion in much of the literature that financial stability is the primary driver of family planning decisions, especially in Western contexts (Lampic et al., 2005; Morin et al., 2003).

The non-significant mediation effect could be due to several reasons. First, it is possible that financial well-being, while important, is not as immediate a concern for Filipino young adults as their emotional well-being. This contrasts with Western societies where financial security is often seen as a prerequisite for starting a family (Hoffower, 2022). Second, it is important to consider that financial well-being is a multifaceted construct, and some aspects of financial stability (such as long-term financial planning or debt management) may not have been fully captured by the scale used in this study. Future research could explore more nuanced measures of financial well-being to better understand its role in family planning.

The study's conclusions emphasize how "Ginhawa" significantly influences young adults' desire to start a family and emphasize the significance of well-being in family planning decisions. The findings show that financial stability does not significantly influence this relationship, despite the expectation that it would. This implies that when choosing to become parents, many young adults prioritize their general sense of contentment and well-being over financial reasons. In the Filipino setting, where cultural norms like "Ginhawa" are strongly embedded, this study adds to the expanding body of work that highlights the psychological and emotional variables that impact family planning.

This study does, however, also highlight some areas for further research. The lack of a strong mediating influence on financial well-being raises the possibility that young adults view other facets of their lives, such as relationships, work stability, or mental health, as more important when making plans for children. Future research could go deeper into these elements and examine the potential effects of various socioeconomic or cultural contexts on the connection between family planning and well-being. From a policy perspective, the results indicate that family planning programs should prioritize improving people's general well-being in addition to financial readiness. As part of more comprehensive family planning techniques, programs should include mental health support, counseling, and teaching about well-being. Policymakers should better assist young adults in making decisions about starting a family by addressing emotional and psychological aspects.

The results of the study have practical implications for students. It implied that young adults who feel a sense of "Ginhawa" are predicted to express a desire to have children. Based on the findings, it is possible that having a healthy mental well-being will be an opportunity for young adults in the future to be good and nurturing parents, as well as have the capability and preparedness to have children. Moreover, before being a parent, one should be mentally prepared and sufficiently knowledgeable about the ways of being a parent.

Conflicts of Interest:

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

Bautista, K. J. (2022). More and more Filipinos are choosing to go child-free and it's pretty clear why. *Esquire Philippines.* https://www.esquiremag.ph/long-reads/notes-and-essays/younger-filipinos-are-choosing-to-go-child-free-a2836-20221103-lfrm

Bernardo, A., & Resurreccion, K. (2018). Financial stress and well-being of Filipino students: The moderating role of external locus-of-hope. *Philippine Journal of Psychology, 51*(1), 1-23.

https://doi.org/10.31710/pjp/0051.01.03

Consumer Financial Protection Bureau. (2015). *Measuring financial well-being: A guide to using the CFPB financial well-being scale.* https://files.consumerfinance.gov/f/201512_cfpb_financial-well-being-user-guide-scale.pdf

Del Monte, P. (2022). More Filipino women are delaying motherhood – here's why. *CNN Philippines.* https://www.cnnphilippines.com/life/culture/2022/11/4/women-delaying-motherhood.html

Grabmeier, J. (2023). Falling birth rate not due to less desire to have children. *Ohio State News.* https://news.osu.edu/falling-birth-rate-not-due-to-less-desire-to-have-children/

India, F. (2023, July 29). Why doesn't Gen Z want children? *UnHerd.* https://unherd.com/thepost/why-doesnt-gen-z-want-children/

Hanns Seidel Foundation. (2022, January 19). Experts analyze the Philippine's declining population growth rate in RTD. *Hanns-Seidel-Stiftung.* https://southeastasia.hss.de/news/detail/experts-analyse-the-philippines-declining-population-growth-rate-in-rtd-news8418/

Hoffower, H. (2022). 5 reasons more millennials are choosing not to have children. *Business Insider.* https://www.businessinsider.com/why-millennials-birth-fertility-rate-declining-fewer-babies-2022-1

Lampic, C., Svanberg, A., Karlström, P., & Tydén, T. (2006). Fertility awareness, intentions concerning childbearing, and attitudes towards parenthood among female and male academics. *Human Reproduction, 21*(3), 558-564. https://doi.org/10.1093/humrep/dei361

Lee, J., Kim, S., Youn, H., & Lee, S. I. (2021). Childhood emotional abuse is associated with the desire to get married and have children in Korean young adults. *Psychiatry Investigation, 18*(11), 1117-1124. https://doi.org/10.30773/PI.2021.0211

Morin, P., Payette, H., Moos, M., St-Cyr-Tribble, D., Niyonsenga, T., & De Wals, P. (2003). Measuring the intensity of pregnancy planning effort. *Pediatric and Perinatal Epidemiology, 17*(2), 97-105.

National Economic and Development Authority (2015). *AmBisyon Natin 2040*. https://2040.neda.gov.ph/about-ambisyon-natin-2040/

Nelson-Coffey, S. K., & Cavanaugh, L. A. (2022). Baby fever: Situational cues shift the desire to have children via empathic emotions. *Journal of Experimental Psychology: Applied, 28*(2), 438–450. https://doi.org/10.1037/xap0000381

Nikolopoulou, K. (2022). What is purposive sampling? | Definition & examples. *Scribbr.* https://www.scribbr.com/methodology/purposive-sampling/

Riitsalu, L., Sulg, R., Lindal, H., Marvi Remmik, & Vain, K. (2023). From security to freedom: The meaning of financial well-being changes with age. *Journal of Family and Economic Issues.* https://doi.org/10.1007/s10834-023-09886-z

Parker, R., & Alexander, M. (2004). Factors influencing men's and women's decisions about having children. *Family Matters, 24*, 32-41.

Philippine News Agency. (2021, October 10). PH birth rate drop amid pandemic lowest in 34 years. *Philippine News Agency.* https://www.pna.gov.ph/articles/1156192

Rackin, H. M., & Gibson-Davis, C. (2017). Low-income childless young adults' marriage and fertility frameworks. *Journal of Marriage and Family, 79*(4), 1096–1110. https://doi.org/10.1111/jomf.12405

Rholes, W. R., Simpson, J. A., Blakely, B. S., Lanigan, L., & Allen, E. A. (1997). Adult attachment styles, the desire to have children, and working models of parenthood. *Journal of Personality, 65*(2), 357-385.

Statistics Sweden. (2001). Why so few babies? [In Swedish]. *Demographic Reports, 2001*(1).

She, L., Waheed, H., Lim, W. M., & E-Vahdati, S. (2023, December 2). Young adults' financial well-being: Current insights and future directions. *International Journal of Bank Marketing, 41*(2), 333-368. https://doi.org/10.1108/IJBM-04-2022-0147

The 17 goals | Sustainable development. (2015). *United Nations.* https://sdgs.un.org/goals

Voxco (n.d.). Purposive Sampling: Advantages & Disadvantages in Research. https://www.voxco.com/blog/purposive-sampling/

Institute of Socioeconomic Research and Development

ISSN Online: 3021-9604

The Instant Food Revolution: Exploring Modern Consumer Buying Patterns

Dr. Anu P. Mathew[1*] *& Fr. Dinoy Mathew* [2]

[1]Assistant Professor in Commerce, Deva Matha College, Kuravilangad, Kottayam, Kerala

[2]Assistant Professor in Commerce, Deva Matha College, Kuravilangad, Kottayam, Kerala

*Corresponding Email: anu.mathew@devamatha.ac.in

Citation: Mathew, A. P., & Mathew, Fr. D. (2024). The Instant Food Revolution: Exploring Modern Consumer Buying Patterns. *International Socioeconomic Review*, *2*(1), 17–32. www.isrd.org.np

Received: August 16, 2024

Revised: November 07, 2024

Accepted: December 03, 2024

Published: December 24, 2024

Abstract

Aims: *This research explores the evolving consumer purchasing behavior towards instant food products, focusing on the Central Kerala region. The study investigates the impact of demographic factors on consumer perceptions, the influence of instant food products, and the role of gender, income, and occupation in shaping purchasing decisions. Additionally, it examines consumer awareness of potential health risks associated with instant food consumption.*

Methodology: *Employing a descriptive and analytical research design, data were gathered from 240 respondents in Central Kerala, using a structured questionnaire and analyzed through statistical tools like SPSS, MS Excel, and various inferential tests, including the Kruskal-Wallis H Test, Mann-Whitney U Test, and Pearson Correlation.*

Results: *Findings reveal that convenience, taste, and time-saving benefits are primary drivers of instant food consumption, especially among urban residents and working professionals. Advertising, peer recommendations, and personal preferences significantly influence purchasing behavior. However, a notable concern for health risks associated with processed foods, such as obesity, diabetes, and heart disease, is emerging among consumers. This health consciousness is reshaping consumer choices, prompting a demand for healthier instant food options.*

Implications: *The study concludes that while convenience and taste remain pivotal, there is a clear shift towards health-conscious decision-making among consumers. This presents a critical opportunity for businesses and policymakers to offer healthier alternatives and promote nutritional awareness.*

Keywords: *Instant food products, consumer behavior, convenience, health consciousness, advertising influence*

JEL Classification: D12, I12, M31, L66

1. Introduction

Food is a fundamental necessity for human survival, providing essential nutrients required for growth, tissue repair, maintenance, and regulating vital bodily functions (Brown, 2000). It serves as a primary source of energy and strength, consumed daily in various forms such as fruits, vegetables, grains, and cereals. A balanced diet, composed of a variety of foods, ensures that the body receives the necessary nutrients (Kamalaveni, 1996). In today's fast-paced world, convenience is paramount, leading to the rise of "instant foods" – a category of food that is simple, quick to prepare, and designed to be both hygienic and free from microbial contamination (Sundaram, 2012). These foods cater to the modern consumer's need for convenience, offering ready-to-eat options that require minimal preparation. The popularity of instant foods is attributed to the shift in lifestyle patterns, particularly in urban settings, where quick and convenient meal solutions have become essential (Ramasamy, 2005).

Instant food products encompass a wide range, including canned, frozen, dried, and preserved foods. This sector has seen significant growth, particularly in India, where Western influences and urbanization have altered traditional food consumption patterns (Sheeja, 1998). The demand for such products has grown substantially, with both catering industries and households increasingly relying on these ready-to-eat options. As more families in urban India adopt double-income lifestyles, the ready-to-eat food market has become a focal point for businesses aiming to cater to this demographic shift (Indumathi, 2007).

The consumption of instant food products has been steadily increasing as people become busier with their daily lives and have less time to dedicate to cooking. As lifestyles shift and nuclear families become more common, consumers are increasingly turning to packaged foods for convenience. The rise in dual-income families is also driving the demand for instant food products (Chinnaiyan, 2003). Analyzing consumer behavior towards food is

critical, as it represents a significant portion of household expenditures and reflects broader lifestyle changes and spending patterns. Consumers are shifting from a cost-conscious mindset to one that is more health-conscious and value-oriented (Brown, 2000).

Despite the growing importance of prepared foods, research into consumer behavior related to instant food products remains limited. This study aims to address this gap by exploring consumer perceptions and behaviors regarding prepared foods. The central research question focuses on understanding the perceptions, purchasing behavior, and health concerns associated with instant food products. Hence, the study seeks to explore consumer behavior concerning instant food products, focusing on factors such as purchasing frequency, consumer awareness, and the drivers behind these buying decisions (Inbalakshmi, 2014).

1.1 Research Objectives

The objectives of the research study are outlined as under:

1. To study demographic factors' effect on the perception of instant food products.
2. To find out the Influence of instant food products on consumers.
3. To analyze the effect of gender, income, and occupation on purchasing behavior of instant food products.
4. To understand the awareness regarding health issues by using instant food products.

2. Literature Review

Several studies have investigated the factors influencing consumer behavior towards instant food products. Kamalaveni (1996) found a significant alignment between the preferences of housewives and working women when it came to the factors driving their purchases of instant food products with age, occupation, education, family size, and income influencing per capita expenditure. Television advertisements emerged as a critical source of information for consumers, significantly impacting their buying behavior, as noted by (Ramasamy, 2005). With the proliferation of social media platforms, influencers, and targeted digital ads, however, the role of traditional television advertising must be reconsidered. Modern consumers increasingly rely on social media for product discovery and validation. According to Shabir et al. (2019), digital influencers and targeted advertising on platforms like Instagram and YouTube now play a significant role in consumer decision-making, especially among younger demographics who are drawn to instant food products for their convenience. Research by Dehghani and Tumer

(2015) showed that social media engagement has become a crucial factor in influencing consumer decisions, providing a more interactive and personalized way to shape purchasing behavior compared to traditional media.

The importance of advertising in influencing consumer perceptions and driving awareness was echoed by (Kumar, 2007), who emphasized that in the case of non-durable products like masala powders, advertising heavily influenced purchasing behavior by enhancing brand awareness and promoting product quality. However, the study did not account for the rise of digital marketing and the increasingly personalized nature of content delivery. Chaffey and Ellis-Chadwick (2019) argue that the shift towards personalized marketing and AI-driven advertising has fundamentally changed how brands engage with consumers. Recent research, such as that by De Vries et al. (2017) has also pointed out that online reviews, user-generated content, and social media conversations now significantly impact brand perception, suggesting the need for updated studies on consumer behavior towards instant food products in a digital-first world.

In terms of rural consumer preferences, (Chinnaiyan, 2003) explored soft drink brand awareness in rural Tamil Nadu, where factors like word-of-mouth marketing and family recommendations were key drivers. Yet, digital technology's penetration in rural areas has significantly increased, changing how rural consumers access information. A study by (Sheth, 2021) found that mobile internet usage in rural areas has transformed consumer behavior, with e-commerce platforms offering new product options and enhancing brand reach. This shift highlights the need to reexamine rural consumer behavior in the context of increased digital access and its impact on product choices, including instant food products.

Using Garrett's ranking technique, Hemameena (2006) identified product quality and retail price as the top factors influencing rural consumer preferences for soft drinks. This was supported by (Indumathi, 2007), whose study highlighted that women's occupations, family income, and the need to save time while cooking were key drivers of purchasing behavior for spicy products. Health consciousness has become a major focus in contemporary consumer behavior studies. Sundaram (2012) examined health-conscious consumers in Southern India, noting that ingredients, brand awareness, and packaging were key factors. However, more recent research suggests that health-conscious consumers are now prioritizing organic, sustainable, and clean-label products, driven by concerns over food safety and environmental impact. Yadav and Pathak (2016) found that consumer awareness about

health and environmental sustainability is rapidly increasing, leading to higher demand for healthier instant food alternatives that minimize artificial additives.

In addition, the role of digital platforms in shaping health awareness has expanded. A study by Pantano et al. (2020) demonstrated that health-related digital content, including nutritional blogs, apps, and influencers, has significantly impacted how consumers evaluate food products. This reflects a modern shift in consumer behavior, as individuals now have immediate access to health-related information, influencing their purchasing decisions for instant food products based on convenience, nutrition, and health.

3. Methodology

The study employed a descriptive and analytical research design to explore consumer behavior towards instant food products. The target population consisted of consumers of instant food products in Central Kerala, and data was collected from a sample of 240 respondents using the Convenience Sampling method. The sampling method was chosen for its practicality and effectiveness in capturing relevant data from a broad section of consumers in a time-efficient manner. This method allowed the researchers to swiftly gather responses from individuals who are readily accessible and actively engaged with instant food products, especially through online platforms like Google Forms. By leveraging this approach, the study could focus on gaining quick, initial insights into emerging trends in consumer behavior, making it a valuable tool for exploratory research. While convenience sampling does not fully ensure the randomness of the sample, its flexibility and ease of implementation provide an efficient starting point for understanding consumer behavior. While the primary data was obtained through a structured questionnaire circulated via Google Forms, secondary data was gathered from various sources, including websites, academic studies, government publications, and relevant articles.

To analyze the collected data, a combination of statistical tools and software were employed, including SPSS, MS Excel, and MS Word. Descriptive statistics such as percentages, mean, and standard deviation were used to summarize the data. Cronbach's Alpha was applied to assess the reliability of the data. Inferential statistical tests, including the Kruskal-Wallis H Test, Mann-Whitney U Test, and Pearson Product-Moment Correlation Coefficient, were utilized to explore relationships between variables.

a. Demographic Composition of the Respondents

The demographic profile of the 240 respondents in the study reveals notable trends. Most respondents (85.6%) fall within the age group of 19-30, followed by 11.1% in the 31-60 age group, and 3.3% under 18 years of age. Regarding occupation, nearly half of the respondents (48.9%) are students, 32.2% are private employees, 7.8% are homemakers, 6.7% are professionals, and 4.1% are business owners. The gender distribution shows that females constitute 64.1% of the respondents, while males account for 35.6%. Income levels also varied, with 46.7% of respondents being students with no monthly income, while 26.7% reported incomes below ₹20,000, and 21.1% in the ₹20,001-₹40,000 range. Only 3.33% earn above ₹80,000, and a small percentage (1.11%) fall in the ₹40,001-₹60,000 and ₹60,001-₹80,000 brackets. Geographically, 56.7% of respondents reside in rural areas, while 43.3% are from urban areas. The most common source of information about instant food products was the Internet (29.4%), followed by advertisements (23.2%), family and friends (18.1%), television (16.9%), newspapers (8%), and other media sources (4.1%).

4. Results and Discussions

4.1 Effect of demographic factors on the perception of instant food products

4.1.1 Perception of Instant Food Products across Age Categories

- H0: There is no significant difference in the mean ranks of Perception on instant food products across Age categories.
- H1: There is a significant difference in the mean ranks of Perception on instant food products across Age categories.

Table 4.1.1: **Kruskal-Wallis H Test**

	Perception
Chi-Square	**1.000**
Df	**2**
Asymp. Sig.	**.607**

a. Kruskal Wallis Test

b. Grouping Variable: Age

The Kruskal-Wallis H test revealed no statistically significant relation in mean rank perception on instant food products among different age categories ($\chi 2 = 1.00$, $p = 0.6070 > 0.05$), with the age below 18, age group of 19-30, and 31-60. Therefore, the null hypothesis failed to be rejected. The lack of a significant relationship between the age group of respondents and their perception of instant food products suggests that preferences for convenience foods might be more universally accepted across different age ranges than previously thought. In the context of Central Kerala, this could imply a broader cultural shift where traditional demographic boundaries around food consumption are becoming less relevant, possibly due to the widespread availability and marketing of such products across all age groups.

4.1.2 Perception of instant food products across Occupation categories

- H0: There is no significant difference in the mean ranks of Perception on instant food products across Occupation categories.
- H1: There is a significant difference in the mean ranks of Perception on instant food products across Occupation categories.

Table 4.1.2: **Kruskal-Wallis H Test**

	Perception
Chi-Square	7.641 4
Df	
Asymp. Sig.	.106

a. Kruskal Wallis Test
b. Grouping Variable: Occupation

The Kruskal-Wallis H test revealed no statistically significant difference in mean ranks of perception on instant food products among different occupation categories ($\chi 2 = 7.641$, $p = 0.106 > 0.05$) of students, professionals, private employees, homemakers, and own businesses. Therefore, the null hypothesis failed to be rejected. The absence of a significant link between occupation and consumer perceptions of instant food products suggests that

professional identity does not play a major role in shaping attitudes toward these products. In Central Kerala, where even rural populations have growing exposure to media and urban lifestyles, this homogeneity in perception might reflect a more pervasive shift in eating habits, independent of occupation.

4.1.3 Perception of instant food products among male and female consumers

- HO: There is no significant difference in the mean ranks of Perception of instant food products among male and female consumers.
- H1: There is a significant difference in the mean ranks of Perception of instant food products among male and female consumers.

Table 4.1.3: Mann-Whitney U Test

	Perception
Mann-Whitney U	890.500
Wilcoxon W	2601.500
Z	-.317
Asymp. Sig. (2tailed)	**.751**

a. Grouping Variable: Gender

Mann-Whitney U Test studied the difference in mean rank of perception and gender and showed that there is no statistically significant difference (U=890.500, p=0.751) among males and females. The gender-based analysis also reveals no significant difference in the perception or purchasing behavior related to instant food products.

4.2 Influence of instant food products on consumers

4.2.1 Influence of instant food products across gender

H0: There is no significant difference in the mean ranks of Influence of instant food products and the gender of respondents.

H1: There is a significant difference in the mean ranks of Influence of instant food products and the gender of respondents.

Table 4.2.1: Mann-Whitney Test

	Influence
Mann-Whitney U	830.000
Wilcoxon W	2541.000
Z	-.830
Asymp. Sig. (2tailed)	**.407**

a. Grouping Variable: Gender

Mann-Whitney U Test studied the difference in mean rank of influence of instant food products and gender and showed that there is no statistically significant difference (U=830, p=0.407) among males and females. The results of this study suggest that, in Central Kerala, both men and women may be equally influenced by the convenience and marketing of instant foods, possibly indicating an evolving dynamic where traditional gender roles related to food are less pronounced.

4.2.2 Influence of instant food products based on the level of usage

- H0: There is no significant difference in the mean ranks of Influence of instant food products based on level of usage.
- H1: There is a significant difference in the mean ranks of Influence of instant food products based on level of usage.

Table 4.2.2: Kruskal-Wallis Test

	Influence
Chi-Square	.780
Df	4
Asymp. Sig.	**.941**

a. Kruskal Wallis Test

b. Grouping Variable: How often do you prefer instant food products

The Kruskal-Wallis H test revealed no statistically significant difference in mean ranks of Influence among different levels of usage ($\chi 2 = 0.780$, $p = 0.941 > 0.05$), with the usage in several times in a day, once a day, several times a week, once a week and at least once a month. The failure to reject the null hypothesis implies that the level of usage does not have a notable impact on the overall perception or influence of instant food products in this sample. These findings challenge the assumption that heavier or more frequent consumers of instant food would exhibit a stronger inclination toward or dependency on these products. Instead, the results suggest a more uniform pattern of influence, potentially driven by factors other than mere consumption frequency, such as convenience, taste preferences, or external influences like advertising.

4.3 Effect of Gender, income and Occupation on the Purchasing behavior of instant food products

4.3.1 Purchasing behavior of instant food products across different income categories

- H0: There is no statistically significant difference in the mean ranks of purchasing behavior of different income categories of consumers.
- H1: There is a statistically significant difference in the mean ranks of purchasing behavior of different income categories of consumers.

Table 4.3.1: Kruskal-Wallis Test

	purchasing behaviour
Chi-Square	8.580
Df	5
Asymp. Sig.	.127

a. Kruskal Wallis Test

b. Grouping Variable: monthly income

The Kruskal-Wallis H test revealed no statistically significant relation in mean ranks of purchasing behavior among different income categories ($\chi 2 = 8.580$, $p = 0.127 > 0.05$), with the income group below 20000, income group of 20001-40000, income group of 40001-60000, income group of 60001-80000, income above 80001 and in case of not applicable. Therefore, the null hypothesis failed to be rejected showing that Income

levels have no significant impact on the purchasing behavior of instant food products. Instant food products are consumed across different income brackets, potentially because they are viewed as affordable by a wide range of consumers or because they are perceived as a quick solution to the time demands of modern life. This finding is particularly relevant in a region like Central Kerala, where the middle and lower-income groups constitute a significant portion of the population, and instant food products might be perceived as cost-effective and accessible.

4.3.2 Relation between Purchasing behavior of instant food products and Gender of buyers

- H0: There is no relation between gender and purchasing behavior of instant food product buyers.
- H1: There is a relation between gender and purchasing behavior of instant food product buyers.

Table 4.3.2: Correlation

		Gender	**Purchasing behaviour**
Gender	Pearson Correlation	1	.071
	Sig. (2-tailed)		.509
	N	240	240
Purchasing behaviour	Pearson Correlation	.071	1
	Sig. (2-tailed)	.509	
	N	**240**	**240**

The analysis reveals no statistically significant correlation between the purchasing behavior of instant food products and the gender of the respondents. With a correlation coefficient ($r = 0.071$, $p = 0.509 > 0.05$), it is evident that gender does not play a role in shaping purchasing patterns for instant foods in this study. The finding challenges common assumptions that gender significantly influences food choices, particularly in contexts where women are traditionally considered more health-conscious or inclined toward certain food products. In the context of Central Kerala, this result might suggest that instant food products are widely accepted and consumed by both genders, driven by convenience and lifestyle factors that transcend traditional gender roles.

4.3.3 Purchasing behavior of instant food products across different occupation categories

- H0: There is no statistically significant difference in the mean ranks of purchasing behavior of consumers across different occupation categories.
- H1: There is a statistically significant difference in the mean ranks of purchasing behavior of consumers across different occupation categories.

Table 4.3.3: Kruskal-Wallis Test

	Purchasing behaviour
Chi- Square	3.089
Df	4
Asym p. Sig.	.543

a. Kruskal Wallis Test

b. Grouping Variable: Occupation

The Kruskal-Wallis H test indicates no statistically significant difference in purchasing behavior among respondents from different occupational categories, including students, professionals, private employees, homemakers, and business owners ($\chi2 = 3.089$, $p = 0.543 > 0.05$). This lack of significant variance in purchasing behavior across occupations suggests that instant food products are equally appealing to individuals regardless of their professional identity.

4.4 Awareness regarding health issues by using instant food products

4.4.1 Awareness regarding health issues of instant food products among male and female consumers

•H0: There is no significant difference in the mean ranks of awareness about health issues of instant food products among male and female consumers.

•H1: There is a significant difference in the mean ranks of awareness about health issues of instant food products among male and female consumers.

Table 4.4.1: **Mann-Whitney Test**

	health problem
Mann-Whitney U	890.500
Wilcoxon W	1418.500
Z	-.319
Asymp. Sig. (2-tailed)	.750

a. Grouping Variable: Gender

Mann-Whitney U Test studied the difference in mean rank of health problems and gender showed that there is no statistically significant difference (U=890.500, p=0.75) among males and females. The rejection of the null hypothesis explains that there is no significant relation between gender and the awareness of health problems of respondents. In Central Kerala, increasing exposure to health-related information through various media channels may have equalized health awareness across genders, leading to a more uniform understanding of the potential health risks of consuming instant foods.

5. Conclusion

The study "The Instant Food Revolution: Exploring Modern Consumer Buying Patterns" reveals a nuanced and multifaceted landscape, shaped by various factors that drive decision-making. Central to this behavior is the perception of convenience, taste, and time-saving advantages, which have made instant food products increasingly popular among consumers. Influences such as advertising, peer recommendations, and personal preferences also significantly contribute to shaping purchasing decisions. However, the growing recognition of health concerns associated with processed foods has emerged as a critical factor in consumer choices.

The study highlights the substantial impact of various external influences on consumer choices. Advertising campaigns and promotional efforts wield significant power in shaping consumer behavior, while recommendations from family, friends, and peers also play an important role in determining preferences. Also, personal factors, including individual tastes and cultural preferences, contribute to the popularity of specific instant food products. One of the most striking findings is the rising concern over health implications linked to the consumption of processed and preservative-laden instant foods. While convenience remains a key driver, many consumers are becoming more aware of the potential health risks, including obesity, diabetes, and cardiovascular diseases,

associated with excessive consumption of such products. This growing awareness has prompted a segment of the population to reassess their choices and seek healthier alternatives.

Despite these insights, the study has several limitations. One limitation is the regional focus on Central Kerala, which may not fully capture variations in consumer behavior across different parts of India or in other cultural contexts. As the study relies on self-reported data, it may introduce biases such as social desirability or recall inaccuracies. Future research could expand the geographic scope to include a broader sample of consumers, allowing for cross-regional comparisons and a deeper exploration of how cultural and socio-economic factors influence instant food consumption. Longitudinal studies could also provide valuable insights into how consumer preferences evolve, particularly in response to shifts in public health campaigns or new product offerings.

Further research could also explore the role of sustainability and environmental consciousness in consumer decision-making. Investigating the potential for "eco-friendly" or "green" instant food products could open new avenues for both research and business strategies.

In conclusion, the study underscores the complex dynamics of consumer purchasing behavior toward instant food products, shaped by a combination of convenience, perception, external influences, and health considerations. While factors like ease of preparation and taste remain influential, there is a clear shift toward greater health consciousness among consumers. As Central Kerala continues to modernize, this presents an opportunity for businesses and policymakers to respond to these concerns by offering healthier instant food options and promoting nutritional education. Future research can build upon these findings by exploring diverse consumer contexts and the long-term impact of health trends on purchasing behavior. Striking the right balance between convenience and health will be key to shaping the future trajectory of instant food product consumption in the region

References

Amitha, K. (1998). *A study of household consumption pattern of selected dairy products in Bangalore city.* Bangalore: university of agricultural science in Bangalore.

Bahl, D. (2012, July). consumers' behaviour towards food retailing system. *Journal of economics and management*(4).

Brown, K., McIlveen, H., & Strugnell, C. (2000). Nutritional awareness and food preferences of young consumers. *Nutrition & Food Science*, Vol. 30 No. 5, pp. 230-235. https://doi.org/10.1108/00346650010340963

Chinnaiyan, R. N. (2003). Brand preference of soft drinks in rural Tamil Nadu. *Indian Journal of Marketing*, 1417.https://www.researchgate.net/publication/346439746_Brand_Perferences_of_Soft_Drinks_in_Rural_Tamil_Nadu

Chaffey, D., & Ellis-Chadwick, F. (2019). Digital marketing: Strategy, implementation and practice (7th ed.). Pearson.

De Vries, L., Gensler, S., & Leeflang, P. S. H. (2017). Effects of traditional advertising and social messages on brand-building metrics and customer acquisition. *Journal of Marketing*,81(5),1-15. https://doi.org/10.1509/jm.15.0178

Gluckman, R. L. (1986). A Consumer Approach to Branded Wines. *European Journal of Marketing*, 20(6), 21–35. doi:10.1108/eum0000000004649

Hemameena, S. B. (2006). Analysis of brand preference of soft drinks in the global environment. *Indian Journal of Marketing*, 12-16. https://www.semanticscholar.org/ paper/Analysis-of-Brand-Preference-of-Soft-drinks -in-the-Banumathy-Hemameena/ b74407704aab1485732b31b986cce95cd75ea03e

Indumathi, S. D. (2007, August). Consumers buying behavior of processed spice products. *Indian Journal of Marketing*, 52-55. https://doi.org/10.36713/epra2013

K Ramasamy, G. K. (2005). Consumers behaviour towards instant food products. *Indian journal of marketing*, 55-59. https://www.semanticscholar.org/paper/Consumer-Behaviour-towards-Instant-Food-Products-Ramasamy-Kalaivanan/f8028aec5fab91e 436e8729a28fbb6fedefed96f

Kamalareni, D., & Nirmala, M. (1996). Consumer behavior in instant food products. *Indian Journal of Marketing*, 12-8.

Kumar, R. R. (2007, April). An evaluation of television advertisement of masala powder in Pollachi. *Indian Journals of Marketing*,13-99.https://www.i-scholar.in/index.php/ ijom/article/view/200425

Inbalakshmi, K. G. (2014, June). A study on consumers' preference towards instant food products. *Thiagarajar school of management, 2*(1), 68-80.https://doi.org/10.23837/ tbr/2014/v2/n1/112859

Shabir, H., Hameed, Y., Safdar, G., & Gilani, S. R. (2019). The impact of social media marketing on consumer buying behavior: A case study of Lahore, Pakistan. *Journal of Business and Social Review in Emerging Economies*, 5(2), 233-244. https://doi.org/10.26710/jbsee.v5i2.618

Sheeja, A. (1998). An analysis of consumer buying behavior towards processed spices. Tamil Nadu Agricultural University, Coimbatore.

Sheth, J. N. (2021). New areas of research in rural marketing: Lessons from India. *Journal of Business Research*, 122, 699-706. https://doi.org/10.1016/j.jbusres.2020.07.036

Pantano, E., Pizzi, G., Scarpi, D., & Dennis, C. (2020). Competing during a pandemic? Retailers' ups and downs during the COVID-19 outbreak. *Journal of Business Research*, 116,209-213. https://doi.org/10.1016/j.jbusres.2020.05.036

Sundaram, M. V. (2012, june). A study on key determinants of ready-to-eat products with respect to tier 1 cities in southern India. *International journal of multidisciplinary research, 2*(6), 168-174.

Yadav, R., & Pathak, G. S. (2016). Intention to purchase organic food among young consumers: Evidence from a developing nation. *Appetite*, 96, 122-128.https://doi.org/10.1016/j.appet.2015.09.017

Institute of Socioeconomic Research and Development

ISSN Online: 3021-9604

Evaluation of Botanical Extracts for their efficacy against In-vitro growth of *Sclerotium rolfsii*

*Bharat Khadka

*Institute of Agriculture and Animal Science (IAAS), Tribhuvan University, Nepal

Corresponding Email: khadkabharat28@gmail.com

How to cite this paper: Khadka, B. (2024). Evaluation of Botanical Extracts for their efficacy against In-vitro growth of Sclerotium rolfsii. *International Socioeconomic Review*, *2*(1), 33–50. www.isrd.org.np

Received: August 23, 2024

Revised: October 21, 2024

Accepted: November 24, 2024

Published: December 24, 2024

Abstract

Sclerotium rolfsii is a necrotrophic, soil-borne plant pathogenic fungus associated with economically significant diseases causing mainly collar rot, southern blight, seedling blight, and stem rot on more than 500 plant species including almost all agronomical and horticultural crops. In contrast to chemical fungicides, plant extracts do not cause pollution and are easily biodegradable, therefore the current study focuses on the affordable, environmentally friendly, safe, and sustainable control of diseases through botanical extracts. An experiment was conducted at the Institute of Agriculture and Animal Science, Lamjung Campus, Plant Pathology Laboratory to ascertain the effectiveness of botanical extracts against this pathogen. Under the in-vitro study, five botanical extracts viz. Allium sativum, Zingiber officinale, Datura stramonium, Azadirachta indica, and Allium cepa were evaluated at three different concentrations (5%, 10%, and 15%) using the poisoned food technique in a Completely Randomized Design and each concentration was replicated three times. The purpose of the study was to assess their efficacy against the mycelial growth of S. rolfsii. The data were analyzed using R-software in R-studio and means were compared at a 5% significance level using Duncan's Multiple Range Test (DMRT). All tested chemicals reduced the pathogen's mycelial development compared to the control. Data on pathogen mycelial growth were collected after 24, 48, and 72 hours of incubation. After 72 hours, among all the tested botanicals, the pathogen's growth was significantly inhibited by 15% Allium sativum (growth inhibition of 80.9%) followed by 15% Azadirachta indica (74.8%), and by 15% Zingiber officinale (70.1%). Datura stramonium at 5% showed the least growth inhibition (12.1%) which was statistically at par with the effect of Allium cepa at 5% concentration (14.9%). Further research and field trials should be conducted to select appropriate concentrations of botanical extracts to control the disease pathogen economically and sustainably.

Keywords: Botanical extracts, Completely Randomized Design, Growth inhibition, Poisoned food technique

1.Introduction

Sclerotium rolfsii is a destructive soil-borne fungal pathogen with a necrotrophic lifestyle that, under conducive conditions, develops profuse white mycelium on infected plants and in culture (Mullen, 2000). It has a wide host range that includes more than 500 plant species of horticulture and agronomic crops (Okabe & Matsumoto, 2000). This pathogen is globally distributed, particularly in tropical, subtropical, and other warm-temperate regions (Aycock, 1966). Numerous symptoms, including seed rot, seedling blight, collar rot, damping-off, stem rot, wilt, crown and root rot, stem canker, and sclerotium blight, are brought on by the fungus in diverse host plants (Mullen, 2001; Arunasri, 2011). This disease causes significant economic losses due to its wide host range, prolific proliferation, and ability to create chronic sclerotia (Kokub et al., 2007). Mayee and Datar (1988) stated that these diseases usually result in yield losses of over 25%, and in extreme cases, this can be as high as 80%.

S. rolfsii is primarily characterized as a polyphagous, non-targeting, moisture-loving, ubiquitous facultative parasitic basidiomycetes fungus that produces oxalic acid, polygalacturonase, and cellulase as pathogenic components (Chen et al., 2020). White fungal mycelia can be visible on the soil around the plant at the base; a characteristic of *S. rolfsii* growth in infected plants. The pathogen's broad host range, rapid development, and propensity to produce persistent sclerotia all contribute to the pathogen's massive economic losses. In adequate organic matter, the pathogen persists successfully in the soil as sclerotia, even under unfavorable climate conditions (Kumar et al., 2018). The occurrence and severity of *S. rolfsii* have been found to increase when beans are grown in rotation with legumes, cucurbits, and other vegetable crops. The pathogen poses a significant management challenge since it can infect crops at different stages of growth.

From an economic standpoint, this pathogen is recognized as the most devastating and destructive to plants, with a wide range of hosts including cereal crops, and different vegetables such as tomatoes, chili, onions, and so on (Abang, 2003). *S. rolfsii* is thought to have caused losses of 10-20 million dollars worldwide, with field yields depleted by 1- 60% (Laiamnhee et al., 2015). Over the past five years, *Sclerotium rolfsii Sacc.* has become more severe in a variety of crops, including rice, onions, and chilies in Nepal. It typically affects legumeous and solanaceous crops (Adhikari et al., 2022). The following areas were infected by *S. rolfsii*: lentil, rajma, chickpea, and mustard in Lumbini and Sudur Paschim province since 2015 (NGLRP, 2015); rice in the Sunsari, Jhapa, Morang, and Udaypur districts during 2016/2017 (Annual Report, 2073); and onion in Dhading district during 2018/2019 (Annual Report, Kathmandu, 2018) and chili in Chitwan since 2015. In Nepal, this pathogen has been regarded as one of the serious in agricultural production, posing a serious threat to all producers.

The diseases caused by *S. rolfsii* can be managed using physical and cultural approaches, resistant cultivars, and chemical and biological control strategies (Vargas Gil et al., 2008). Effective strategies for managing the pathogen include various soil management techniques. Deep plowing reduces the viability of sclerotia or destroys the

pathogen's hyphae in the fields by burying infected tissues under 6–20 cm. Rotation with non-host crops increases the nutritional condition of the soil and may harm pathogen inoculum density. Furthermore, soil solarization is also one of the effective management strategies. Moreover, different fungicides are predominantly used for the control of the disease viz tebuconazole, carbendazim, pentachloronitrobenzene, and mancozeb. Mancozeb suppressed *S. rolfsii* in vitro by approximately 55%, 73%, and 83% at 500, 750, and 1000 ppm, respectively (Manu & Nagaraja, 2012). At 4 DAI, *S. rolfsii* growth inhibition was 100.00, 78.15, 75.64, 59.10, and 44.53% for Provax-200, Score 250 EC, Tilt 250 EC, Pencozeb 80 WP, and Rovral 50 WP, respectively (Rahman et al., 2020). These five fungicides were noted as highly effective. Besides chemical fungicides, biological controls have effectively managed multiple plant diseases based on their antagonistic nature (Sivan, 1987). Fungal biocontrol agents and *Trichoderma* species are well agent for controlling plant diseases caused by soilborne fungi (Prasad & Naik, 2008). *S. rolfsii* was successfully controlled by Trichoderma species in both in-vitro and in-vivo conditions (Singh et al., 1997). In the same way, it has been demonstrated that several organic plant products such as Alfalfa *(Medicago sativa)*, Basil *(Ocimum basilicium)*, Chamomile *(Matricaria chamomilla)*, Palmarosa *(Cymbopogon martini)*, and Thyme *(Thymus vulgaris)* (Sekhar et al., 2020) don't exhibit phytotoxicity and have systemic action, reduce pathogen activity, and monitor the spread of disease. Plant extracts can be employed as environmentally friendly substitutes, cost-effective, and crucial elements in integrated pathogen management (Perello et al., 2013). The reasonable integration of all these methods can provide the economic and sustainable management of *S. rolfsii*.

The antifungal properties of botanical extracts have been demonstrated against a variety of plant pathogenic fungi. They are biodegradable and free from environmental contamination and health hazards (Rahman, 2020). Different botanicals' antifungal potency varies due to variations in the active chemical makeup of the extracts (Shrestha & Tiwari, 2009). The medicinal and aromatic herbs contain antifungal and antioxidant properties that not only slow the spread of disease but also result in goods that are free of hazardous residue (Dalbeer, 2015; Pun et al., 2020). Numerous studies have highlighted the antifungal potential of botanical extracts against various fungal pathogens, including *S. rolfsii*. These botanical extracts were selected due to their diverse therapeutic value and potential anti-microbial properties. Garlic has a strong flavor and therapeutic value due to its high starch and aromatic component content. Diallyl sulphide, diallyl disulphide, diallyl trisulphide, allyl methyl trisulphide, dithiins, and ajoene are some of the antibacterial compounds which are obtained from the breakdown of allicin, a phytochemical found in garlic (Khan & Katiyar, 2000). In addition to allicin, Ajoene is a significant antifungal component in garlic that can harm fungi's cell walls (Yoshida et al., 1987) and inhibits the activity of certain enzymes necessary for fungal growth (Kutawa et al., 2018). The secondary metabolites of the Dhatura plant have a potent antimicrobial and antifungal effect (öz arık, 2017). Alkaloids, triterpenoids, steroids, flavonoi,ds, triterpenes, phenolic chemicals, and tannins are said to be responsible for the antibacterial characteristics of the Dhatura plant. *Datura*

sp. produces pharmacologically important alkaloids like hyoscyamine and scopolamine. The quantity of triterpenoids, peaks, and pure compounds (isomeldenin and nimonol) in Neem gives it antifungal properties. Neem organic extracts contain active components such as Quercetin, sitosterol, 6-deacetylnimbin, azadiradione, Nimbin, salannin, and epoxy-azadiradione, which have antifungal and antibacterial qualities (Govindachari et al., 1998). The onion's phytochemical components and total phenolic contents (quercetin and kaempferol) helped to effectively prevent fungal growth (Singh, 2017). The high content of antioxidants in onions and onion by-products makes them powerful scavengers of free radicals. As a result, it has anti-inflammatory and anti-mutagenic properties. Ginger possesses antibacterial, anti-inflammatory, and antioxidant properties. Over 400 distinct chemicals, including zingerone, shogaols, gingerols, sesquiterpenoid, and a minor monoterpenoid portion, are thought to be responsible for ginger's antibacterial activities (Pun et al., 2020). Additionally, ginger contains non-volatile pungent components and 1% to 3% volatile oils, oleoresin (Zick et al., 2008).

The heavy use of agrochemicals for disease control causes toxicity to non-target organisms, neurological effects, reproductive health effects, population development of resistant pathogens, and pollution in the environment (Ganie et al., 2013). This has prompted research into safe and economical substances that don't have any harmful effects on the general health of consumers or the environment (Nxumalo et al., 2021). Utilizing plant materials as innovative chemotherapeutic agents in plant protection has recently received interest in many parts of the world. Finding new plant protectants that can reduce fungal pathogenicity has become more important because of the emergence of resistance to conventional fungicides and tighter regulations on the use of hazardous compounds in the environment. Plant extracts are now utilized against numerous plant pathogenic fungi due to their antifungal properties, which have received a lot of attention (Swami et al., 2013).

Methodology

Experimental Site

The present study was conducted at the Central Plant Pathology Laboratory of the Institute of Agriculture and Animal Science (IAAS), Sundarbazar, Lamjung, in 2022, under strictly controlled conditions to prevent contamination. A pure culture of *Sclerotium rolfsii* was sourced from the Division of Plant Pathology, NARC, Khumaltar, Lalitpur, Nepal, and preserved at 4˚C in a refrigerator. The experiment followed a Completely Randomized Design (CRD) with six distinct treatments, as detailed in Table 1. Three concentrations (5%, 10%, and 15%) of five different plant extracts, excluding the control, were evaluated. Each concentration was tested in three replications. The details of the various treatments are as follows:

Table 1: Treatment details used in the experiment

Treatments Symbol	Botanical Extracts (Common Name)	Scientific Name	Plant parts used
T1	Dhatura	*Datura stramonium*	Leaves
T2	Garlic	*Allium sativum*	Bulb
T3	Ginger	*Zingiber officinale*	Rhizome
T4	Neem	*Azadirachta indica*	Leaf
T5	Onion	*Allium cepa*	Bulb
T6	Control (Distilled Water)		

General Laboratory Procedure

Equipment, Apparatus, and their sterilization

Test tubes, beakers, conical flasks, glass funnels, and petri plates were cleaned with a detergent solution under running water, rinsed with distilled water, and allowed to air dry. Following that, the glass wares were wrapped in aluminum foil and autoclaved for 20 minutes at 15 psi and 121ºC to sterilize it. The inoculation needle, inoculation loop, forceps, blades, and cork borer were all sterilized by heating them to a red-hot over the flame. The procedure was carried out two or three times. The laminar flow chamber was sterilized by activating UV light for fifteen minutes, and the base and wall of the chamber were cleaned using 70% ethanol.

Media Preparation

Potato Dextrose Agar (PDA), which contains 2% agar was used as the growth medium for *S. rolfsii*. PDA powder was mixed with 1000 ml of distilled water in a reagent bottle at a rate of 39 gm per 1000 ml, as directed, to provide the necessary number of media. The media was then autoclaved at 15 pressure, 121 ºC for 20 minutes to sterilize it, after which it was allowed to cool. When the media's temperature reached about 40 ºC, it was placed into sterile Petri plates in a laminar flow environment and allowed to solidify. After solidification, the media was infused with botanical extracts and used to inoculate the pathogen.

Preparation of Mother Culture

The mother culture was utilized for further multiplication and treatment purposes, prepared using pure culture, which was refrigerated. A small amount of mycelial thread was excised from the pure culture plate using a sterile

inoculation loop and transferred to a sterile Petri plate containing about 20 ml of sterile PDA media. Those mycelial inoculated Petri plates were called mother cultures which were incubated in an incubator at 27±2˚C for 3 days.

Preparation and In vitro evaluation of selected botanical extracts

The plant extract was prepared by following the guidelines used by Ul-Haq et al. (2014). The essential plant parts such as matured fresh leaves, bulbs, and rhizomes were collected, thoroughly cleansed with tap water, sterilized with distilled water, and then allowed to dry in the shade. Separately, the materials were pulverized in a mortar and pestle with sterilized distilled water (1:1 w/v). The mixture was filtered using a four-layered muslin cloth and boiled at 80 ºc for ten minutes in the hot water bath. After that, the extract was centrifuged for 5 minutes at 4000 rpm. Whatman's filter paper No. 1 was used to filter the supernatant. Thus, the resulting filtrate was regarded to have a concentration of 100 % and was taken as a basic stock solution. Streptomycin (0.25 g/l) was added in sterilized and cooled PDA (40 ºc) to check bacterial growth.

The pathogen was examined at three concentration levels in a comparative study: 5%, 10%, and 15% for the botanicals listed below. Three replications of each concentration were used in the completely randomized design (CRD) experiment, which was carried out using the poisoned food approach.

Food poisoning technique

The Poisoned Food Technique was used to evaluate botanical extracts in vitro against *Sclerotium rolfsii*. To make the necessary concentrations for food poisoning the determined amount of stock solution of botanical extracts was mixed with sterilized PDA (Potato Dextrose Agar) medium. Each sterilized Petri plate received 20 ml of adjusted or amended PDA, which was allowed to solidify. The control treatment was maintained where no amended medium was used. In the center of the solidified PDA plates, identical circular discs of mycelial growth from a 3-day-old culture of *Sclerotium rolfsii* were transferred aseptically using a sterilized cork borer. Three Petri plates were used to replicate each treatment. The Petri plates were then incubated for 3 days at 27±2 ºC.

Growth inhibition test

The measurements of mycelial growth were performed using a Vernier caliper in the 24, 48, and 72 hours of incubation for each treatment. Two readings at a perpendicular angle from each other, forming a "+" sign, were used to compute the average diameter of mycelial growth. Both control and amended plates were used to take readings. The percentage inhibition of mycelial growth compared to the control was computed using the formula of Vincent (1947):

$$PGI = (C - T)/C * 100$$

Where PGI= Percent growth inhibition, C = Average Growth of hyphae in control (mm), and T = Average Growth of hyphae in Treatment (mm).

Statistical analysis

All the data were entered in Ms. Excel (2019) and analysis of variance was done using R-Stat software version (4.2.2). The mean comparison was done using the Duncan Multiple Range Test (DMRT) and Least Significant Difference (LSD) at a 0.05 level of significance.

Results and Discussion

Five different botanical extracts were evaluated against Sclerotium rolfsii at different concentrations viz., 5%,10%, and 15% in laboratory conditions by poisoned food technique. Our result (Table 2) shows that all the tested botanicals inhibited pathogen growth over unamended media. Different plant extracts showed different levels of fungicidal properties against the pathogen. Plant extracts are now utilized against numerous plant pathogenic fungi due to their antifungal properties, which have received a lot of attention (Swami et al., 2013).

The inhibitory effect of the various extracts was found to differ significantly ($P \leq 0.001$). Regardless of the concentration used, the range of growth inhibition ranged from 12.06% to 80.91% after 72 hours of inoculation.

Table 2: Invitro evaluation of botanical extracts against Sclerotium rolfsii at 27±2 ºC

S.N.	Botanical Extracts	Concentrations (%)	Growth Inhibition Percentage (%)		
			24 hours	**48 hours**	**72 hours**
1.	Garlic (*Allium sativum)*	5	32.36^{f}	34.92^{g}	37.23^{g}
		10	61.08^{c}	63.84^{d}	65.03^{d}
		15	69.54^{a}	77.77^{a}	80.91^{a}
2.	Neem (*Azadirachta indica*)	5	28.88^{g}	31.76^{h}	33.67^{gh}
		10	58.61^{c}	61.95^{d}	64.82^{d}
		15	67.45^{a}	72.07^{b}	74.80^{b}
3.	Ginger *(Zingiber officinale)*	5	21.15^{i}	23.36^{j}	26.60^{hi}
		10	51.92^{d}	54.80^{e}	57.11^{e}
		15	64.18^{b}	66.80^{c}	70.13^{c}
4.s	Onion (*Allium cepa*)	5	10.67^{j}	12.38^{k}	14.88^{j}
		10	27.81^{g}	30.65^{h}	32.01^{h}
		15	50.41^{d}	53.61^{e}	55.76^{e}

5.	Dhatura *(Datura stramonium)*	5	9.22^{j}	10.88^{k}	12.06^{j}
		10	24.76^{h}	26.53^{i}	29.96^{hi}
		15	42.39^{e}	45.12^{f}	48.48^{f}
	Grand Mean		41.36	44.42	46.89
	SEM (±)		1.74	1.50	2.73
	CV (%)		4.22	3.39	5.82
	LSD at 5%		2.91	2.51	4.55

LSD: Least Significant Difference SEM: Standard Error of Mean CV: Coefficient of Variation

The mycelial growth of *Sclerotium rolfsii* was observed to decrease as the concentration of the plant extracts increased. After 24 hours of inoculation, maximum growth inhibition was recorded in 15% Garlic i.e. inhibition percentage of 69.54% which was statistically at par with 15% Neem (67.45%) with each other. It was followed by 15% Ginger (64.18%), 10% Garlic (61.08%) which was statistically at par with 10% Neem (58.61%), 10% Ginger (51.92%) which was statistically at par with 15% onion (50.41%), and by 15% Dhatura (42.39%). Minimum inhibition was obtained in 5% Dhatura (9.22%) which was statistically at par with 5% Onion (10.67%).

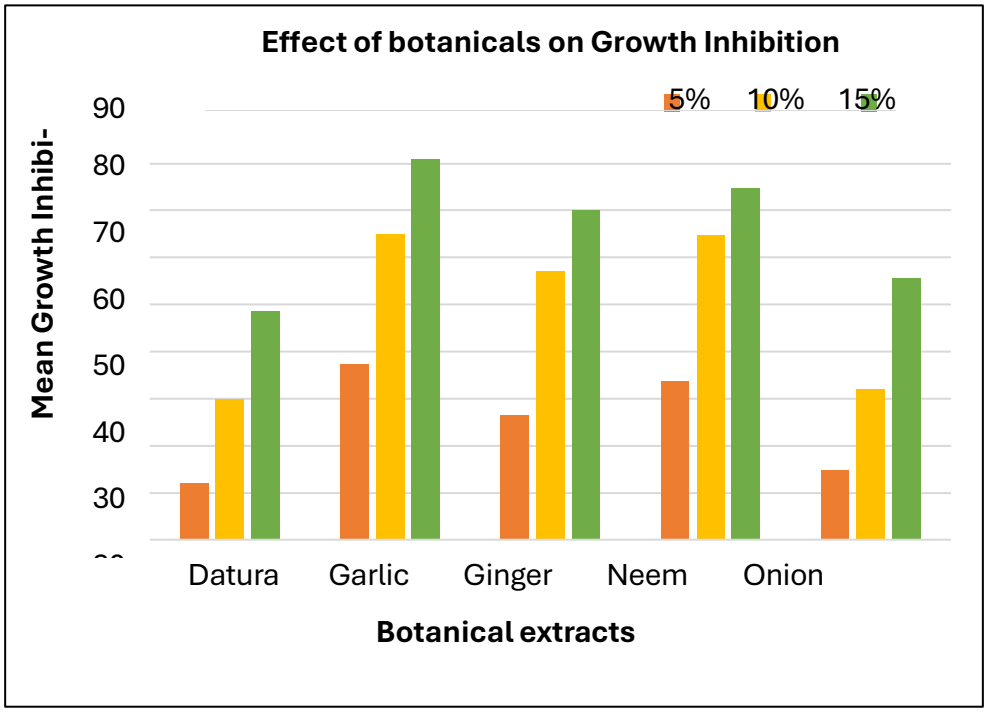


Figure 1: Mycelial Inhibition (%) after 72 hours of inoculation at different treatments

After 48 hours of inoculation, the inhibition percentage varied from 10.88% to 77.77%. Garlic was proved to be the most effective botanical extract at 15% concentration showing 77.77% inhibition followed by 15% Neem (72.07%) and 15% Ginger (66.80%). 10% Garlic with an inhibition percentage of 63.84% which was statistically at par with 10% Neem (61.95%). 5% Dhatura (10.88%) was least effective in restricting the mycelial growth of pathogen which was statistically at par with 5% Onion (12.38%).

Similarly, after 72 hours of inoculation, maximum growth inhibition was recorded by 15% Garlic (80.91%) followed by 15% Neem (74.80%) and 15% Ginger (70.13%). 10% garlic (65.03%) was statistically at par with 10% Neem (64.82%). Minimum growth inhibition was recorded by 5% Dhatura (12.06%) followed by 5% Onion (14.88%) which were statistically at par with each other.

Figure 2: Mycelial growth of S. rolfsii in PDA- unamended media as a control

The highest inhibitory effect was observed in Garlic extract at 15% concentration as compared to control against the tested pathogen in the present investigation. The result obtained agreed with (Mahato et al., 2018), where Allium sativum recorded maximum growth inhibition of *S. rolfsii*, significantly superior to all other botanical

extracts. (Rahman et al., 2020) also evaluated the antifungal property of phytoextracts against *S. rolfsii* and obtained the highest growth inhibition with garlic extract than other botanicals at all concentrations tested. Bioefficacy of ten botanical extracts on growth of *S. rolfsii* and *A. niger* were tested invitro at two concentrations viz., 10 and 20%. *Allium sativum* was proved to be an effective botanical and recorded a maximum reduction of growth of both *A. niger* and *S. rolfsii* by 100% which was significantly superior to all the plant extracts at 20% concentration. Chrysanthemum at both concentrations was least effective in reducing fungal growth (Vineela et al., 2020).

The antifungal metabolites present in plants may be responsible for the fungitoxicity of plant extracts. Different botanicals' antifungal potency varies due to variations in the active chemical makeup of the extracts (Shrestha

& Tiwari, 2009). The primary component of garlic, allicin, which is produced by the phosphopyridoxal enzyme allinase, is believed to be responsible for the antibacterial properties of garlic (Arunachalam, 1980). Garlic contains other bioactive compounds such as garlicin, ajoene, and allylsulfides. Ajoene derived from garlic causes morphological changes such as the disappearance of surface ornaments, thickening of a cell wall, and destruction of cell organelle by acting on the cell wall of a fungus (Yoshida et al., 1987). The efficacy of garlic clove extracts is attributed to the volatile oil, which contains diallyl disulphide, diallyl trisulphide, and sulphodoxides, which are all obtained from allicin (Chethana et al., 2012). The allicin or ajoene restricts the performance of some enzymes that are important to fungal growth (Kutawa et al., 2018). Along with sulfur compounds, garlic contains arginine, 17 amino acids, and their glycosides, as well as other amino acids and other amino acids. minerals like selenium, as well as enzymes like myrosinase, allinase, peroxides, and others. Numerous studies have noted that garlic has a similar impact.

The second-best inhibitory effect was shown by 15% of Neem i.e. (74.80%). The presence of triterpenes or limonoids such as azadirachtin, nimonol, quercetin, nimbin, β-sitosterol, and other butter substances viz., alkaloids, glycosides, and gums contribute to the antimicrobial properties of Neem (Mahmoud et al., 2011). Neem is known to inhibit protease activity and alter the hydrophobicity of fungal cells, leading to anti-adhesion effects (Polaquini et al., 2006). According to Begum et al. (2014), Neem *(Azadirachta indica)* had the highest average inhibition (74.81%) of the investigated botanicals at 5 and 10% concentrations, followed by Tulsi *(Ocimum sanctum)* (67.10%) and Nirgudi *(Vitex negundo)* (65.81%) against *S. rolfsii*.

The third-best inhibitory effect was observed in Ginger. Citral-containing chemicals in ginger essential oil are lipophilic, making the cell wall and cytoplasmic membrane more permeable and causing membrane integrity loss in fungus. The phenolic compounds in ginger are mainly gingerol and shagelol as antifungal compounds that inhibit the mycelial growth of pathogens (Jain et al., 2011). In the in-vivo condition, Mahato et al. (2018) tested botanicals such as ginger, neem, garlic, kalmegh, turmeric, periwinkle, tulsi, and onion at 5, 10, and 20% against *Sclerotium rolfsii. Azadirachta indica* (Neem) showed the best effectiveness against collar rot disease by reducing 64.9% incidence which was followed by *Allium sativum* (60.34%), and *Zingiber officinale* (58.83%) and discovered that the concentrations of 5%, 10%, and 20%, resulted in the greatest reduction of mycelial growth (35.31%, 68.50%, and 84.89% respectively) in in-vitro condition.

Dhatura i.e. inhibition percentage of 12.06% was found to be the least effective which is by (Hosen et al., 2016) who also showed the least inhibition of Dhatura and maximum inhibition of Garlic against S. rolfsii at all tested concentrations (5, 10 and 15%).

According to an evaluation of the effectiveness of botanicals by Bharathi et al. (2018), the combination of black tulsi rust extract, turmeric rhizome extract, and garlic bulb extract at a concentration of 15% produced the

highest level of mycelial growth inhibition (85.00%). The five botanical essential oils—Palmarosa, Karanja, Thyme, Menthol, and Lemongrass oils—were examined by (Sekhar et al., 2020) at varying concentrations (0.5, 1, 1.5, and 2%). Palmarosa *(Cymbopogon martini)* and Thyme *(Thymus vulgaris)* demonstrated the most significant efficacy, delivering 100% growth inhibition at 1.5 and 2.0%, regardless of the various concentration levels of essential oils evaluated against the mycelial growth of S. rolfsii. The effectiveness of several botanicals, including the leaves of *Bauhinia purpurea, Caesalpinia gilliesii, Cassia fistula, Cassia senna, Chrysanthemum frutescens, Euonymus japonicus,* and *Thespesia populnea var. acutiloba,* was assessed separately and found that the leaf extracts considerably inhibited the radial growth of *S. rolfsii* when compared to the control. The leaf extracts of *T. populnea var. acutiloba* were the most effective against the pathogen, with an inhibition percentage of 82.8% followed by *Chrysanthemum frutescens, Caesalpinia gilliesii, Euonymus japonicus, Cassia senna, Bauhinia purpurea,* and *Cassia fistula* with the inhibition percentage of 79.5, 78.3, 78.0, 77.2, 75.0, and 74.0 %, respectively at 200 ppm concentration (Derbalah et al., 2012). In conclusion, botanical extracts have been shown to have potent inhibitory activity against a wide variety of phytopathogenic fungi, making them a viable alternative to chemical fungicides.

Conclusion

Sclerotium rolfsii is one of the devastating pathogens that has been regarded as one of the serious in agricultural production, posing a serious threat to all farmers. To combat obvious environmental pollution issues and prevent the hazardous effects of synthetic chemicals on non-target organisms, research on the use of pesticides with plant origin is becoming more and more significant in the field of plant pathology. Plant products must be periodically examined before they can be included as a component in integrated disease management. Likewise, the study showed that all the botanical extracts examined had a significant inhibitory effect compared to the control. In this experiment, garlic was found to be an effective botanical extract for radial growth inhibition of *Sclerotium rolfsii*. The use of botanicals could be a cheap, safe, and environmentally sound approach to disease management. The present research finding is limited to laboratory conditions so, more in-vitro and field trials are required to validate this finding for further recommendation in field conditions.

Acknowledgment

The author extends his sincere gratitude to Mr. Sanjay Mahato, Assistant Professor at the Institute of Agriculture and Animal Science (IAAS) for his invaluable guidance, persistent encouragement, and steadfast support throughout the duration of this research. We also acknowledge IAAS, Lamjung, for supplying the necessary materials and equipment, and the Plant Pathology Division, NARC (Khumaltar), for providing the *Sclerotium rolfsii* culture essential for this study.

Author contribution statement

The author has significantly contributed to this article's development and writing.

Funding statement

No specific grant from a public, private, or non-profit funding organization was obtained for this study.

Statement of Declaration of Interest

No conflict of interest is disclosed by the author.

References

Abang, M. M. (2003). Genetic Diversity of *Colletotrichum-gloeosporioides Penz.* Causing Anthracnose Disease of Yam. 87.

Abhijit, R., & Vrijendra. S. N. N. (2010). In vitro antifungal study of the efficacy of some plant extracts for inhibition of *Alternaria carthami* fungus. *Indian Journal of Natural Products and Resources.*, 384–386.

Adandonon, A. (2000). Damping-off of cowpea in Benin and South Africa.

Adhikari, P., Shrestha, S. M., Manandhar, H. K., & Marahatta, S. (2022). Morphology and cross infectivity of *sclerotium rolfsii Sacc*. Isolated from different host plants in Nepal. In *the Journal of Agriculture and Environment* (Vol. 23)

Al-Askar, A., & Rashad, Y. (2010). Efficacy of some plant extracts against *Rhizoctonia solani* on pea. *Journal of Plant Protection Research*, *50*(3), 239–243. https://doi.org/10.2478/V10045-010-0042-0

Anahosur, K. H. (2001). Integrated management of potato Sclerotium wilt caused by *Sclerotium rolfsii. Indian Phytopathology*, *54*, 158–166.

Annual Report. (2073). http://www.narc.gov.np.

Annual Report. Kathmandu. (2018). Antimicrobial activity of garlic, onion and honey. Geobios, - Google Scholar. Retrieved December 28, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=+Antimicrobial+activity+of+garlic%2C+onion+and+ honey.+Geobios%2C&btnG=

A.R. Bharathi D, & VI Benagi. (2018). In vitro evaluation of botanicals and bio-agents against *Sclerotium rolfsii Sacc*. incitant of wilt complex disease of betelvine (Piper betle L.). *The Pharma Innovation Journal*.

Aycock, R. (1966). Stem rot and other diseases caused by Sclerotium rolfsii or the status of Rolf‟s fungus after 70 years. *North Carolina Agricultural Experiment Station. Technical Bulletin*, 174–202.

Bashir Kutawa, A., Daniel Danladi, M., & Haruna, A. (2018). Antifungal activity of garlic (*Allium sativum*) extract on some selected fungi. *Journal of Medicinal Herbs and Ethnomedicine*, *4*, 12–14. https://doi.org/10.25081/jmhe.2018.v4.338

Begum, A., Dadke, M. S., Wagh, S. S., Kuldhar, D. P., Pawar, D. V., Chavan, A. A., & Thaware, D. S. (2014). In vitro evaluation of fungicides and botanicals against stem rot of chilli caused by Sclerotium rolfsii. *International Journal of Plant Protection*, *7*(2), 437–440. https://doi.org/10.15740/HAS/IJPP/7.2/437-440

Benkeblia, N. (2004). Antimicrobial activity of essential oil extracts of various onions (*Allium cepa*) and garlic (*Allium sativum*). *LWT - Food Science and Technology*, 263–268.

Block, E., Naganathan, S., Putman, D., & Zhao, S. H. (1992). Allium chemistry: HPLC 23 analysis of thiosulfinates from onion, garlic, wild garlic (ramsoms), leek, scallion, shallot, elephant (great-headed) garlic, chive, and Chinese chive. Uniquely high allyl to methyl ratios in some garlic samples. *Journal of Agricultural and Food Chemistry*, 2418– 2430.

Chandra Sekhar, J., Prakash Mishra, J., Prasad, R., Reddy, V. P., Kumar, S., Thakur, A., Pal, J., Mishra, J. P., & Reddy, P. (2020). Isolation and in vitro evaluation of biocontrol agents, fungicides and essential oils against stem blight of tomato caused by *Sclerotium rolfsii* (Curzi) C.C Tu & Kimber. *~ 700 ~ Journal of Pharmacognosy and Phytochemistry*, *9*(3), 700–705. www.phytojournal.com.

Chethana B.S., Ganeshan G., Rao, A. S., & Bellishree, K. (2012). In vitro evaluation of plant extracts, bioagents and fungicides against *Alternaria porri* (Ellis) Cif., causing purple blotch disease of onion. *Pest Management in Horticultural Ecosystems*, *18(2)*, 194–198.

Cilliers, A. J., L. Herselman, & Z.A., Pretorious. (2000). Genetic variability within and among mycelial compactibility groups of *Sclerotium rolfsii* in South Africa. *Phytopathology 90*, 1026–1031.

Dalbeer, K. (2015). Efficacy of different botanicals against *Alternaria brassicae* in in vitro condition. *International Journal of Science and Research (IJSR)*, 791–793.

Derbalah, A. S., Dewir, Y. H., & El-Sayed, A. E. N. B. (2012). Antifungal activity of some plant extracts against sugar beet damping-off caused by *Sclerotium rolfsii*. *Annals of Microbiology*, *62*(3), 1021–1029. https://doi.org/10.1007/s13213-011-0342-2

Farr, D. F., Bills, G. F., Chamuris, G. P., & Rossman, A. Y. (1989). Fungi on plants and plant products in the United States. *Fungi on Plants and Plant Products in the United States.*

Ganie, S. A., Ghani, M. Y., & Nissar, Q. (2013). *African Journal of Microbiology Research Bioefficacy of plant extracts and biocontrol agents against Alternaria solani*. *7*(34), 4397–4402. https://doi.org/10.5897/AJMR2013.5901

Govindachari, T. R., Suresh, G., Gopalakrishnan, G., Banumathy, B., & Masilamani, S. (1998). Identification of antifungal compounds from the seed oil of *Azadirachta Indica*. *Phytoparasitica 1998 26:2*, *26*(2), 109–116. https://doi.org/10.1007/BF02980677

HANIF, S., Jabeen, K., Akhtar, N., & Amp; IQBAL, S. (2022). GC-MS analysis & antifungal activity of *Datura metel L*. against *Rhizoctonia solani*. *Kuhn. Anais Da Academia Brasileira de Ciências*.

Hosen, S., Shamsi, S., & Bashar, M. A. (2016). In vitro efficacy of fungicides and plant extracts on the growth of *Colletotrichum gloeosporioides* (penz.) *Penz*. & *Sacc*. and *Sclerotium rolfsii Sacc*. The causal organisms of anthracnose and soft rot of Jute. In *J. Biol. Sci* (Vol. 25, Issue 2).

Jain, J., Tikare, S., & Mhauli, A. (2011). Antifungal activity of ginger extracts on *Candida albicans*: An invitro study. *Journal of Dental Sciences and Research*, 18–21.

Kantwa, S. L., Tetarwal, J. P., & Shekhawat, K. S. (2014). In vitro effect of fungicides and phyto-extracts against *Alternaria alternata* causing leaf blight of groundnut. *IOSR Journal of Agriculture and Veterinary Science*, *7*(6), 28– 31. https://doi.org/10.9790/2380-07612831

Khan, Z. K., & Katiyar, R. (2000). Potent Antifungal Activity of Garlic (*Allium Sativum*) Against Experimental Murine Dissemenated *Cryptococcosis*. *Pharmaceutical Biology*, *38*(2), 87–100. https://doi.org/10.1076/1388-0209(200004)3821-1FT087

Kohiyama, C., Yamamoto Ribeiro, M., Mossini, S., Bando, E., Bomfim, N., Nerilo, S., Rocha, G., Grespan, R., Mikcha, J., & Machinski, M. (2015). Antifungal properties and inhibitory effects upon aflatoxin production of *Thymus vulgaris* L. by *Aspergillus flavus* Link. *Food Chemistry*, *173*, 1006–1010. https://doi.org/10.1016/j.foodchem.2014.10.135

Kokub, D., Hassan, A., Ansar, M., Asad, M.J., & Khanum, A. (2007). Comparative growth, morphological and molecular characterization of indigenous *Sclerotium rolfsii* strains isolated from different locations of Pakistan. *Pakistan Journal of Botany*, *39*, 1849–1866.

Kossou, D. K., Ghehounou, G., Ahanchede, A., Ahohuendo, B., Bouraïma, Y., & Huis, V.A. (2001). Indigenous cowpea production and protection practices in Benin. *Insect Science and Its Application 21*, 123–132.

Laiamnhee, Z. H, & Onah. Daniel, O. (2015). *Sclerotium rolfsii*; Causative organism of southern blight, stem rot, white mold and sclerotia rot disease. *Annals of Biological Research*, 78–89.

Le, C. N. (2011). *Diversity and biological control of Sclerotium rolfsii, causal agent of stem rot of groundnut.* Wageningen University.

Mahato, A., Biswas, M. K., & Patra, S. (2018). Efficacy of Medicinal Plant Extracts Against Collar Rot of Tomato Caused by *Sclerotium Rolfsii (Sacc.*). *International Journal of Microbiology Research*, *10*(5), 1224. https://doi.org/10.9735/0975-5276.10.5.1224-1227

Mahmoud, D. A.; Hassanein, N.M.; Youssef, K.A.; & Abou Zeid, M. A. (2011). Antifungal activity of different neem leaf extracts and the nimonol against some important human pathogens. *Brazilian Journal of Microbiology*, *42*, 1007– 1016.

Manu, T. G., & Nagaraja, A. (2012). In vitro evaluation of fungicides against *Sclerotium rolfsii*, causing foot rot disease on finger millet. *Mysore Journal of Agricultural Sciences*, *46*(4), 924–927.

Mehan, V. K., C.D. Mayee, T.B. Brenneman, & D. Mc Donald. (1995). Stem and pod rots of groundnut. *International Crops Research Institute for the Semi-Arid Tropics, Information Bulletin*.

Mukherjee, P. K. and K. Raghu. (1997). Effect of temperature on antagonistic and biocontrol potential of *Trichoderma sp*. on *Sclerotium rolfsii. Mycopathologia*, 151–155.

Mullen, J. (2000a). Southern blight, southern stem blight, white mold. *The Plant Health Instructor*. https://doi.org/10.1094/PHI-I-2001-0104-01

Mullen, J. (2001). Southern blight, Southern stem blight - Google Scholar. (2001). Retrieved December 18, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Mullen%2C+J.+2001.+Southern+blight%2C+Southe rn+stem+blight%2C+White+mold.&btnG=

Nashwa M. A. Sallam. (2011). Control of tomato Early Blight disease by certain plant extracts, *Plant Pathology Journal10*, 187–191.

Nxumalo, K. A., Aremu, A. O., & Fawole, O. A., (2021). Potentials of medicinal plant extracts as an alternative to synthetic chemicals in postharvest protection and preservation of horticultural crops: A review. *Sustainability (Switzerland)*.

Okabe, I., & Matsumoto, N. (2000). Population structure of *Sclerotium rolfsii* in peanut fields. *Mycoscience*, *41*(2), 145–148. https://doi.org/10.1007/BF02464323

öz arık, U. (2017). The antifungal effects of *Datura stramonium l., D. Metel L., D. Innoxia Mill*. In Flora of Turkey. *Mugla Journal of Science and Technology*, *96–103.*Perello, A., Noll, U., & Slusarenko, A. J. (2013). Invitro efficacy of garlic extract to control fungal pathogens of wheat. *Journal of Medicinal Plants Research*, *7(24)*, 1809–1817.

Prasad, G., & Dwivedi, S. K. (2020). Efficacy of Bioagents, Plant extracts and chemical fungicides against root rot disease in Zea mays caused by *Sclerotium rolfsii*. *Asia Pacific Journal of Multidisciplinary Research*, *8*(1), 47–55.

Prasad, R. D., & M. K. Naik. (2008). Advances in plant diseases caused by *Sclerotium rolfsii* and their management. *New Delhi: New India Publishing Agency*, 89–127.

Prasad, S., & Tyagi, A. K. (2015). Ginger and its constituents: Role in prevention and treatment of gastrointestinal cancer. In *Gastroenterology Research and Practice* (Vol. 2015). Hindawi Publishing Corporation. https://doi.org/10.1155/2015/142979

Punja, Z. K. (1985). The biology, ecology, and control of *Sclerotium rolfsii. Annual Review of Phytopathology,* 97–127.

Punja, Z. K., & Rahe J.E. (1993). *Sclerotium*. In Methods for research on soilborne phytopathogenic fungi. *The American Phytopathological Society*.

Punja, Z. K., & Grogan R.G. (1983). Basidiocarp induction, nuclear condition, variability and heterokaryon incompatibility in *Athelia (Sclerotium) rolfsii*. *Phytopathology 73*, 1273–1278.

Punja, Z. K., Smith, V. L., Campbell, C. L., & Jenkins, S. F. (1985). Sampling and extraction procedures to estimate numbers, spatial pattern, and temporal distribution of sclerotia of *Sclerotium rolfsii* in soil. *Plant Disease*, *69*(6).

Pun, L. B., Chhetri, K., Pandey, A., & Poudel, R. (2020). In vitro Evaluation of Botanical Extracts, Chemical Fungicides and *Trichoderma harzianum* Against *Alternaria brassicicola* Causing Leafspot of Cabbage. *Nepalese Horticulture*, *14*(1), 68–76. https://doi.org/10.3126/nh.v14i1.30612

Rahmani, A. H., Al Shabrmi, F. M., & Aly, Salah. M. (2014). Active ingredients of ginger as potential candidates in the prevention and treatment of diseases via modulation of biological activities. In *International Journal Pathophysiol Pharmacol* (Vol. 6, Issue 2). www.ijppp.org

Rahman, M. H., Islam, M. R., Aminuzzaman, F. M., Latif, A., & Rahman, H. (2020). In-vitro evaluation of plant extracts and fungicides against mycelial growth of *Sclerotium rolfsii* causing foot and root rot of betelvine. In *Online Bangladesh J. Agril. Res* (Vol. 45, Issue 1).

Ramarao, P., & Raja, U. (1980). Effect of soil moisture on development of foot and root rot of wheat and on other soil microflora. *Indian Journal of Mycology and Plant Pathology*, *10*(1), 17–22.

Roberts, P. D., French-Monar, & McCarter. (2014). Southern Blight. In J. B. Jones.

Shrestha, A. K., & Tiwari, R. D. (2009). Antifungal Activity of Crude Extracts of Some Medicinal Plants against *Fusarium solani* (Mart.) Sacc. *Ecoprint: An International Journal of Ecology*, *16*, 75–78. https://doi.org/10.3126/ECO.V16I0.3476

Singh, B.B, Mohan Raj D.R., Dashiell, K.E., & Jackai L.E. N. (1997). Advances in cowpea research. *Co-Publication of International Institute of Tropical Agriculture (IITA) and Japan International Research Center for Agricultural Sciences (JIRCAS)*.

Singh, B. K., & Singramau, (2017). Assessment of Antifungal Activity of 27 Onion *(Allium Cepa L.)* Bulb Extracts.

Singh, S. R., & Rachie K.O. (1985). Cowpea research, production and utilization. *International Institute of Tropical Agriculture (IITA)*.Singleton, L. L., Mihail, J.D., & Rush, C.M. (1992). Methods for research on soilborne phytopathogenic fungi. *The American Phytopathological Society Minnesota, USA.*

Sittrsart, P., Yossan. S., & Prasertsan, P. (2017). Antifungal property of chili, shallot and garlic extracts against pathogenic fungi, *Phomopsis spp*., isolated from infected leaves of para rubber. *Agriculture and Natural Resources*, 485–491.

Sivan, A. (1987). Biological Control of Fusarium Crown Rot of Tomato by *Trichoderma harzianum* Under Field Conditions. *Plant Disease*, *71*(7), 587. https://doi.org/10.1094/PD-71-0587

Ouza R.J., & Macedo, F.S. (2009). *Cultura do Alho: tecnologias modernas de produção.* 181.

Suleiman, E., & Abdallah, W. (2014). Invitro activity of Garlic on some pathogenic Fungi. *European Journal of Medicinal Plants*, 1240–1250.

Swami, C. S., & Alane, S. K. (2013). Efficacy of some botanicals against seed-borne fungi of green gram (*Phaseolus aureus Roxb*.). *Biosci. Disc*, 107–110.

Tu, C. C., & Kimbrough, J.W. (1978). Systematics and phylogeny of fungi in the Rhizoctonia complex. *Botanical Gazette*, 454–466.

Ul-Haq, S., Hasan, S.S., Dhar, A., Mital, V. & Sahaf, K. A. (2014). Antifungal properties of phytoextracts of certain medicinal plants against leaf spot of disease of Mulberry, Morusspp. *Plant Pathology and Microbiology*.

Vargas Gil, S., Haro, R., Oddino, C., Kearney, M., Zuza, M., Marinelli, A., & March, G. J. (2008). Crop management practices in the control of peanut diseases caused by soilborne fungi. *Crop Protection*, *27*(1), 1–9. https://doi.org/10.1016/J.CROPRO.2007.03.010

Vineela, D., Beura, S. K., Dhal, A., & Swain, S. K. (2020). Efficacy of bio-agents, botanicals, and organic amendments against groundnut pathogens Sclerotium rolfsii and Aspergillus niger in-vitro. *~ 1206 ~ Journal of Pharmacognosy and Phytochemistry*, *9*(3). www.phytojournal.com

Woods-Panzaru, S., Nelson, D., McCollum, G., Ballard, L. M., Millar, B. C., Maeda, Y., Goldsmith, C. E., Rooney, P. J., Loughrey, A., Rao, J. R., & Moore, J. E. (2009). An examination of antibacterial and antifungal properties of

constituents described in traditional Ulster cures and remedies. *The Ulster Medical Journal*, *78*(1), 13./PMC/articles/PMC2629014/

Yoshida, S., Kasuga, S., Hayashi, N., Ushiroguchi, T., Matsuura, H., & Nakagawa, S. (1987). Antifungal activity of ajoene derived from garlic. *Applied and Environmental Microbiology.*

Zick, S.M., Djuric, Z., Ruffin, M.T., Litzinger, A.J., Normolle, D.P., Airawi, S., Feng, M.R., & Brenner, D.E. (2008). Pharmacokinetics of 6-gingerol, 8-gingerol, 10-gingerol, and 6-shogaol and conjugate metabolites in healthy human subjects. *Cancer Epidemiol Biomarkers Prev*, 1930–1936.

Zitter, T., Hopkins, D., & Thomas, C. (1996). *Compendium of cucurbit diseases*. https://agris.fao.org/agris-search/search.do?recordID=US9715473

Institute of Socioeconomic Research and Development

ISSN Online: 3021-9604

Climate change adaptation strategy: Cardamom, Community and Community Based Forest users of Nepal

Ganesh Raj Acharya[1], **Krishna Raj Tiwari**[2] **and Sanjaya Acharya**[3]

[1] Institute of Forestry, Tribhuvan University, Nepal

[2] Institute of Forestry, Tribhuvan University, Nepal

[3] Faculty of Humanities and Social Sciences, Tribhuvan University, Nepal

Corresponding email: grajacharya@gmail.com

How to cite this paper: Acharya, G.R., Tiwari, K.R., & Acharya, S. (2024). Climate change adaptation strategy: Cardamom, Community and Community Based Forest. *International Socioeconomic Review*, *2*(1), 51–75. www.isrd.org.np

Received: August 15, 2024

Revised: October 28, 2024

Accepted: December 10, 2024

Published: December 24, 2024

Abstract

The paper intends to capture how communities are developing climate change adaptation strategies according to their own context. Climate change is a global issue. Communities are providing local solutions to tackle this challenge. This study was conducted in in Rolpa, Dang, Dolakha, and Ilam districts of Nepal. The household survey was conducted in three districts (Dolakha, Rolpa and Dang). The Focus Group Discussion, Key Informant Interview, and SWOT analysis was held in all four districts. The national level secondary information was reviewed. Based climate adaptation theory, a conceptual framework was developed where adaptation process contributes the livelihoods in achieving resilience in the community. Based on this model, findings are discussed. The cardamom is considered as one of the high value crops in Nepal. Switching to cardamom crops from conventional crops in community and its introduction in community-based forestry is one of the strategies to tackle adverse effects of climate change. Such strategies contribute to the livelihoods of the community and enhance resilience. Cardamom is produced in community land, private land and in community-based forests. The production of cardamom is in increasing trend in all three districts, Rolpa, Ilam and Dolakha. The cardamom farming is giving farmers almost three to five times benefit in comparison to traditional crops such as maize, and rice etc. The traditional trade route of cardamom involves

stakeholders including local level farmer as producer, district level aggregation and subsequently to central level. Cardamom is also exported to India from ground transportation, Kathmandu, and international market. Some associated challenges evolved in each stage. The international trade of cardamom depends on the level of exposure, capacity and quality.

Key words: Climate Change Adaptation, Cardamom, Resilience, Livelihoods

1. INTRODUCTION

Climate change adaptation has been a global issue (Kumar et al., 2023; Taylor, 2022; Kabir et al., 2021). Both the national and local level communities develop climate change adaptation strategies according to their context (Laukkonen et al., 2009; Cid et al., 2023). Climate variability and environmental change are some of the major aspects that govern such strategies (Cannon et al., 2010; Maru, 2014; IPCC, 2014). The practice of adaptation is not new to the local communities (Cabana et al., 2023; Rijal et al., 2022). Various forms of climate change adaptation strategies exist locally through conventional form. Among others, such local level strategies are conservation of water source, planting trees and grasses in the farmland, and crop diversification. Communities practice these choices both in their farmland as well as in communal land (Rijal et al., 2022; Car et al., 2022; Tiwari et al., 2014).

In responding climate change and concurrently addressing livelihoods, cardamom (Elettaria cardemomu) has been practiced as cash crop among small and medium level farmers in Nepal and some other countries of South Asia (Dhananjayan et al., 2023; Reyes et al., 2006; Parthasarathi et al., 2008). In Nepal, the cardamom production is increasing every year in Nepal (MoALD, 2022; MoALD, 2023; Shreshta et al., 2022). One of the eastern districts, *Ilam*, is a pioneer district to introduce cardamom in the country (Dhungana et al., 2010; Shrestha et al., 2022).

The record shows that cardamom was imported from Sikkim, India through eastern border of Nepal (TKP, 2018). During 1850s, people of eastern region began cardamom farming. It was first introduced in Ilam district being adjoined to eastern border of India (Paudyal & Rai, 2020). Gradually, the cardamom crop practice in Ilam district also motivated farmers to introduce cardamom in other districts of Nepal. Rolpa district is on the western side of Nepal and is reported to produce cardamom on 17 hectares of land in total (CBS, 2013). This production in Rolpa district is on household level. Dolakha district also adopted learning from Ilam. Farmers are producing cardamom

as preferred species. At the national level, cardamom farming has the strength to contribute to economy as one of the keystone spice species enhancing the economy of Nepalese people (Kandel, 2019; Kalauni & Joshi, 2019).

Principally both the Non-Timber Forest Product (NTFP) and agricultural cash crops are prioritized areas to address the livelihoods in rural Nepal. Cardamom is regarded as one of the high value crops. Switching to cardamom crop in community and its introduction in community-based forestry is one of the strategies to tackle adverse effect of climate change in Nepal (Aryal et al., 2023; Zakari et al., 2022). The paper intends to capture how the Cardamom is practiced in the community and switching earlier traditional crops to new species (Cardamom) is a climate change adaptation strategy in the study area.

TOWARDS THEORY AND CONCEPTUAL FRAMEWORK

Climate change adaptation practices contribute livelihoods (Clay, 2018; Nelson et al., 2007) of the community and enhance resilience (Nelson et al., 2007; Sargani, 2022; Kapruwan, 2024). Similarly, adaptation plans aim to decrease vulnerability to climate change and increase resilience (Folke, 2006). The adaptation has been defined as "the capacity of actors in a system to influence resilience (Folke et al., 2010). Adaptation acts as an element of pathways of interacting global changes and societal responses (IPCC, 2014; Wise et al., 2014). Resilience emphasizes the speed of recovery and is the buffer capacity or the ability of a system to absorb perturbations, or the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables and processes that control behavior (Holling et al., 1995; Adger, 2010). The adaptation, livelihoods and resiliency are closely connected (Marschke & Berkes, 2006; Rahut et al., 2014; Acharya et al., 2021; Atube et al., 2021).

Based on this theoretical understanding as shown in Figure 1 below, adaptation strategy contributes livelihoods. This process absorbs shock, maintaining or enhancing resilience. The integrated resilience process contributes to community livelihoods ultimately.

Conceptual Framework of Study

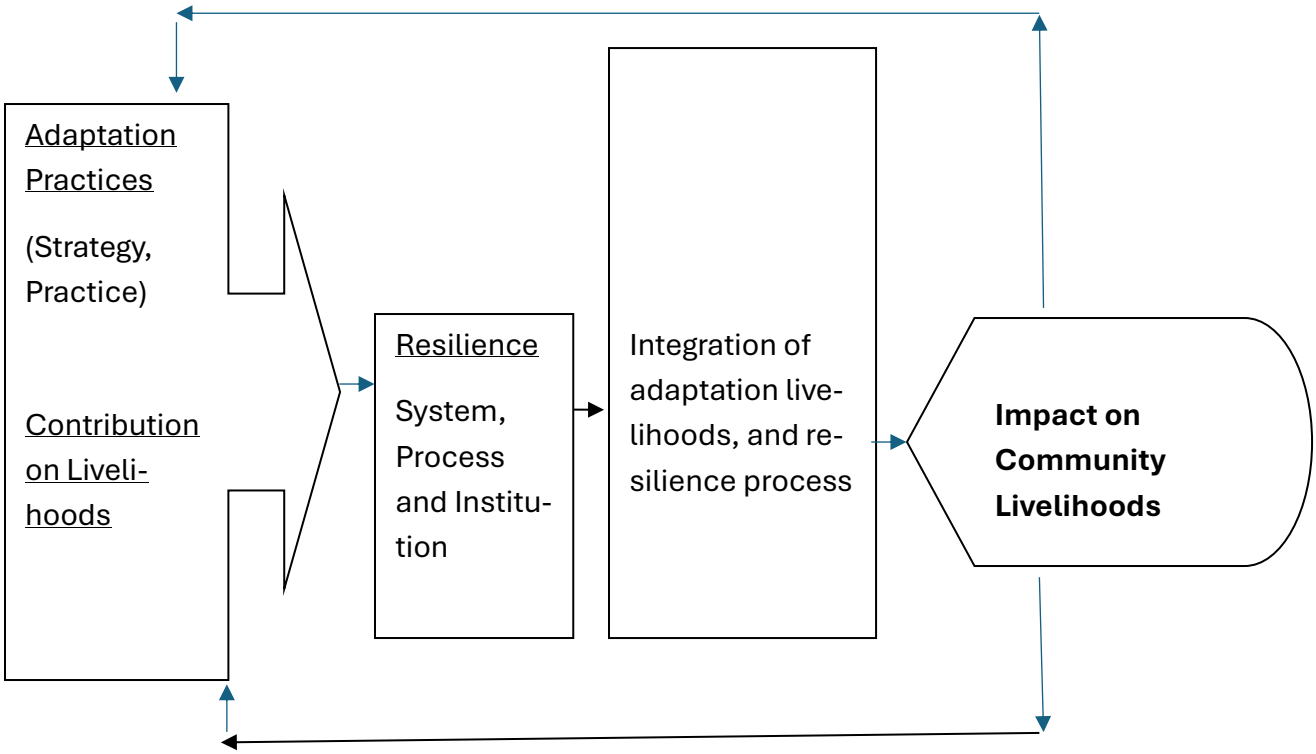


Figure 1: Theoretical Framework for Study

Source: Acharya (2021/22)

METHODOLOGY

Methods and study area

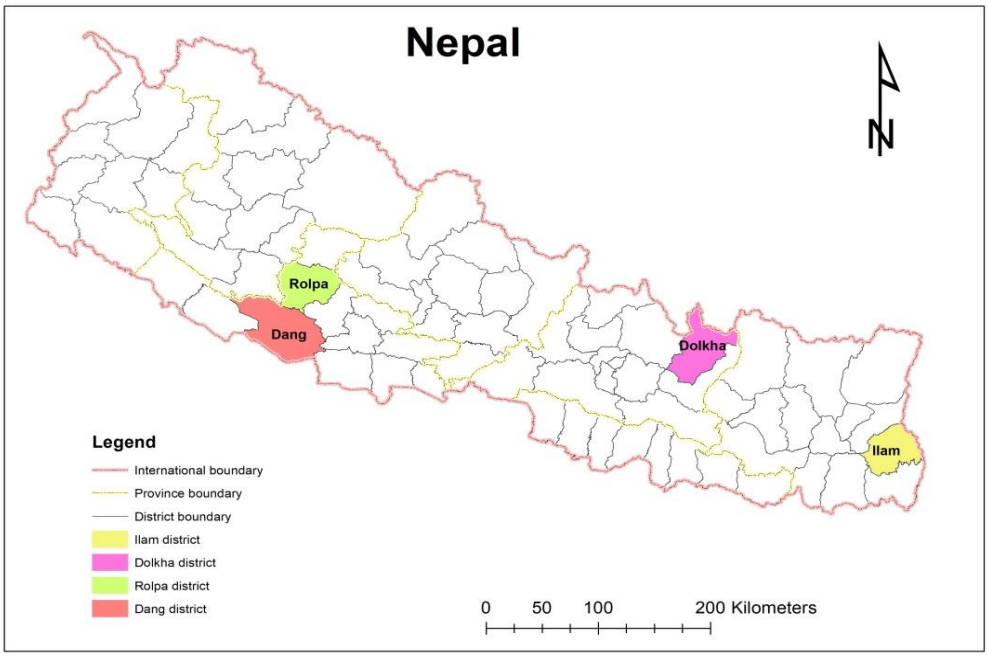
A mixed method was adapted for this study. The Household (HH) Survey, Focus Group Discussion (FGD), Key Informant Interview, and SWOT analysis were conducted to gather the information and data. The field visit was conducted in all four districts (Dolakha, Rolpa, Ilam and Dang). The household survey was conducted in three districts (Dolakha, Rolpa and Dang) and checklists were developed to conduct interviews. In Ilam district, FGD, KII and SWOT analysis was conducted to gather facts and understanding. The selection of district is based on the (i) proven production cardamom in national production system as reflected from MoAD (Ilam district), (ii)

recently producing district (Dolakha), (iii) production at household level but not yet acknowledged in national production system (Rolpa district), (iv) does not have production yet but can be prospective site for production (Dang district). The prospect of Cardamom production was explored in Dang district. Dang district is not yet a producer but farmers from hilly parts of Dang responded that the crop is feasible there.

In Dolakha, production was surveyed among 40 HHs. Since Rolpa still does not have mass production, some qualitative information about its production was assessed with 40 HHs.

The study sites were the community of Holeri and Jhenam area (Rolpa); Danabari area (Ilam); and Lapilang area (Dolakha). In Dang district, users of Community Forest User Group (CFUG) of Dudhras, Kuti Chaur, Dharna (Pandaweshwor CFUG, Khadgadevi CFUG, Kartikerani CFUG, Jharana CFUG, Bhulke CFUG, Kalika CFUG and Gadibara CFUG) were visited with 70 HHs. Altogether 6 KIIs were conducted in each district. The data was analyzed through descriptive statistics. Descriptive statistics provided information about production of cardamom and its trend for 6 years. National level information was received from the Ministry of Agriculture and Livestock and other government sources.

Similarly, the existing cardamom practice was reviewed in the papers. Literature review was carried out documents' adaptation aspect of cardamom and its value chain.



FINDINGS

Cardamom production as strategy of climate change adaptation

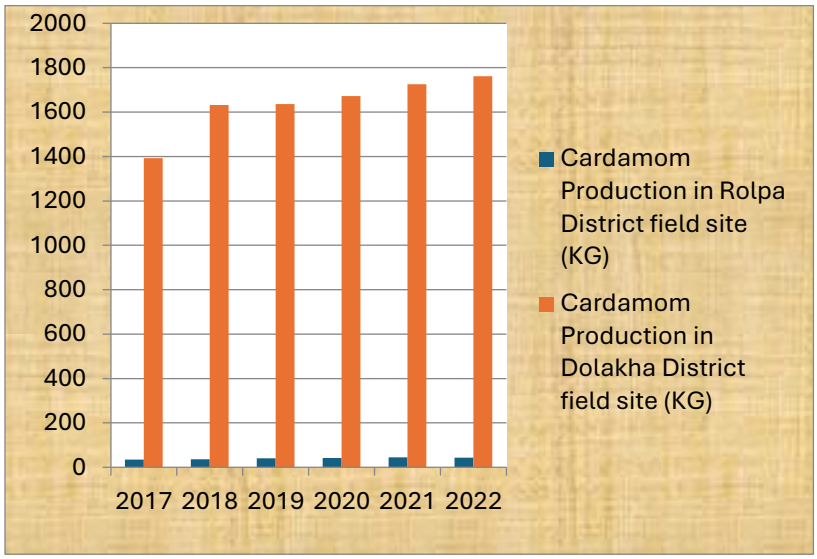


Figure 3 Cardamom production in Rolpa and Dolakha district study sites

Cardamom is produced in community land, private land and in community-based forests. Mostly community people prefer to produce cardamom on private land because they can easily sell it at their own interest and do not need to comply with other procedural complications. The cardamom species yields production from third year onwards of plantation. In some cases, good cardamom seedling production was reported in the first year as well. In both Dolakha and Rolpa districts cardamom production is increasing every year. Figure 3 shows the trend of production in the household surveyed area. The amount of production in Rolpa district is reported to be very low whereas that in Dolakha district is more. Production in Dang district has not yet started. Similarly, In Ilam district, KII and secondary data review was conducted. So, the above figure does not consist of the production of Ilam and Dang district. "Community people produce cardamom for its economic benefit and immediate return. The shift of weather pattern such as sudden rain fall does not adversely impact the cardamom, but it does to crop varieties such as wheat, maize. It is a strategy to address climate change effect," said Naresh BK, a producer from Dolakha district. The trend of cardamom production has been found to have increased in Dolakha district (trend

ISSN Online: 3021-9604

of 2017 to 2022 in the figure). The short rotation and income yielding crops have been considered for such intervention.

The production of cardamom depends on geography and climate. The geography, 500 to 1500 MSL and climate,15 to 35 Degree Centigrade is feasible for cardamom farming (Swar et al.2023). The northern belt of Dang district adjoining to Mahabharat hill range with moist area are found suitable for this species.

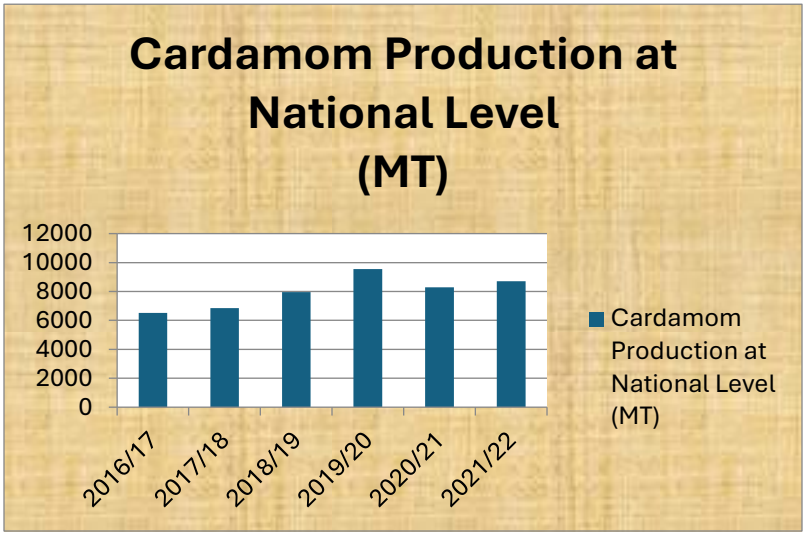


Figure 4: National level cardamom production

The production of cardamom has been found in an increasing trend in all three Rolpa, Ilam and Dolakha districts. In the northern part of Dang district, the practice of cardamom has been practiced very recently at the household level. Commercialization of this prouct has not been started yet in this district. The lesson learned from cardamom production from Ilam district has motivated other districts to expand it. The contribution of cardamom to the local economy is one of the reasons for its acceptance. The concern to upscale cardamom in different parts of the country including Rolpa, Dang and Dolakha reflects success in the Ilam district. Nationally more than 80% of the cardamom harvest comes from the eastern part of Nepal where Ilam district, the pioneering district of cardamom production has important share. The cardamom production in both Rolpa and Dolakha are recent initiatives where seeds and expertise were brought from Ilam district. The practice of cardamom has scope in the northern part of Dang district where the climate is suitable for its farming. During the interaction meeting in Dolakha, farmers shared that they are switching to these income generating crops from earlier conventional cereal crops. The cardamom farming is yielding them return of almost three to five times benefit in comparison to traditional crops such as maize, rice etc.

Cardamom price, like another commodity, fluctuates. The range of cardamom price is NRs 650 per KG to 2400 per KG based on demand. The traditional crop production in a piece of land and its income outweighs the price

ISSN Online: 3021-9604

of paddy and maize which is below 40 NRs/KG. The agricultural input price in cardamom is significantly lower than that in rice and paddy (Based on consultation from field).

Cropping pattern, risk, trade route and knowledge

The sustainability of cardamom production depends on cropping pattern, risks and trade. The stock needs to be replenished after harvesting. Ensuring the stock or the production aspect of cardamom only guarantees the benefit to the farmers. The cropping pattern, associated risks on this process and knowledge make the whole flow as an integrated process. Based on this rationale, the findings on cropping pattern, risk, trade route and knowledge were explored. The availability of irrigation is a prerequisite of cardamom cropping. It needs moist areas for success. The plant survival rate is about 70 to 75 percent (FGD in Ilam, Dolakha and Rolpa). Based on the FGD, KII and interaction with local people, cropping pattern of Cardamom crops practised has been explored as following:

Table 1: Cropping patter and risk

<table>
<tr><th>Activities</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sept</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="6">Cardamom practice cycle and associated Challenges</td><td colspan="3">Planation and germination (Jan-Mar)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="3">Flowering period (Feb-Apr)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="3">Fruit generation (Mar-Jun)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="3">Fruit Maturation and Ripening (June-Aug)</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Harvest (Aug-Oct)</td><td colspan="2">Plantation begins</td></tr>
<tr><td colspan="5">Possibility of wildlife damage, rat, monkey, drought, aphid infection and fungal disease</td><td colspan="4">Possibility of wildlife damage, rat, monkey Hail, Water logging through excessive rain fall</td><td colspan="2"></td></tr>
</table>

Source: Source: Field visit (Ilam, Dolakha, Rolpa, Dang), 2021 and 2022

Animals damage the cardamom crop from its seedling stage to fruit ripening period as continuous threat. Cardamom is a vulnerable crop and monkeys; porcupines and other animals depredate it. "Monkeys also eat seedling stage of cardamom and its buds," says a local farmer. Similarly, the long-time storage of cardamom is also found detrimental to farmers. Farmers want to sell the cardamom as soon as they harvest it to avoid the risk in future. Once it is stored for a long time, its weight is gradually lost. "As the time of cardamom storage is increased, cardamom gets shrinked and weight gets lost. As a result, price becomes lesser," said Sarita Phago, a local farmer from Ilam district.

In the beginning, cardamom, plants were purchased in Nepali Rupees (NRs) 4 to 10 per seedling according to district and place. In Ilam district, it is cheaper and becoming more and more expensive in Dolakha and Rolpa districts gradually. The trade route of cardamom involves stakeholders including (i) local level farmer/producer, (ii) district level aggregation, (iii) export to India from ground transportation adjoining border area of Nepal such as Mahendra Nagar, Nepalgunj, Krishna Nagar etc., (iv) national actors in Kathmandu, and (v) international market. The growing knowledge about production is enabling farmers to produce it more. The technology of cardamom processing is still primitive in nature. The cardamom is graded based on color. The first point of contact for trading cardamom starts from the household themselves. Local trader approaches household also as their first point of contact. They visit individual household level at producer level and negotiate the price.

The proximity matters in trade. Producers, collectors and traders all intend to shorten the routes. The specific trade root of the study area is as following:

Table 2: Trade route

District	Domestic trade route	International trade route (India)	International trade route (Other countries)	Remarks
Ilam	Ilam (Jhapa, Madhesh province, Chitwan)	Eastern border to India (Kakarvitta, Pashupati Nagar)	Via Kathmandu	Most of the export route is adjoining India border and border of Jhapa district

ISSN Online: 3021-9604

Dolakha	Charikot (Major hub of the district)	Mostly, local traders aggregate and transport it to Kathmandu	Via Kathmandu	Ground transportation to Dhulikhel and Kathmandu. Transportation from Dhulikhel to Janakpur is also in practice
Rolpa	Dang (Nepalgunj, Krishna Nagar)	Local traders collect and trade to India through Nepalgunj, Krishna Nagar (Production is very low)	Via Kathmandu	Most of the export is to India from Nepalgunj and Krishna Nagar via Dang district
Dang	(Nepalgunj, Krishna Nagar)	Local traders collect and trade to India through Nepalgunj, Krishna Nagar	Via Kathmandu	The production scope is in the hilly area of Dang district

Source: Field visit (Ilam, Dolakha, Rolpa, Dang), 2021 and 2022

The cardamom farming is already institutionalized in Ilam district. The cardamom price fluctuates each year. However, the price 6 US $ (NRs 800) per KG for cardamom was a standard price found during field visit.

Cardamom, Climate Change Adaptation and Linkage in Value Chain

The study has explored that cardamom value chain is analyzed from adaptation perspectives as well (Sharma et al., 2017; Nelson et al., 2007). At the producer's stage of value chain, direct benefit from climate change adaptation strategy has been noted through direct sale of the production. In all other subsequent value chain aspects, use of local resources and economic benefit are the most important elements. Similarly, diversifying income from the same piece of land adapting bee keeping, mushroom and livestock, poultry etc. also contributes to the livelihood's enhancement and resilience.

The result below is a common finding and specific finding of the district from climate adaptation perspectives. The SWOT analysis of cardamom value chain is as following:

Table 3: SWOT analysis of cardamom value chain and linkage to climate change adaptation

Aspect	Input supply	Production	Processing	Packaging	Marketing	Trading
Climate change perspectives	Focus on local situation (Local resource)	• Direct benefit from switching the crops (Climate Adaption process) • Economic benefit (livelihoods improvement) • Diversifying income from same piece of land by bee keeping, mushroom and livestock, poultry etc • Eco-friendly process Nature based solution	• Economic benefit (livelihoods improvement) • Contribution to resilience • Eco-friendly process	Economic benefit (livelihoods improvement)	Economic benefit (livelihoods improvement)	Economic benefit (livelihoods improvement)
Strength	• Land & availability (personal l&, community, CFs)	• Seedlings available at locally (Ilam, Dolakha)	• Lack of technology is still a critical issue (Traditional technology use)	• Packaging material support needed • Entrepreneur getting higher price of	• Community is aware about the local marketing process	• Cardamom Trading history is more than 3 decades in Ilam; Rolpa &

	• Wage worker availability & economic prices • Indigenous & local material use • Availability of supports from different organization & business support as well	• Household level production is recorded for last 15 years (Rolpa) • Prospect of production is available in hilly area of Dang district • Higher commercial collection (Ilam) • High potentiality growth at local village as well as community forest • Source of water is available • Locally available & no collection barrier • Collectors utilize their leisure time for additional income at community	• Well knowledge about processing method to the entrepreneurs through interaction meetings (Ilam, Dolakha) • Electricity (national grid/micro hydro) facility for making product at local level	packaging & its market is higher than non-packaging	• Supported needed to make them marketing beyond outside of Rolpa & Dolakha districts	Dolakha are recent with 10 years • Producer aware about price in the market

Weakness	• Inadequate inputs suppliers & chemicals (Cardamom) • Fertilizer is not available timely (Cardamom)	• Inadequate knowledge on modern technology • The irrigation channel from source of water to farm & is lacking (cardamom specific) • Motivation to the group members on processing at local level is lesser • Fertilizer availability	• Reliance on Fire-wood furnace (Rolpa, Dolakha) • High operational cost due to lack of technical know-how (Rolpa, Dolakha) • Poor quality due to use of traditional technology creating problem in external marketing • Training about product diversification needed • Excursion to eastern hilly zone to learn new ideas	The practice of aggregation of product does not exist. As a result, quality packing at producer level is not practiced	• Not fixed price, fluctuation • No proper & updated market information • The coordinated approach of dealing market does not exist	• High price fluctuation & not fixed price • Inadequate proper & updated market information
Opportunity	• Job creation prospect at the local level	• Hilly site of Dang district suitable for	• Knowledge on new processing technologies	Prospect of high return to the producers	• Potential market for products	Potential market for products

		cardamom production • Higher economic benefits • Possibility of establishing more cardamom nurseries employment opportunities to the rural poor people	Develop product diversified for better options		Possibility of linkage to Kathmandu, and other countries	
Threat	• The local entrepreneurs do not have skills and appropriate technology for product diversification at municipal and district level	• Crop damage by Monkey, Kala (an animal) • Pathogenic problem: Phurke disease and others • Drying of water sources	• Due to firewood furnace, pressure on forest area • Lack of modern technology for cardamom product making • In some places, there is only one	Adulteration of different quality of cardamom	• Entrepreneur themselves search market • Constraints on direct access of any trader in village/ external market constraint	Price fluctuation

		• Unavailability of appropriate technology for processing –applied traditional technology	furnace to dry cardamom • Threat for rotting of cardamom exists due to long storage		• Lesser marketing competition • Price fluctuation	

Source: Field visit (Ilam, Dolakha, Rolpa, Dang), 2022

The cardamom value chain was explored in four districts and the basic understanding about the value chain of cardamom follows following path. Mainly the following supply chains are used in marketing cardamom products. The whole supply chain of cardamom is attributed to the promotion of nature-based solutions.

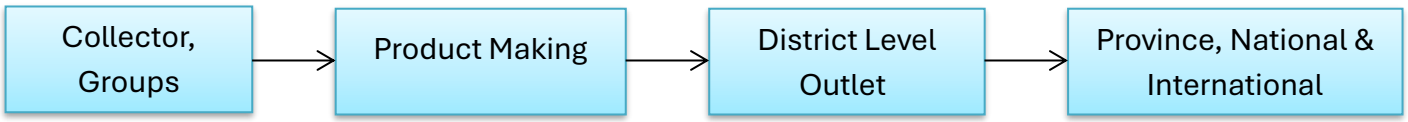


Figure 5: Supply chain of cardamo

Value addition and product diversification

As discussed in theoretical framework, the adaptation strategy has connection with livelihoods enhancement (Clay, 2018, Nelson et al.,2007). The value addition and diversification provide the opportunity to farmers towards sustaining livelihoods and resilience. This is also supported by studies and theory (Folke, 2010). Both value addition and product diversification are critical to it.

Value addition

The value addition consists of processing, grading and associated stages as an important part. The processing part is one of the challenging aspects in all crops. The processing part of cardamom is relatively better in Ilam district with the application of electric furnace. It has energy efficiency and lowers the carbon footprint avoiding firewood furnace. In other districts, firewood is used to process cardamom. The processing was explored poorer mostly from firewood furnace and that from sun burning. This type of process was recorded in Dolakha and Rolpa districts. Similarly, the community people do not grade it based on category. Conventional practice of subjective grading is in practice. Similarly, the process of tail cut among others is also in existence. The other forms of grading based on structure rot and not rot is also in practice. Similarly, some of the farmers of the community have received capacity development training.

Table 4: Value addition constituents

Value addition constituents	Actors	Barriers
The seed/seedling system	Farmers, seed researchers, seed bank	The seedling availability is informal, the availability of good seedling is lower and there is no choice for farmers (except Ilam district).
Production system (quality, variety, availability)	Farmers, including producers, farmer groups, cooperative farmers	Inadequate production (Dolakha), the availability of different types of seedlings is lower (Rolpa, Dang, Dolakha) and there is also a lack of production technology (Rolpa, Dang, Dolakha)

ISSN Online: 3021-9604

Processing and value addition	Farmers, processing etc.	Processing is labor intensive, and value addition is less than expected. The process is not women friendly.
Increasing market aspect (All types of formal and informal market)	Cooperatives, traders, etc.	Producers do have bargain capacity. Individual households sell it.
Policy approach	Farmers, traders, etc.	Inadequate research and infrastructure is poor

Source: Field visit (Ilam, Dolakha, Rolpa, Dang), 2022

Product diversification

Product diversification is one of the important aspects of farmers. "Farmers tend to diversify products for enhanced income and tackle climate change effects such as drought, crop failure," said Sarala Budha, a local farmer. In the value chain, such diverse products provide the opportunity of better income.

DISCUSSION

The production of cardamom in Ilam district is recorded for more than three decades (Magar et al., 2022). Similarly, the trend of cardamom production in Dolakha district is relatively new. The Rolpa district has been the cardamom producer (at least on household level) for a long-time though on a very small scale. However, still this product has not been accounted in MoALD national accounting system (CBS, 2013; MoALD, 2023). Despite the suitability of sites, temperature and other niche factors in Dang district, the production of cardamom has not started yet. At individual level, cardamom plantation exists but not in an entrepreneur level.

The introduction of cardamom is an adaptation strategy of community addressing the adverse effect of climate change. The key species have been game changers in the community (Kattel et al., 2020). For example, cardamom has been an important species for enhancing rural livelihoods (Hasan et al., 2023; Shreshtha et al., 2020). The acquired learning from Ilam, Dolakha districts are good examples for other prospective hilly areas (Dhungana et al., 2023).

Cardamom is considered one of the proven climate change adaptation strategies in hilly areas of South Asia (Possibia et al., 2022; Sharma et al., 2015). The reflection of this development in India has helped Nepal to adapt this crop. Cardamom has been perceived as viable income generating species for rural livelihoods (Dhungana et al., 2010). Cardamom crop is practiced in all provinces of Nepal (MoALD, 2023; KC et al., 2016).

The cardamom is a switching strategy from traditional crop to new crop to tackle adaptation challenges. The switching concurrently enhances income with increased resilience of farmers. This empirical finding from the field is substantiated with the studies. The finding explores the relation of adaptation, livelihoods and resilience as addressed in conceptual framework. The study finding from different study also suggests that crop switching for income generation and livelihoods is closely linked with the adaptation strategy to address the adverse impact of climate change (Cooper & Messina, 2023; Taylor, 2022). Similarly, different strategies are applied to climate change and crop switching being one of the prominent strategies (Nor Diana, 2022). Farmers have switched traditional crops to cardamom in other parts of South Asia (Bhutia et al., 2017).

Cardamom is also considered in agro-forestry model with *Alnus* and *Albizia* species (Paudel & Shrestha, 2022). Similar practices in different part of the country are also reported where cardamom is regarded as one of the climate change adaptation strategies and enhancing livelihoods in mid-hills of Nepal (Ranabhat et al., 2023; KC et al., 2016). Unfortunately, on some cases duplicate large cardamom has been found labelled as Nepal's production is also reported (GoN, 2017). It needs to be curbed timely.

It can be argued that switching towards crops such as cardamom from other conventional crops enhanced the resiliency and livelihoods of the farmers through increased income (Shrestha et al., 2018, Yazdanpanah, 2022; Carmen et al., 2022). This secondary review supports the claim that switching cardamom is an adaptation strategy that has potential for livelihoods enhancement and resilience. It further enabled the community to manage their bare land because of shortage of human resources for conventional farming practice (Pun, 2018).

CONCLUSION

The growing trends of cardamom production of national and sampled area indicate that farmers are enthusiastic about this cash crop innovation. The motivation of switching of the conventional crop to cardamom and insights of the farmers has revealed that cardamom cultivation continues to grow because the income with increased

adaptation, and its contribution on livelihood. The production aspect is linked to sustainability as stock. The processing part of cardamom is relatively with weaker focus area. Cardamom processing in some areas still rely on conventional firewood hearth for cardamom drying purpose. Use of conventional firewood contributes to deforestation. The high fluctuation of market price of cardamom year to year is making it indecisive to farmers to sell it. It makes them confusion about the sale, if they wait longer, the risk is there. If they do not wait, the price is lower.

Communities are reaping advantages from switching of the crop. Ilam and Dolakha are already in the cardamom scenario of Nepal, but Rolpa and Dang are progressing towards this. Despite the long tradition of trading history of cardamom, producers are not still linked with the major hub of marketing such as capital city Kathmandu adequately. The production Cardamom in Rolpa district and possibility of cardamom production hilly part of Dang district needs intervention. Similarly, the link to the international market is constrained. The farmers switch crops for adaptation purposes. The increased resilience and livelihoods through adaptation makes cardamom farming an innovative approach among rural farmers.

Acknowledgements

Authors would like to acknowledge the respondents and stakeholders for their support during the study.

Disclosure statement

The finding of this paper is original, and the first author has conducted field work in Dang, Rolpa, Dolakha and Ilam districts of Nepal.

REFERENCES

Adhikari, D., Prasai, R., Lamichhane, S., Gautam, D., Sharma, S., & Acharya,S. (2021). Climate change impacts and adaptation strategies in trans-himalaya region of Nepal. *Journal of Forest and Livelihood* 20 (1): 16-30.

Aryal, K., Maraseni, T., & Apan, A. (2023). A call for 'management authorship' in community forestry, *Environmental Science and Policy* 139: 204-208.

Atube, F., Malinga, Gm., Nyeko, M., Okello, D.M., Alarakol, S.P., & Okello-Uma, (2021). Determinants of smallholder farmers' adaptation strategies to the effects of climate change: evidence from northern Uganda, *Agric & Food Secur*, 10 (6): 14 pps.

Bhutia, K. C., Bhutia, S. O., Chatterjee, R., & Pariari, A. (2017). Post harvest processing and marketing of large cardamom in India, *Journal of Crop and Weed*, 13(3): 212-218.

Cabana, D., Rölfer, L., Evadzi, P., & Celliers, L. (2023). Enabling climate change adaptation in coastal systems: A systematic literature review. *Earth's Future*, 11, 18 pps.

Cannon, T., & Muller Mahn, D.(2010). Vulnerability, resilience and development discourses in context of climate change, *Nat Hazards*, Vol 55, 621–635.

CBS (2013). National Sample Census of Agriculture Nepal 2011/12, 124 pps, available on https://nsonepal.gov.np/wp-content/upLoads/2018/12/53-Rolpa.pdf, accessed on 7 August 2023.

Chambers, R., & Conway, G.(992). Sustainable rural livelihoods: practical concepts for the 21st century, discussion Paper 296, Institute of Development Studies: Brighton.

Cid, A., Siqueiros-García J.M., Mazari-Hiriart, M., Guerra, & Learner, A.M. (2023). Local governments as key agents in climate change adaptation: challenges and opportunities for institutional capacity-building in Mexico, *Climate Policy*, 1-12 pps.

Clay, N. (2018). Integrating livelihoods approaches with research on development and climate change adaptation, Progress in Development Studies, Vol 18 (1), pp. 1–17.

Dhananjayan, P., Joshi, S.R., Rajbhandari, U., & Gyeltshen, M. (2023). Capacity needs assessment for implementation of renewable energy and energy efficiency in the cardamom value chain of Nepal's mountain regions: results of a survey study, *Green and Low-Carbon Economy*, 1-17.

Folke, C. (2006). Resilience: the emergence of a perspective for social-ecological systems analyses. *Global Environmental Change,* 16:253-267.

Folke, C., Carpenter, S.R., Walker, B., Scheffer,M., Chapin,T., & Rockström, J., (2010). Resilience thinking: integrating resilience, adaptability and transformability; *Ecology and Society*, Vol 15 (4), 9.

GoN. (2017). Nepal national sector export strategy large cardamom 2017-2021, 94 pps.

Holling, C.S. (1973). Resilience and stability of ecological systems, *Annual Review of Ecology and Systematics*, 4: 1-23.

Holling, C.S., Schindler, D.W., Walker, B.W. & Roughgarden, J. (1995). Biodiversity in the functioning of ecosystems: an ecological synthesis. In Perrings, C., Mäler, K.G., Folke, C., Holling, C.S. & Jansson, B.O., editors, Biodiversity loss: economic and ecological issues, Cambridge: Cambridge University Press, 44–83.

IPCC (2014). Climate Change 2014 Synthesis Report Summary for Policymakers, 31pps.

Kabir, A., Amin, M.N. Roy, K., & Hossain, M.S. (2021). Determinants of climate change adaptation strategies in the coastal zone of Bangladesh: implications for adaptation to climate change in developing countries, *Mitigation and Adaptation Strategies for Global Change*, 26: 30.

Kandel, S. (2019). Economics of Production and Marketing of Organic Large Cardamom in Panchthar District of Nepal, Vol 3(8), 133-144 pps.

Kalauni, D., & Joshi, A. (2019). Production economics, marketing and critical success factors of Large Cardamom in Bhojpur, Nepal, Cogent Food & Agriculture, Vol 5(1), 1-11 pps.

Kapruwan, R., Saksham, A.K., Bhadoriya, V.S., Kumar, C., Goyal, Y., & Pandey, Y. (2024). Household livelihood resilience of pastoralists and smallholders to climate change in Western Himalaya, India, *Heliyon*: 10, 15 pps.

Kattel, R.R., Regmi, P.P., Sharma, M.D., Thapa, & Y.B. (2020). Factors influencing adoption of major post-harvest handling practices of large cardamom in Nepal, *Cogent Food and Agriculture*, 6(1): 1-17.

Kumar, K.N.R., Reddy, M.J.M., Reddy, K.V., Paramesha, V., Balasubramanian, M., Kumar, T.K., Kumar, R.M., & Reddy, D.D. (2023). Determinants of climate change adaptation strategies in south India: empirical evidence, *Frontiers in Sustainable Food Systems*, 1-11.

Magar, M., Budhathoki, P., Kandel, S., Tandan, Chhetri, R, & Devkota, L. (2022). A Review on Marketing and Value Chain of Nepal Cardamom (Amomum Subulatum Roxb.) In The Eastern Hills of Nepal. Food & Agribusiness Management, 3(1): 28-32.

Maru, Y.T., Smith, M.S., Sparrow, A., Pinho, P.F., & Opha, P.D. (2014). A linked vulnerability and resilience framework for adaptation pathways in remote disadvantaged communities. *Global Environ. Change*, 28, 337-350.

MoALD. (2022). Statistical information on Nepalese agriculture, 274 pps.

MoALD, (2023). Statistical information on Nepalese agriculture, 269 pps.

Nelson, D.R., Adger, W.N., & Brown, K. (2007). Adaptation to Environmental Change: Contributions of a Resilience Framework, Annu. Rev. Environ. Resour.

Nofal, O.M., Van, D.E., Lindt, & J.W. (2022). Understanding flood risk in the context of community resilience modeling for the built environment: research needs and trends, *Sustainable and Resilient Infrastructure*, 7 (3): 171-187.

Nor Diana, M.I., Zulkepli, N.A., Chamhuri, S., & Zainol, M.R. (2022). Farmers' adaptation strategies to climate change in southeast Asia: a systematic literature review, *Sustainability*, 14: 15.

Paudel, Y. & Shrestha, S. (2022). Agroforestry Practices Prevailing in SAARC Countries: A Review, *Indonesian Journal of Social and Environmental Issues*, 3(1), 10-18

Paudyal, N.P., & Rai, K. (2020). Large Cardamom Farming In Falelung Rural Municipality Of Panchthar District, Nepal: An Overview, *International Multilingual Journal of Science and Technology,* Vol 5 (10), 1867-1874 pps.

Possibia, M., Ram, D., Feroze, & S.M. (2022). Adaptation strategies of climate change effect and factors affecting the adaptation choices of large cardamom in Sikkim, *Indian Res. J. Ext. Edu.*, 22(5), 155-159.

Pun, A.B. (2018). A review on different factors of large cardamom decline in Nepal, *Asian Journal of Research in Crop Science,* 2(4): 1-6.

Ranabhat, S., Acharya, S. Upadhaya, S., Adhikari, B., Thapa R, Ranabhat, S, & Gautam, D.R. (2023). Climate change impacts and adaptation strategies in watershed areas in mid-hills of NepaL, *Journal of Environmental Studies and Sciences*, 10.

Rijal, S., Gentle, P., Khanal, U., Wilson, C., & Rimal, B. (2021). A systematic review of Nepalese farmers' climate change adaptation strategies, *Climate Policy*, 1-15.

Sargani, G.R., Jiang, Y., Chandio, AA., Shen, Y., Ding, Z., & Ali, A. (2022). Impacts of livelihood assets on adaptation strategies in response to climate change: evidence from Pakistan, Environment, Development and Sustainability, 24 pps.

Sharma, G., Sharma, R., & Sharma, E. (2009). Traditional knowledge systems in large cardamom farming: biophysical and management diversity in Indian mountainous regions, *Indian Journal of Traditional Knowledge*, 8(1), 17-22.

Sharma, G., Joshi, S.R., Gurung, M.B., & Chilwal, H.C. (2017). Package of practices for promoting climate resilient cardamom value chains in Nepal. ICIMOD Manual 2017/3. Kathmandu: ICIMOD

Sharma, G., Partap, U., Dahal, D.R., Sharma, D.P., Sharma, & E. (2015). Declining large-cardamom production systems in the Sikkim Himalayas: climate change impacts, agroeconomic potential, and revival strategies, *Mountain Research and Development*, 36(3): 286-298.

Shrestha, K.P., Regmi, P.P., Pant, K.P., Kc, G.B., & Pandey, Y.R. (2022). Supply chain analysis of large cardamom in eastern Nepal, *Agricultural Science and Technology*, 14 (2):132-142

Shrestha, S., Shrestha, J. & Shah, K.K. (2020). Non-Timber Forest Products and their Role in the Livelihoods of People of Nepal: A Critical Reviews. *Grassroots Journal of Natural Resources,* 3(2): 42-56. Doi: https://doi.org/10.33002/nr2581.6853.03024

Taylor, P.J. (2022). The geographical ontology challenge in attending to anthropogenic climate change: regional geography revisited, *Tijdschrift voor Economischeen Sociale Geografie*, 114 (2): 63–70.

Tiwari, K.R., Rayamajhi, S., Pokharel, R.K., & Balla, M.K. (2014). Determinants of the Climate Change Adaptation in Rural Farming in Nepal Himalaya, *International Journal of Multidisciplinary and Current Research*, 2: 234-240.

Tiwari, K.R., Awasthi, K.D., Balla, M.K., & Sitaula, B.K. (2010). Local people's perception on climate change, its impact and adaptation practices in Himalaya to terai regions of Nepal, *Himalayan Journal of Development and Democracy*, 5: 56-63.

TKP (2018). Nepali large cardamom being pushed out of world markets, accessed on https://kathmandupost.com/money/2018/03/02/nepali-large-cardamom-being-pushed-out-of-world-markets, accessed on 25 Sept 2024, The Kathmandu Post.

Wise, R.M., Fazey, I., Stafford Smith, M., Park, S.E., Eakin, H.C., Archer Van Garderen, E.R.M., & Campbell, B. (2014). Reconceptualizing adaptation to climate change as part of pathways of change and response, *Global Environmental Change*, 325-336 pps.

Yazdanpanah, M., Wheeler, S.A., Zuo, A., & Tahereh Zobeidi, T. (2022). Understanding the influence of Iranian farmers' climate change beliefs on their adaptation strategies and mitigation intentions, *Climate and Development*, 14 pps.

Institute of Socioeconomic Research and Development

ISSN Online: 3021-9604

Can Participatory Irrigation Management be an answer to Sustainable Irrigation Water Management: A case study from India

Snigdha Giri [1], Dr. Subhra Chattopadhyay [2]

[1.] Senior Research Fellow, Department of Geography, Lady Brabourne College, University of Calcutta, India.
ORCID – https://orcid.org/0000-0001-8333-8303

[2.] Associate Professor, Department of Geography, Lady Brabourne College, University of Calcutta, India.

* Correspondence email: snigdhagiri16@gmail.com

How to cite this paper: Giri, S., & Chattopadhyay, S. (2024). Can Participatory Irrigation Management be an answer to Sustainable Irrigation Water Management: A case study from India. *International Socioeconomic Review*, *2*(1), 76–93. www.isrd.org.np

Received: August 05, 2024

Revised: October 25, 2024

Accepted: December 06, 2024

Published: December 24, 2024

Abstract

Participation of the communities at various tiers of irrigation management has gained popularity over the years. A parallel urge has been the promotion of sustainable practices that can provide high resource efficiency and greater returns with smaller resource outlay. Though studies have focused on both the issues, few have tried to link both. This study attempts to add to the existing knowledge by exploring whether sustainable management of irrigation can be achieved with the inclusion of farmers themselves in the operation and management of irrigation. For these 250 farmers who are members of Water Users Associations (WUAs) and 120 farmers who have never been a part of any WUA have been interviewed using Focus Group Discussion. Relative Irrigation Supply (RIS) and Irrigation Water Productivity (IWP) calculated using the CROPWAT 8.0 software of FAO, have been selected as the indicators of sustainability. Results show that the RIS among the participant farmers is lower than the non-participant farmers. The variability in RIS between the groups is statistically significant at $p<0.05$. The IWP is higher among the participant farmers and lower among the non-participants. The variance in IWP between the groups is not significant statistically. The strict adherence to water fees payment and training on rationed water use has imbibed water saving practices among the participant farmers. Thus, the study indicates that Participatory Irrigation Management can sustainability of irrigation practices among users and hence establishes a link between sustainable irrigation practice and community participation.

Keywords: CROPWAT, Irrigation Water Productivity, Participatory Irrigation Management, Relative Irrigation Supply, Sustainable Irrigation, Water Users Association

1. Introduction

Sustainability in terms of resource utilization in a way such that it provides for the present needs without compromising with the ability of the future generations to meet their resource needs was introduced by the Brundtland Commission (Bruntland, 1987). The Agenda 21 is the 'blueprint' of the practices and measures that are to be taken up globally across all scales to achieve sustainable development (UN-DESA 2012; Bryner 1999). In providing the world with sustainable policy practices, the Agenda in its 28th chapter recognizes the importance of communities and their participation in realizing the goal of sustainable development (Eckerberg & Forsberg, 1998; Meadowcroft, 2004; Coenen, 2009). UNDP (2012) has hinted that water governance in terms of political, social, economic and administrative systems is crucial for the attainment of sustainable water management (Sinclair et al., 2013). This is what connects PIM and sustainable irrigation management, although both differ in their reasons for emergence.

While the concept of sustainable development emerged to provide for a long lasting and efficient utilization of resources and the entire ecosystem in general, PIM emerged to address the glitches of traditional irrigation system. The PIM practice started gaining momentum in the decade of the 1970s when universally it was felt that the traditional, bureaucratic and centralized nature of the irrigation system was to be blamed for the inefficiency of the irrigation sector (Cremers et al., 2005; Gandhi & Namboodiri, 2008).

PIM as the name suggests is the practice of involving farmers and users themselves in the management of the irrigation systems. According to Gandhi and Namboodiri (2012), PIM involves the water users for the management of water at various tiers. Under this process, groups of farmers are organized into "formal bodies" which are variously referred to as Water Users Associations (WUAs), irrigation cooperatives or partnerships (Pg.7, ibid). Another parallel practice, Irrigation Management Transfer (IMT) also involves the users for operation and management of irrigation, but it differs a little from PIM. While IMT intends to replace the role of government in irrigation management, PIM aims at strengthening the links between the users and government by allowing farmers/ beneficiary's participation (Restrepo et al., 2007; Hamada & Samad, 2011). Chattopadhyay et al. (2022) in their study point out that participation of the communities leads to modification of the collective rules to promote proper implementation of such rules, which in turn leads to sustainable management of water resources. Similar claims have been made by Rao et al. (2021) in their study on China where PIM promoted the adoption of the sustainable techniques like Mulched drip irrigation techniques among the participant farmers.

Thus, the importance of community involvement in providing for sustainable and eco-friendly resource use has been felt globally and the water resource, especially irrigation resources, has been no exception. The rising crisis of global freshwater resources stands in crossroads with the rising global population that requires food security

for its sustenance. The World Bank (May 2020) states that about 20% of the total cultivated area of the world is irrigated and it produces 40% of the world's food. This hints at the rising demand for irrigation water to feed the increasing world population. In the light of present-day climate change and scarcity of water resources, efficient use of water for irrigation becomes crucial (Calzadilla et al., 2011; Mancosu et al., 2015). This efficiency is often hindered by the absence of proper institutions for sustainable water resource management (Sudgen et al., 2020; Chattopadhyay et al., 2022).

Taking cue from the global attempts, India introduced the Command Area Development (CAD) Program way back in 1974 which recommended the involvement of farmers and water users in the management of irrigation. Though the program could not achieve much, it did set the ground for PIM. The National Water Policy of 1987 led to formal introduction of PIM in India and participation of the stakeholders was seen as an instrument for better irrigation management (Nayak & Manasi, 2016). The National Water policy of 2002 further emphasized on the involvement of users, especially the women users and gave impetus to necessary legal and institutional changes for the devolution of irrigation management rights to local bodies like WUAs (Devi, 2018). Similar attempts were made in the subsequent Water Policy of 2012 that recommended the involvement of WUAs at the planning and decision-making stages of irrigation management. Policies like Per Drop More Crop, Pradhan Mantri Krishi Sinchai Yojana, Har Khet Ko Pani etc., have emphasized the adoption of PIM. Since then, the farmers have been an integral part of irrigation management in India but there is no unified PIM law in the country and each state has adopted the practice flexibly. For instance, states like Andhra Pradesh, Gujarat, Tamil Nadu and Odisha have enacted legislations for the adoption of PIM while the state of West Bengal has refrained from legalizing PIM. Apart from the government initiatives, various non-government actors have also enabled the introduction of PIM in India. This list may include Non-Government Organizations like Society for Promoting Participative Ecosystem Management (SOPECOM) of Pune and Development Support Centre (DSC) of Gujarat and funding agencies like World Bank, the State Water and Land Management Institutes (WALMI).

PIM has been in practice across the globe for over four decades now and its impact analysis is becoming crucial. Majority of the works that have been taken up previously have either portrayed the practice of PIM in the light of institutional and bureaucratic changes in the irrigation management or have assessed it based on the improvements in water fees collection, conflict resolution, irrigated area or area under crops (Jadeja & Parmar, 2017; Pèk et al., 2019; Husain et al., 2021). These works have highlighted the chequered nature of PIM's outcome, and the factors have been promoting or obstructing the successful implementation of PIM (Cambaza et al., 2020; Senanayake et al., 2015). Though Chattopadhyay et al. (2022) have emphasized on the importance of the WUAs in devising irrigation management plans that are locally sustainable, they have not devised quantitative measures to approve of the sustainability that is claimed to have been achieved with the introduction of PIM. Thus, few papers have gone beyond the institutional and participatory features in understanding the sustainable resource management introduced by PIM. Moreover, a comparative analysis of such outcomes in the presence and absence of PIM is lacking in most of the literatures. This paper tries to bridge this gap by including the measures on irrigation supply

and the per unit productivity of irrigation water supplied by comparing the participant and non-participant farmers.

This paper thus attempts to understand the practice of sustainable resource management through the prism of Participatory Irrigation Management (PIM). Though a lot of work has been taken up individually on the concepts, few works have reflected on whether the involvement of the communities and stakeholders leads to sustainable irrigation management. The PIM here has been considered as the means to attain the end that is sustainability. It attempts to bring out the implication of the participation of the users on the efficiency of water use. For this, firsthand information has been collected across two groups that are similar in their socio-cultural, economic and demographic characteristics, but are different in terms of a 'treatment' or 'placebo'. The treatment here is PIM, where the treatment group has been a part of the PIM bodies like Water Users Association while the control group has never participated in any such PIM body. Overall, the study aims to highlight whether sustainable management of irrigation water can be brought about by PIM by measuring the RIS and IWP between the two groups of farmers.

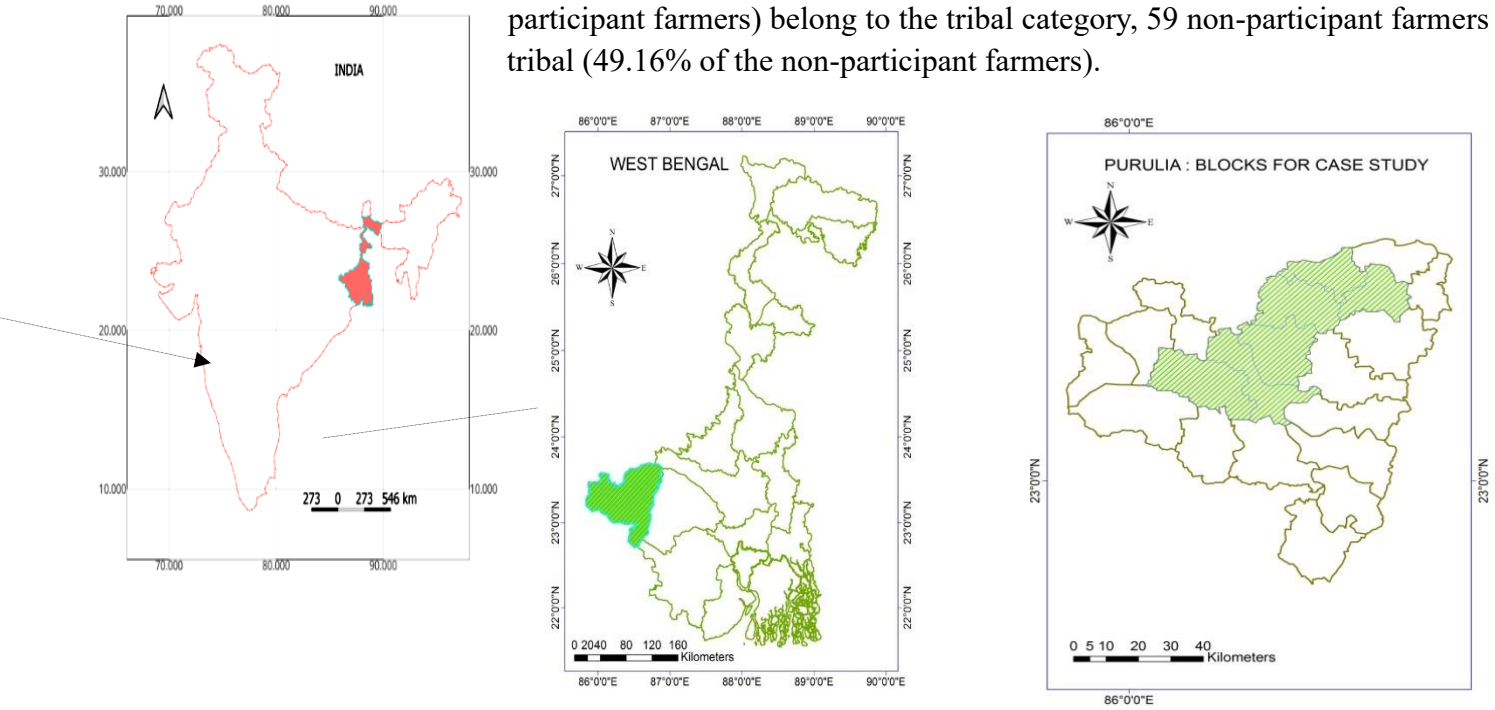
2. Materials and Methods

2.1 Study area and Sampling

The study is based on the Indian District of Purulia in the state of West Bengal (Map 1). The district is in the undulating red and lateritic agroclimatic zone and is characterized by low rainfall and poor soils with low fertility. The district experiences dry tropical climate with very high evapotranspiration rates (Ezung et al., 2022). The district has a high preponderance of small and marginal farmers with 79% of the farmers with a land holding size of less than or equal to 1 hectare (NABARD Report, 2022). Thus, irrigation and its sustainable utilization have become crucial for the district. The study is based on six Community Development Blocks drained by three major rivers from the district, namely Kangsabati, Damodar and Kumari. The blocks chosen for the study lie within these three river basins. The selection of the Blocks has been further done based on two factors a) the post monsoon water level b) presence/absence of the PIM bodies. From each river basin, one block with participant farmers and one non-participant farmer has been selected, thus adding up to six blocks. Moreover, each block selected recorded the lowest post monsoon water level within the river basin with or without PIM bodies.

A total of 250 Farmers who have participated in PIM have been chosen from 25 WUAs across three blocks from each river basin and 120 non-participant farmers have been chosen for the study from each. The participant farmers were chosen using Purposive Sampling Technique and the non-participants were chosen using random sampling technique. Purposive sampling has been utilized to intentionally focus on the participants and their experiences, while random sampling was done in case of non-participants to avoid biases. Both the farmer groups have been selected from similar demographic and socio-economic profiles so that near similar characteristics of the respondents can be maintained. This has been done cautiously to avoid any bias in estimating the 'treatment'

effect. Thus, the farmers chosen for the study are mainly small and marginal ones for both the groups. While the former farmers own 1-2 hectares of land, the latter own land below 1 hectare. Respondents also come from two broad demographic categories, tribal and non-tribal. While among the participant 120 farmers (48% of the total participant farmers) belong to the tribal category, 59 non-participant farmers are tribal (49.16% of the non-participant farmers).



Map1. The hierarchical selection of Study area

2.2 Data Collection

Both primary and secondary data have been utilized for the study. The primary data has been collected firsthand from both the participants and the non-participants using face to face interviews conducted between 2021 to 2023. The data mainly relates to inputs on the duration of water supply, power of the pump, distance of water source from the farm. Secondary data has been collected from various Government reports on input related to weather.

2.3 Indicators and Techniques Used

The study is based on two water related indicators – a) Irrigation Water Productivity (IWP) b) Relative Irrigation Supply. These two indicators have been used to identify whether PIM could attain sustainable management of irrigation.

Irrigation Water Productivity is a measure output produced with per unit water supplied in m3. It is the per unit productivity of water. Thus, it requires data both on the production of crops and the amount of water supply. It is the ratio of the input in terms of water supply while output in terms of crop production. The measure of IWP as a

measure for sustainability has been common across literatures (Li et al., 2024; Mali et al., 2016; Kassam, 2007; Zhang, 2013). Similar implications have been noted in the Economic Survey of India (2018-19), where the suggestion has been to shift the focus from 'land productivity' to 'irrigation water productivity' with a view to improve the water efficiency (PIB, Government of India, Ministry of Finance 4th July 2019). Thus, this factor has been used as an indicator of water use efficiency as it is backed both by the research fraternity as well as the Government.

It includes the surface water diverted to the fields through pumps. The IWP has been considered as an effective tool in assessing the sustainability of irrigation management. This is the volume of the water applied and includes all kinds of water losses from evaporation and run off.

The data on the production of crops includes the average production of the major crops grown by the respondents from 2021 to 2023. The crops include paddy and horticultural crops. The data has been collected both from the participants and from the project reports. The value of the production of the crops is in kg. The data on the volume of water used has been calculated from the data on flow rate (gallons per million or gpm) of the pumping system, the area irrigated and the time for which the pumping system has been used. It has been calculated in two steps. The volume of irrigation water supplied is given by,

*V = Q * t (Equation1)*

Where, *V is the volume of water in m3, Q is the flow of Water in gpm, and t is the time of the pump's operation.*

Since the flow of water needs to be measured, this was calculated by,

Q = HP 3690 / TDH *SG…… (Equation 2)*

Where, *Q is the flow rate of water in gpm, HP is the Horsepower of the pump, SG is the Specific gravity = 1, TDH is the Total Dynamic Head = Vertical height travelled + friction loss in the pipe.*

The efficiency of the pumping system has been taken as 55% according to FAO guidelines (pumping efficiency for surface water ranges between 50%-60%).The Calculations have been computed from the website of *Irrigated Agriculture and Extension Centre (IAREC)* of the *USDA* www.irigation.wsu.edu

The Relative Irrigation Supply is the ratio of the total supply of irrigation water to the total demand of the same by the crops (Benavides et al., 2021; Chandran & Ambili, 2016). It is thus the total amount of water that a crop needs from irrigation and doesn't include the part of crop water demand that is met by precipitation. For this, data on two variables were taken: a) crop water demand b) water supplied.

The Crop Water Need is given by,

$Et_{(c)}$ = *Water supply (mm)* – $Et_{(0)}$ *(mm)* …… (Equation1)

Where, $ET_{(c)}$ is the total crop water demand and $Et_{(0)}$ is the potential evapotranspiration (PET).

Again, *Irrigation water need (IN) = $ET_{(c)}$ (mm) - Pe (mm)*……. (Equation2)

Where, *$ET_{(c)}$ is the Crop water demand and Pe is the effective rainfall in mm.*

But IN is the depth of water needed by the crops in mm, but RIS requires volumetric data.

Thus, *Volume of Irrigation Water needed by the crop (INc) = IN (From Equation2) * Area to be irrigated.*

For estimating the Potential Evapotranspiration (PET) data and effective rainfall (Pe) the FAO Penman-Monteith method has been utilized using the CROPWAT 8.0 software to calculate the PET.

Once both the IWP and RIS have been calculated for the participants and non-participants, the data was put to statistical test to understand whether there exists any significant difference between the two sets of samples used for the study. For this, the data was checked for homogeneity using Levene's method and for normality of the distribution using the Shapiro-Wilk measure. Depending on these, the data fulfilling the assumptions of Parametric test was put to Independent T test while the failing the assumptions was put to the non-parametric Man-Whitney U test. While RIS qualified for parametric test, IWP was non- parametrically tested.

2.4 Limitations of the Study

The study did face constraints and limitations in terms of sampling, time and money. The use of purposive sampling for the participant farmers was relevant for the FGD and in-depth study of the participants' experiences but the sampling bias could not be dealt with altogether. There were constraints on time and money and hence the study could not be conducted over a larger geographical area. This could not lead to the study of the spatial variations in the nature and working of PIM.

3. Result

3.1 Irrigation Water Productivity

This indicator gives an overview of the productivity of crops in terms of the irrigation water applied and measures the per unit output of crop that can be procured from each unit of irrigation water applied. Table 1 shows that participant farmers who belong to some PIM group have scored a higher IWP than the non-participants. While the participants have an IWP of 1.54kg of crops per m^3 of irrigation water application, the non-participants can grow 1.33kg of crops with $1m^3$ of irrigation water (Fig.1). This may be attributed to the higher levels of both the production of crops as well as higher irrigation water supply among the participant farmers.

Table 1: The Irrigation Water Productivity indicating the per unit crop production of Irrigation Water among the Participants and Non-participants.

Group	Production (kg)	Supply (m3)	IWP (kg/m3)

Participants	54463.7	35366	1.54
Non-Participants	29706.09	22335.41	1.33

Source: Computed by authors from field data

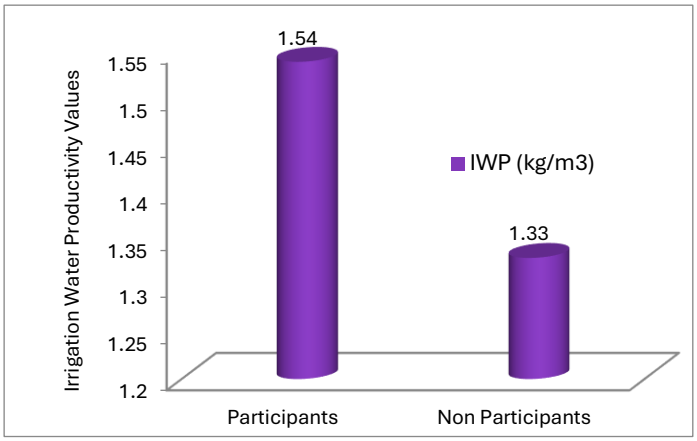


Fig.1The Irrigation Water Productivity indicating the per unit output from irrigation water

3.2 Relative Irrigation Supply

This section brings out the ratio between the crop water demand in terms of irrigation water needed and the water that is supplied to the crops. It is an indicator of the demand supply gap of irrigation water. An RIS of 1 indicates a perfect balance between the demand and supply; a value of less than 1 indicates a deficit while a value of more than 1 indicates excess water supply.

Table 2 shows that both the participants and the non-participants have recorded a surplus supply of irrigation water. But the non-participants showed a greater RIS value than the participants. While the demand for irrigation water has been higher for the participant farmers (28292.81 m^3), the non-participants have a lower demand (10245.6 m^3) (Fig.2). But in terms of supply, the participants have shown a lower value (35366.01m^3) as compared to the non-participants (22335.41 m^3). Thus, the non-participants tend to supply more than what is demanded by the crops. This has been highlighted by the RIS figures, where the RIS value for the participants is 1.25 but for the non-participants it is almost double at 2.18 (Fig.3)

Table 2: The demand-supply gap and Relative irrigation Supply among the participants and non-participants.

Group	Demand (m3)	Supply (m3)	RIS
Participants	28292.81	35366.01	1.25

ISSN Online: 3021-9604

Non-Participants	10245.6	22335.41	2.18

Source: Computed by authors from field data

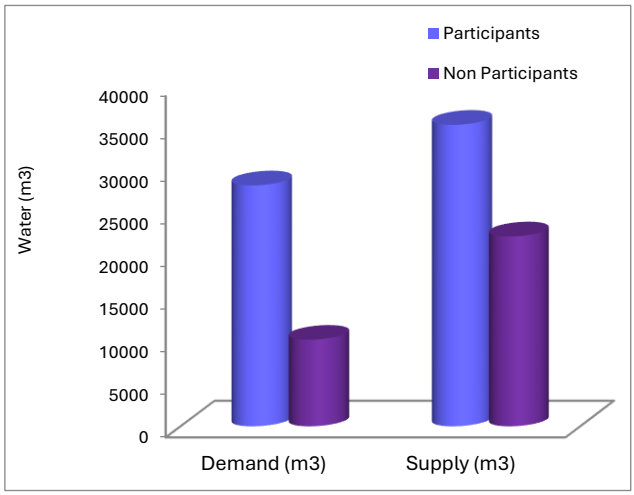


Fig.2 The demand supply situation of irrigation water participants and non-participants

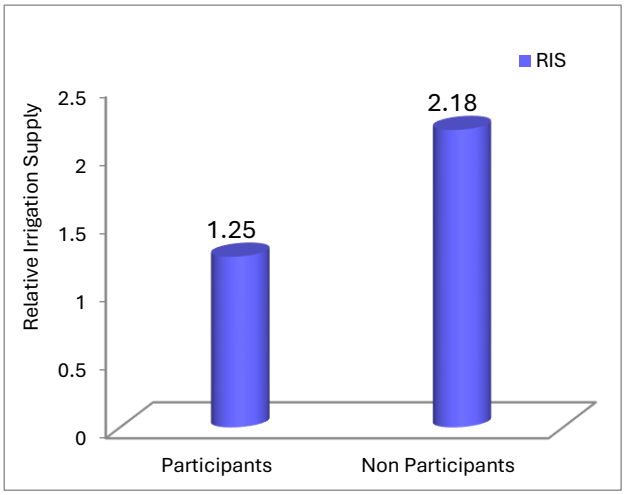


Fig.3 The Relative irrigation supply between the between the participants and non-participants

3.3 Significance testing of the Variance between the Groups

The previous section hinted at the variation in the values of PIS and IWP across the two groups. Thus, it becomes crucial to identify whether such values and their variation is statistically significant. To analyze the statistical significance of the variance in terms of the IWP and RIS among the groups, a variability test must be conducted. For conducting the parametric test, the data needs to meet the assumptions of a) homogeneity of data b) normal distribution of the data. For check if the data is normal, the *Shapiro-Wilk's* measure of normality has been tested. A value of more than 0.05 or a significance value below 95% indicates the data is distributed normally. For the homogeneity of variance, *Levene's Test* for Equality of Variances has been utilized. A value with 95 % significance or one with a p value of less than 0.05 indicates that there is homogeneity of variance.

a) Homogeneity of data: To assess the homogeneity of data, Levene's Test has been conducted with the help of SPSS (Table 3). While the significance level for RIS is 0.008 the significance of IWP is 0.003. Thus, the data for both the indicator is statistically significant ($p<0.05$). This shows that the data is homogenous and hence confirms with the requirement for conducting the parametric test

Table 3: Levene's Test for checking the homogeneity of the data

	Levene Statistic	df1	df2	Sig.

RIS	Based on Mean	7.913	1	368	.008
IWP (kg/m3)	Based on Mean	10.016	1	368	.003

Source: Computed by authors using SPSS

b) Normality of the distribution: The Shapiro –Wilk's measure has been used to test whether the data is distributed normally (Table 4). The participants have been denoted by '0' while the non-participants have been denoted by '1'. For RIS, both the groups have a significant value above 0.05 and hence show a normal distribution. While for IWP, while non-participants show a normal distribution ($p>0.05$), the participants don't show a normally distributed data ($p<0.05$). Hence it violates the assumption of parametric test.

Table 4: Shapiro-Wilk's Test for testing the normality of the data

	GROUPS	Shapiro-Wilk		
		Statistic	Df	Sig.
RIS	0	.954	120	.468
	1.0	.915	250	.079
IWP (kg/m3)	0	.777	120	.001
	1.0	.980	250	.933

Source: Computed by authors using SPSS

The preceding tests thus imply that parametric independent t test may be conducted for RIS as it fulfills the assumptions for both homogeneity and normality of data. While IWP failed the assumption of the normality of distribution and hence the non-parametric Mann Whitney U test has been conducted for it.

a) RIS: The parametric t test was employed to check the variance in RIS between the groups (Table 5). The test assumes two conditions- a) that there are equal variances between the two groups and b) that the variances are not equal. The significance table indicates that there lies significant variation between the two groups in terms of irrigation supply for both the assumptions as indicated by the p value ($p<0.05$). A negative mean difference indicates that the first group represented by the participants has recorded a lower supply as compared to the non-participants. The mean relative irrigation supply of the participant farmers is about 0.9 times lower than the non-participant farmers as is evident from the mean difference column.

Table 5: Independent t test for checking the significance of variance in RIS between the groups

		T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
RIS	Equal variances assumed	-3.253	370	.002	-.933879	.28706	-1.51552	-.35223
	Equal variances not assumed	-3.311	260.624	.003	-.933879	.282079	-1.51304	-.35471

Source: Computed by authors using SPSS

b) IWP: Table 6 indicates the results for the variance in Irrigation Water Productivity between the groups calculated by the non-parametric Mann Whitney U test. The significance table implies that there is no significant variation in the water productivity between the two groups ($p>0.05$). Thus, significant variation between the groups could not be achieved when it comes to per unit productivity of the irrigation water.

Table 6: Mann-Whitney U test indicating the variance between the groups in terms of IWP

	IWP (kg/m3)
Mann-Whitney U	168.000
Wilcoxon W	358.000
Z	-.618
Asymp. Sig. (2-tailed)	.536
Exact Sig. [2*(1-tailed Sig.)]	.550

Source: Computed by authors using SPSS

4.Discussion

The study hinted at the variations in irrigation water management between the participants and non-participants in the wake of a better and sustainable irrigation supply. The RIS and IWP were utilized as indicators for measuring this sustainability. While the RIS is an indicator of the balance between the demand and supply of irrigation

water, the IWP is a measure of the productivity of the irrigation water. Thus, while RIS is a direct measure of sustainable water utilization, IWP is a latent indicator and has economic implications of sustainability. This is because under ideal conditions, a sustainable IWP will lead to greater production with lesser water (Playón & Mateos, 2006; Ali & Talukder, 2008).

The study finds that both the participants and the non-participants have a surplus supply of irrigation water. This hints at the improvement in the irrigation situation in both the traditional and participatory irrigation systems. But the non-participants recorded a higher supply of irrigation water as compared to the participants. Thus, while the RIS for the non-participants is 2.18, it is 1.25 for the participants. A supply twice the demand as indicated by the RIS values of the non-participants is indicative of a wasteful use of water by the non-participant farmers. This may be explained by the lack of awareness and training about efficient utilization of irrigation water among the non-participants. That lack of training on the techniques that lead to improved irrigation conditions as a factor affecting irrigation performance has been highlighted by many scholars in their study (Batt & Merkley, 2010; Samian et al., 2015; Serote et al., 2021). Wang et al. (2013) in their study on northern China found that the amount of water diverted for irrigation tends to be lower when the water charges are levied as per duration of irrigation instead of the area to be irrigated. This indicates that a strict levy of water charges among the participant farmers in terms of the time length of water supply, as part of the WUA norm is yet another reason for the near balanced supply of irrigation by the participants. As noted by Walker (1989) in the FAO irrigation and Drainage Paper 45, more than 40% of the total water diverted for irrigation is wasted at the farm level. Thus, a switchover to water saving techniques like drip irrigation and sprinkler irrigation can reduce the water consumption among the non-participant farmers.

The IWP values are higher among the participant farmers than the non-participant farmers, although the difference is a small one. Thus, while the IWP for the participants is 1.54, it is 1.33 for the non-participants. A better IWP indicates that the per unit productivity of water is greater for the participants than the non-participants. This indicates a greater utilization of irrigation water by the participants as compared to the non-participants. But the difference being negligible, there is still scope for the participants to improve their IWP. Similar results where the difference in the Irrigation Water Use Efficiency between the participants and the non-participant farmers was negligible, was found by Zhou et al. (2017) and Zema et al. (2018).

The test for variance in the IWP and the RIS between the two groups indicated by both nonparametric and parametric tests show variable results. For IWP, the groups don't show any significant variation. Thus, in terms of the per unit productivity of irrigation water, the groups don't show much variance. This can also be sensed from the negligible difference in the values of the IWP of the two groups. The IWP in this case doesn't clearly imply sustainable management of irrigation water under PIM. Again, in terms of the RIS, the groups show significant statistical difference as evident from the independent t test ($p<0.05$). This holds importance, as the RIS is an important measure of sustainable water use. The significance in variation hints at the stark difference in the pattern of irrigation supply between the two groups and a higher value for the non-participants indicates wasteful use.

Although variability in test results couldn't be established between the participants and non-participant farmers in terms of IWP, RIS varied significantly. The presence of sustainable practices among the participant farmers like the timely payment of water fees, lesser conflicts in water distribution, adherence to water sharing norms during the dry periods are indeed indicators of sustainability. As noted by Chai, Gan, Turner, Zhang, Yang, Niu and Siddique (2014) in their study on Chinese agriculture, that involvement of the stakeholders improves the water saving technologies where farmers were found to move from being passive to active in water-saving actions. Higher water use efficiency and better utilization of water with improved participation conditions and greater involvement of communities in the operation and management of irrigation systems has been confirmed by Chaudhry (2018), in her study on Pakistan. The water pricing can thus be used as a measure to introduce water-conserving technologies even among the non-participant farmers (Schoengold & Zilberman, 2007).

5. Conclusion

Overall, the study tried to analyze the sustainable use of irrigation water in the light of participatory irrigation management. The indicators utilized in the study are representative of sustainable irrigation management as with proper demand supply balance and efficient utilization of each water unit, the wasteful usage of irrigation water can be lowered. This in turn will reduce the demand for water as a part of the "waste not want not" strategy. The study incorporates the treatment-control mechanism for understanding the practice of sustainability among the users. It finds that with participation, efficient utilization of irrigation can be achieved. This is partly because of the training and awareness generation among the participants and partly because of the stringent water pricing policy among the participants.

The constraint of time and money didn't allow the study to be conducted in a varied spatial unit with a different geographical setting. This could have further enabled a comparative and comprehensive understanding of sustainable PIM practices in varied physical settings. This gap can be bridged by future research endeavors to understand how physio-climatic conditions shape as well as modify the urge to participate and in turn affect the sustainable resource utilization. Moreover, whether PIM emerges as the future of sustainable irrigation management in the light of the present-day environmental crisis needs deeper understanding. As noted by Shah et al. (2002), there can be no blueprint for the success of PIM as each case is peculiar and is guided by the local opportunities and constraints ranging from physical to institutional and socio-economic factors. The disappointing outcomes of applying the WUAs model to various regions of South Africa, Sub Saharan Africa, Central Asia etc. are classic examples of how the mere imitation of irrigation models from developed nations cannot benefit the developing ones (ibid). Thus, each institution formed under PIM should be seen as unique and its success mantra should be based on its local determinants.

The study also promotes greater inclusion of the stakeholders themselves at various tiers of irrigation management to ensure greater proficiency of the irrigation systems. It suggests that the IWP among the participant farmers needs to be improved and one way of doing it could be switching over to the modern irrigation techniques like sprinkler and drip irrigation which can ensure lesser wastage and greater outputs. Similarly, among the non-

participant farmers the introduction of volumetric water charges can be a way towards prudent and economical water utilization. Moreover, the Government policies should be designed to mandate the inclusion of communities at the decision making and planning stages of irrigation management. More sensitization among the non-participants about the benefits of PIM can organize more and more water users under an institutional umbrella like the WUA. Above everything, the study testifies that greater inclusion of communities as managers and operators of irrigation can be regarded as a sustainable practice and thus more communities should be transformed from mere water users to water managers.

Author Contribution: Conceptualization, S.G. and S.C.; methodology, S.G.; software, S.G.; validation, S.G., and S.C.; formal analysis, S.G.; investigation, S.G.; resources, S.G.; data curation, S.G.; writing—original draft preparation, S.G.; writing—review and editing, S.G.; visualization, S.G.; supervision, S.C. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Funding Status: This work did not receive any funding.

Reference

Ali, H. M., & Talukder, U.S.M. (2008). Increasing water productivity in crop production – A synthesis. *Agricultural Water Management, 95(11)*, 1201-1213. https://doi.org/10.1016/j.agwat.2008.06.008

Bat, A.H., & Merkley, P.G. (2010). Water management and user association analysis for irrigation improvement in Egypt. *Irrigation and Drainage: The Journal of the International Commission on Irrigation and Drainage, 59*(2), 150-160. https://doi.org.10.1002/ird.465

Benavides, J., Plaza, H.E., Mateos, L., & Fereres, E. (2021). A global analysis of irrigation scheme water supplies in relation to requirements. *Agricultural Water Management,* 243. https://dx.doi.org/10.1016/j.agwat.2020.106457

Bruntland, G.H. (1987). Our Common Future: Report of the World Commission on Environment and Development. *United Nations General Assembly document,* A/42/427. https://www.un-documents.net/ocf-ov.htm

Bryner, C.G. (1999). Agenda 21: Myth or Reality? In, *The Global Environment: Institutions, Law, and Policy,* 157-189. Washington DC.

Calzadilla, A., Rehdanz, K., & Tol, J.S.R. (2011). Water scarcity and impact of improved irrigation management: a computable general equilibrium analysis. *Agricultural Economics, 42(3):*305. Wiley Online Library. https://doi:10.1111/j.1574-0862.2010.00516.x

Cambaza, C., Hoogesteger, J., & Veldwisch, J, G. (2020). Irrigation management transfer in sub-Saharan Africa: an analysis of policy implications across scales. *Water International, 45(1):* 3-19. Taylor & Francis Group. https://doi.org/10.1080/02508060.2019.1702310

Chai, Q., Gan, Y., Turner, C.N., Zhang, Z.R., Yang, C., Niu, Y., & Siddique, M.H.K. (2014). Water Saving Innovations in Chinese Agriculture (in) *Advances in Agronomy, 126*, 149-201. https://doi.org/10.1016/B978-0-12-800132-5.00002-X

Chandran, M.K., & Ambili, K.G. (2016). Evaluation of minor irrigation schemes using performance indicators: case studies from South India. *Sustainable Water Resources Management, 2*: 431-437. https://doi.org/10.1007/s40899-016-0074-3

Chaudhary, M.A. (2018) Improving on-farm water use efficiency: Role of collective action in irrigation management. *Water Resources and Economics, 22*: 4-18. https://doi.org/10.1016/j.wre.2017.06.001

Chattopadhyay, S., De, I., Mishra, P., Parey, A., & Dutta, S. (2022). Participatory water institutions and sustainable irrigation management: evidence and lessons from West Bengal, India. *Water Policy, 24(4)*: 667-684. https://doi.org/10.2166/wp.2022.306

Coenen, F. (2009). Local Agenda 21: 'Meaningful and Effective' Participation? In: *Public Participation and Better Environment Decisions.* https://doi.org/10.1007/978-1-4020-9325-8_10

Cremers, L., Ooijeevaar, M., & Boelens, R. (2005). Institutional reform in the Andean irrigation Sector: Enabling policies for strengthening local rights and water management. *Natural Resources Forum, 29*(1), 37-50.

Devi, V.C. (2018). Participatory management of irrigation system in Northeastern region of India. *International Journal of Rural Management, 14(1)*: 69-79. https://doi.org.10.1177/0973005218765552

Eckerberg, K., & Forsberg, B. (1998). Implementing Agenda 21 in local government: The Swedish experience. *The International Journal of Justice and Sustainability, 3*(3): 333-347. https://dx.doi.org/10.1080/13549839808725569

Ezung, T.Z, Barua, M., & Choudhury, A. (2022). Aquifer Mapping and Management Plan of Purulia District West Bengal. *Technical Report Series 213*(A). Central Ground Water Board Eastern Region Kolkata, Ministry of Jal Shakti, Government of India.

Gandhi, P. V., & Namboodiri, V. N. (2008). Participatory Irrigation Management in India: An Evaluation of the Performance in Andhra Pradesh, Gujarat and Maharashtra.Centre for Mangement in Agriculture, Indian Institute of Management, Ahmedabad.

Hamada, H., & Samad, M. (2011). Basic principles for sustainable participatory irrigation management. *Japan Agricultural Research Quarterly 45*(*4):* 371-376. https://doi.org.10.6090/jarq.45.371

Hussain, S., Khan, M, M., Shoaib, M., Raza, A., Shah, R, A, S., Khan, A, T., & Khan, S. (2021). Performance evaluation of participatory irrigation management system as an alternative to state- managed irrigation system. *Irrigation and Drainage*, 70(1), 150-168. https://doi.org/10.1002/ird.2515

Kassam, A.H., Molden, D., Fereres, E. & Doorenbos, J. (2007). Water productivity: science and practice – introduction. *Irrigation Science, 25*: 185-188. https://doi.org.10.1007/s00271-007-0068-x

Li, J., Ma, W., Botero-R, C.J., & Luu, Q.P. (2024). Mechanisation in land preparation and irrigation water productivity: insights from rice production. *International Journal of Water Resources Development, 40(3)*, 379-400. https://doi.org.10.1080/07900627.2023.2197080

Mali, S.S., Jha, K.B., Naik, K.S., Singh, K.S., & Kumar, A. (2016). Effect of fertigation pattern and planting geometry on growth, yield, and water productivity of tomato (Solanum lycopersicum). *Indian Journal of Agricultural Sciences, 86(9)*: 108-113. https://doi.org.10.56093/ijas.v86i9.61522

Mancosu, N., Synder, L.R., Kyriakakis, G., & Spano, D. (2015). Water Scarcity and Future Challenges for Food Production. Water *7(3)*: 975-992. https://doi.org/10.03390/w7030975

Meadowcroft, J. (2004) Participation and Sustainable development: modes of citizen, community and organisational involvement. In, *Governance for sustainable development: The Challenge of adapting form to function,* 162-190. https://doi.org/10.4337/9781845421700

NABARD. (2012). Purulia – PLP 2021-22. https://www.nabard.org

Nayak, P.B., & Manasi, S. (2016). Performance of participatory irrigation management in Odisha: a study of Pani Panchayats in two irrigation projects. *Indian Agriculture, 1 :*324-369.

Pék, É., Fert˝o, I., & Alobid, M. (2019). Evaluating the Effect of Farmers' Participation in Irrigation Management on Farm Productivity and Profitability in the Mubuku Irrigation Scheme, Uganda. *Water* (11), 2413. https://doi.org10.3390/w11112413

Playán, E., & Mateos, L. (2006). Modernization and optimization of irrigation systems to increase water productivity. *Agricultural Water Management, 80(1-3):* 100-116. https://doi.org/10.1016/j.agwat.2005.07.007

Rao, F., Abudikeranmu, A., Shi, X., Heerink, N., & Ma, X. (2021). Impact of participatory irrigation management on mulched drip irrigation technology adoption in rural Xinjiang, China. *Water Resources and Economics,* 33, 100170. https://.doi.org/10.1016/j.wre.2020.100170

Restrepo, G.C., Vermillion, D., & Munoz, G. (2007). Irrigation management transfer: worldwide efforts and results. *Water reports 32*: 1-63.

Samian, M., Mahdei, N, K., Saadi, H., & Movahedi, R. (2015). Identifying factors affecting optimal management of irrigation water. *Journal of the Saudi Society of Agricultural Sciences, 14(1)*: 11-18. https://dx.doi.org/10.1016/j.jssas.2014.01.001

Schoengold, K., & Zilberman, D. (2007). The Economics of Water, Irrigation, and Development (in) *Handbook of Agricultural Economics*, *Chapter 8, 3*: 2933-2977. https://doi.org/10.1016/S1574-0072(06)03058-1

Serote, B., Mokgehle, S., Plooy, D.C., Mpandeli, S., Nhamo, L., & Senyolo, G. (2021). Factors Influencing the Adoption of Climate-Smart Irrigation Technologies for Sustainable Crop Productivity by Smallholder Farmers in Arid Areas of South Africa. *Agriculture, 11(12)*. https://doi.org/10.3390/agriculture11121222

Senanayake, N., Mukherji, A., & Giordano, M. (2015). Re-visiting what we know about Irrigation Management Transfer: A review of the evidence. *Agricultural Water Management*, *149*: 175–186. https://doi.org/10.1016/j.agwat.2014.11.004

Shah, T., Van K.B., Merrey, D., de Lange. M., & Samad, M. (2002). Institutional Alternatives in African Smallholder Irrigation: lessons from international experience with irrigation management transfer. *IWMI Research Report 60*, Colombo, Sri Lanka.

Sinclair, J.A., Kumnerdpet, W., & Moyer, M.J. (2013). Learning sustainable water practices through participatory irrigation management in Thailand. *Natural Resources Forum 37 (1)*: 55-66. https://doi.org/10.1111/1477-8947.12012

Sudgen, F., Agarwal, B., Leder, S., Saikia, P., Raut, M., Kumar, A., & Ray, D. (2020). Experiments in farmer's collectives in Eastern India and Nepal: process, benefits, and challenges. *Journal of Agrarian Change,* 1-32. https://doi.org/10.1111/joac.12369

UN-DESA (2012). Review of implementation of Agenda 21 and the Rio Principles – Synthesis. *Sustainable Development in the 21st Century. http://www.sustainabledevelopment.un.org*

Wang, X., Otto, M.I., & Yu, L. (2013). How physical and Social Factors affect village level irrigation: An institutional analysis of water governance in Northern China. *Agricultural Water Management, 119*: 10-18. https://dx.doi.org/10.1016/j.agwat.2012.12.007

World Bank (2020). Water in Agriculture. *https://www.worldbank.org/en/topic/water-in-agriculture*

Zema, A.D., Nicotra, A., Luciano, M., & Zimbone, M.S. (2018). Improvement of the irrigation performance in Water Users Associations integrating data envelopment analysis and multi-regression models. *Agricultural water Management, 205*: 38-49. https://dx.doi.org/10.1016/j.agwat.2018.04.032

Zhang, L., Heerink, N., Dries, L., & Shi, X. (2013). Water users' associations and irrigation water productivity in northern China. *Ecological Economics 95*: 128-136. Elsevier. https://dx.doi.org/10.1016/j.ecolecon.2013.08.014

Zhou, Q., Deng, X., Wu, F., Li, Z., & Song, W. (2017). Participatory irrigation management and irrigation water use efficiency in maize production: evidence from Zhangye City, Northwestern China. *Water 9*(*11)*: 822. https://dx.doi.org/10.3390/w9110822.\

Institute of Socioeconomic Research and Development

ISSN Online: 3021-9604

Economic Development and Changing Women Lives: Evidence from Women Employment Participation in India

Suhail Ahmad Bhat[1], L.C Mallaiah[2] and Shambhavi Singh[3]

[1]ICSSR Post-Doctoral Fellow, Department of Economics, Babasaheb Bhimrao Ambedkar University Lucknow, Orcid: 0000-0003-0609-9067

[2] Professor, Department of Economics at University of Hyderabad (UOH)

[3] Doctoral Fellow in Economics from Dr Bhimrao Ambedkar University, Agra

Corresponding email: bhatsuhail2000@gmail.com

How to cite this paper: Bhat, S. A., Mallaiah, L. C., & Singh, S. (2024). *Economic Development and Changing Women Lives: Evidence from Women Employment Participation in India. International Socioeconomic Review*, *2*(1), 94–115. www.isrd.org.np

Received: August 14, 2024

Revised: October 25, 2024

Accepted: December 03, 2024

Published: December 24, 2024

Abstract

This paper examines the trends and patterns of women employment in India with the use of NSSO data from 1984 to 2011-12 and the latest PLFS data from 2017-2022. The paper draws out the changes in female employment during the period 1984-2022 by using exploratory research methods. The paper analyses the temporal trends from 1984 to 2022 across rural and urban areas and presents an overview of the status of female employment in India. The results show that over the period of last ten years the women employment in India has increased with manifold. The employment opportunities of women are showing an increasing trend with a shifted patterns of employment from agriculture sector to territory sector. The WPR of rural women of 15 years and above has increased to 35.8 percent. Whereas, among the urban female, it has been increased to 21.9 percent Moreover, the Indian economy is also witnessing the women entrepreneurship development in the country. Results shows that the unemployment rate (in percent) in usual status (ps+ss) among rural women has declined from 3.8 percent in 2017-18 to 1.8 in 2022-23. Whereas, among the urban female it has declined from 10.8 percent to 7.5 percent in the recall period. Therefore, the present paper attempts to analyze the economic

development and the changing women employment participation in both organized and unorganized sector in India.

Keywords: Economic Development, Woman Employment, Women Entrepreneurship, Workforce Participation, Organized Sector and Un-organized Sector, India.

1. Introduction

Indian economy has experienced a massive shift and has achieved substantial growth and development. However, the challenge of generating employment and creating quality jobs on a large scale continues to be a significant concern for the Indian economy (Sunita & Srija, 2014). Since the second five-year plan, creating job opportunities in the economy has been established as a key goal for attaining economic development. The eighth five-year plan intended to generate employment in the nation. The eleventh and twelfth five-year plans sought to achieve inclusive economic development (Behera, 2012). The Indian labor market has witnessed a significant change, the economy has been shifted from primary sector to tertiary sector with the distribution of occupations among gender in the country (Sunita & Srija, 2014).

The employment trends in India, particularly women employment have remained in a substantial debate among academicians and policy makers. Nonetheless, women constitute half of the population in India, but the share of women in labor force was only one fourth of the total labor force in the country (Bhalla & Kaur, 2011). In fact, women had always remained the victim of gender inequalities in India. However, over the period of last ten years, the women employment in India has increased with manifold. The employment opportunities of women are showing an increasing trend. The employment patterns of women have been shifted from agriculture sector to territory sector. Moreover, the Indian economy is also witnessing the women entrepreneurship development in the country. There are enormous number of evidence which shows that the share of women workforce participation has increased in India. In the era of 21st century, globalization has led rapid shifts in labor market across the globe (Sundari, 2020). Therefore, with the introduction of liberalization and globalization, the physical and financial limitations from Indian economy have abolished and it has improved the job participation rates in the country. Many of these changes, particularly for women, are supposed to have profound benefits for the degrees and quality of jobs or participation in economic activities (Anant *et al.,* 2006*)*. However, women's employment in the informal

sector has consistently increased over the few decades (Kundu, 2015). As a result, majority of women workers are engaged in the unorganized sector. Although, the data reveals that majority of women workers are engaged in the informal sector in India (Chen, 2012), but the work participation rates of women have increased. Earlier the women were highly engaged into traditional household and unpaid work, even women were carrying the burden of unpaid childcare and household chores in the country (Lota, 2011). At present, many women are also engaged into self-employment work and most of them are entrepreneurs, who are providing now employment to many other people in the country.

On the other women are also engaged into the formal sector (Mehrotra, 2019; Sundari, 2020) and they enjoy leisure or find it as a respectable job. and they have no other choice than to take low-wage positions that allow them to meet their major needs. In fact, 2011 women workforce constituted 20.5 percent of total employment in organized sector in the country. However, as per the previous employment assessment of Directorate General of Employment & Training (DGE&T), about 59.54 lakh women workers were employed in the organized sector (Public and Private Sector). At present, women are employed in a variety of organizations and enterprises within the organized sector. In the public sector, job opportunities exist in central government, state government, quasi-government organizations (autonomous entities such as educational institutions, developmental institutions, public sector enterprises, etc.) and different municipal authorities. Therefore, the present study aims to explore the women employment participation in organized and unorganized sector in India.

2. Review of Literature

There is an extensive evidences which shows that a large proportion of women are opting to stay out from the labor force to attend the domestic duties, reflecting the pressures of household and caring obligations of women (Sarkar *et al., 2019;* Pattnaik & Lahiri-Dutt, 2020; Li, 2023; Goel, 2023; Chakrabarti, 2023).There are also other studies which reflects that the low women job rates are mainly due to the lack of employment opportunities in the non-farm sector, especially for rural women in India (Sabreen & Behera, 2021; Menon & Nath, 2022; Das & Mahanta, 2023).The previous literature also highlights that the work participation rate (WPR) among women is decreasing in India, as the income of the households increases a vast chunk of women are getting enrolled in the schools due to which the women work force are declining (Chatterjee et al., 2018; Bhattacharya, 2023; Goli et al., 2023). Therefore, female enrolment in schools have resulted the withdrawal of female labor force participation

in India (Krishna et al., 2016; Natarajan et al., 2020; Biswas & Banu, 2023). However, over the past few years, the Govt of India is more concerned about women empowerment and in this regard even the Government of India has passed a bill in the parliament which seeks to reserve one-third of the total number of seats for women in Lok Sabha, State Legislative Assemblies and Delhi Assembly to have a better participation and representation of a women in the country (Akar & Meshram, 2019; Sharma, 2023). Therefore, the affirmative policies of the government of India have increased the workforce participation rates of women and a vast literature shows that over the past few years the women employment in both organized and un-organized sector has been increased in India (Mahapatro, 2019; Sundari, 2020; Gupta, 2021; Mehta, 2021; Chatterjee & Banerjee, 2023). Therefore, the women employment needs in-depth study to understand its trends and patterns in India.

3. Methodology

The present paper is exploratory study based on the descriptive statistics, which aims to explore how women employment trends have changed in organized and un-organized sector in India. The study is based on secondary data, which have been taken from various rounds of the National Sample Survey Organization (1983 to 2011-12 round) and Periodic Labour Force Survey (PLFS) 2017-18 to 2021-22, Statista and Indiastat.com. The study explores the temporal trends from 1993 to 2021-22, contrasting rural and urban areas, and offers an overview of the status of female employment in India. The paper is based on the descriptive statistics and the compound growth rate has been calculated by using following formula (1/N)*LN (current year/previous year)*100.Whereas, N=number of years and LN= Natural Logarithm.

4. Results and Discussion

Work Participation Rate (%) Trends in India by Usual Status (ps + ss).

The Workforce Participation Ratio (WPR) accurately reflects the total number of employed persons within an economy, and it is obtained by dividing employed persons with the total population. The Usual Principal status encompasses all those who have worked for a relatively long part of the 365 days preceding the date of survey, and Usual principal subsidiary status encompasses individuals who did not engage in employment for most of the 365 days but were employed for a minimum of 30 days within the 365-day reference period prior to the survey date. Table 1 below reveals that among rural male, the WPR was 54.7 percent in 1983, which has increased to 55.3 percent in 1993-94 and after that it has remained constant in between 53 to 54 percent till 2011-12. Whereas,

among urban male it has increased from 51.2 percent to 54.6 percent in the recall period. However, in 2017-18 the Periodic Labor Force Survey (PLFS) measures the WPR in two categories i.e. 15 years and above and all ages. The 15 years and above data reveals that the WPR of rural male workers have been increased from 72 percent in 2017-18 to 75.3 percent in 2021-22 and among urban male, it has increased from 69.3 percent to 70.4 percent respectively.

The WPR of rural women was 34.0 percent in 1983, which has declined to 24.8 percent in 2011-12. Whereas, in case of urban females, it has decreased from 15.1 percent in 1983 to 14.2 percent in 2011-12. However, the Periodic Labor Force Survey (PLFS) shows that the WPR of rural women of 15 years and above has increased from 23.7 percent in 2017-18 to 35.8 percent. Whereas, among urban female, it has been increased from 18.2 percent to 21.9 percent in the recall period. Therefore, the results indicates clearly that the WPR of women has increased significantly from 2011-12 to 2021-22 in the country.

Table 1: Work Participation Rate (%) Trends in India by Usual Status (ps + ss).

	Male Workers		Female Workers	
	Rural	Urban	Rural	Urban
38th Round (1983)	54.7	51.2	34	15.1
43rd Round (1987–1988)	53.9	50.6	32.3	15.2
50th Round (1993–1994)	55.3	52.1	32.8	15.5
55th Round (1999–2000)	53.1	51.8	29.9	13.9
61st Round (2004–2005)	54.6	54.9	32.7	16.6
66th Round (2009–2010)	54.7	54.3	26.1	13.8
68th Round (2011–2012)	54.3	54.6	24.8	14.7
PLFS (2017–2018) 15 years &above	72	69.3	23.7	18.2
All Ages	51.7	53.0	17.5	14.2
PLFS (2018–2019) 15 years &above	72	68.6	25.5	18.4
All Ages	51.7	52.7	19.0	14.5
PLFS (2019-20) 15 years &above	74.4	69.9	32.2	21.3

ISSN Online: 3021-9604

All Ages	53.8	54.1	24	16.8
PLFS (2020–2021) 15 years &above	75.1	70	35.8	21.2
All Ages	54.9	54.9	26.6	17
PLFS (2021–2022) 15 years &above	75.3	70.4	35.8	21.9
All Ages	54.7	55	26.6	17.3

Source: NSSO, 68th Round, Report No. 554, Employment and Unemployment Situation in India, 2011– 2012 and Periodic Labour Force Survey, 2017–2018, 2018-19, 2019-20, 2020-21, 2021-22.

Gender Wise Labor Force Participation in India by age group (In millions)

It has been observed from the table 2 that the labor force participation among male in the age group of 15-24 years were 64.08 million in 2010, which has been declined to 55.04 million persons in 2021. However, the labor force participation rate among male in the age group of 25-54 years has been increased from 237.62 million persons in 2010 to 277.58 million persons in 2021. Similarly, the labor force participation of male in the age group of 55-64 is also showing an inclining trend i.e., it has been increased from 32.89 million in 2010 to 42.13 million in 2021.

Similarly, the labor force participation of females in the age group of 15-24 years has declined drastically from 22.27 million persons to 14.14 million persons. Similarly, the force participation rate of females in the age group of 15-24 years have also declined from 82.45 million in 2010 to 74.91 in 2018. However, after that it has been increased to 86.18 million in 2021. The declining women labor force participation is mainly associated with the increasing school admissions/ educational attainment among females, which has been discussed in the literature section. Moreover, the labor force participation of females in the age group of 55-64 has increased slightly from 11.02 million persons in 2010 to 12.19 million in 2021.

Table 2: Gender Wise Labor Force Participation in India by Age Group (In millions)

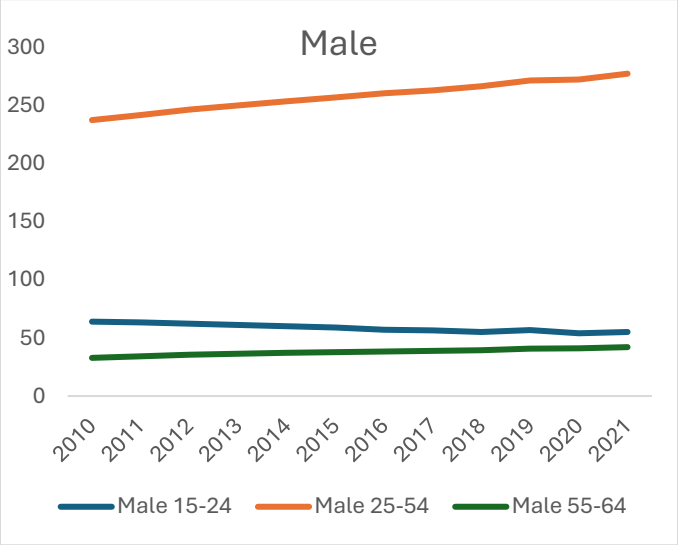
Male				Female		
Year	15-24	25-54	55-64	15-24	25-54	55-64
2010	64.08	237.62	32.89	22.27	82.45	11.02
2011	63.53	242.09	34.22	21.35	82.02	11.06
2012	62.19	246.53	35.53	20.44	81.89	11.09
2013	61.19	250.16	36.52	18.88	80.97	10.92
2014	60.09	253.74	37.29	17.39	79.95	10.69
2015	58.96	257.21	37.89	15.96	78.83	10.41
2016	57.08	260.61	38.44	14.66	77.62	10.01
2017	56.56	263.09	38.92	13.41	76.33	9.77
2018	55.19	266.88	39.34	12.24	74.91	9.43
2019	56.72	271.64	40.74	14.65	86.21	12.19
2020	54.05	272.45	41.05	13.59	84.02	12.01
2021	55.04	277.58	42.13	14.14	86.18	12.45

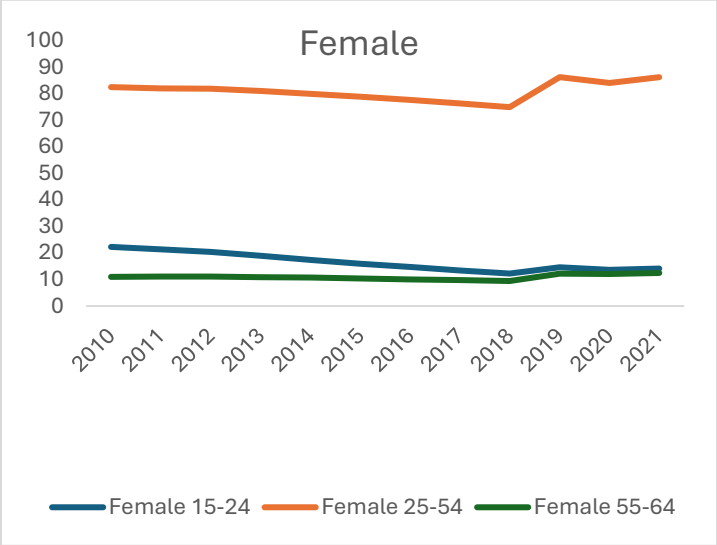
Source: Statista.

ISSN Online: 3021-9604

Figure 1: Gender Wise Labor Force Participation in India by age group (In millions)

Source: Calculated by Authors





Trends of Sectoral share of Female Employment in India.

Over the past twenty-five years, India has experienced swift economic growth, structural transformations within its economy, heightened educational attainment, and accelerated urbanization (Lahoti & Swaminathan, 2013). Table 3 below indicates that the employment percentage of rural females in the primary sector has decreased from 87.8 percent in 1883 to 73.4 percent in 2017-18. The most significant reduction occurred between 2004-2005 and 2009-2010, as well as between 2009-2010 and 2011-2012, with rural female employment shares decreasing by 3.9 percentage points and 4.5 percentage points, respectively.

In the secondary sector, the proportion of employment among rural females has rose from 7.1 percent in 1983 to 13.4 percent in 2017-18. The most significant upward trend was noted from 2004-2005 to 2009-2010 and from 2009-2010 to 2011-2012, i.e. the share of employment among rural females has increased by 2.8 percentage points and 3.8 percentage points respectively. In the Tertiary sector, the proportion of rural female employment rose from 5.1 percent in 1983 to 13.2 percent in 2017-18. The most significant growth was from 2011-2012 to 2017-2018, during which the percentage share of female employment in the tertiary sector rose by 4.9 percentage points.

ISSN Online: 3021-9604

Comparable patterns have been noted among urban females. The proportion of urban female employment in the primary sector has decreased from 31.6 percent in 1983 to 9.3 percent in 2017-18. The most significant decrease happened between 2004-2005 and 2009-2010, as well as between 2009-2010 and 2011-2012, with the employment share among rural females decreasing by 4.1 percentage points and 3 percentage points, respectively. Whereas, in case of employment in the Secondary sector of urban females it is showing meandering trend, i.e. its percentage share of employment has increased from 30.0 percent in 1983 to 30.9 percent in 1987-1988, then it has declined to 29.0 percent in 1999-2000. After that, it increased to 33.7 percent in 2011-12 and has later declined again to 29.9 percent in 2017-18. In the Tertiary sector, the employment percentage among urban females has significantly risen from 38.4 percent in 1983 to 60.8 percent in 2017-18. The most significant upward trend was from 1993-1994 to 1999-2000 and from 2011-12 to 2017-18, during which the percentage share of urban female employment rose by 7.3 and 5.7 percentage points, respectively.

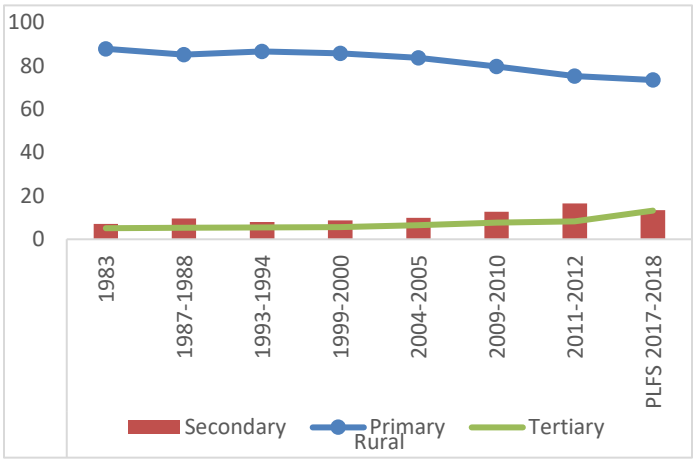
Table 3: Trends of Sectoral share of Female Employment in India.

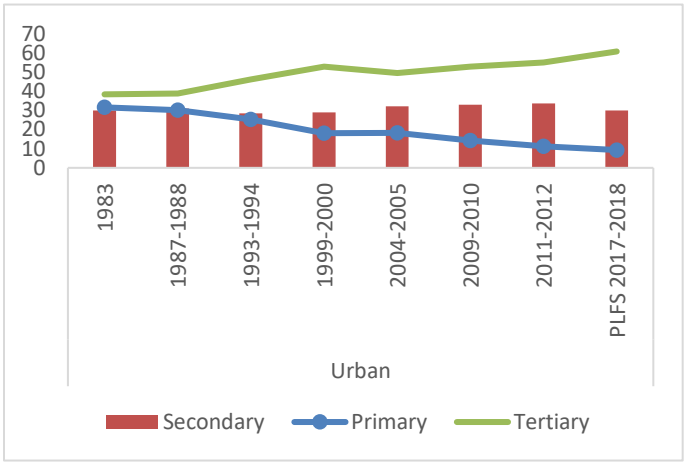
Rural									
	1983	**1987-1988**	**1993-1994**	**1999-2000**	**2004-2005**	**2009-2010**	**2011-2012**	**PLFS 2017-2018**	**CAGR**
Primary	87.8	85.1	86.6	85.7	83.6	79.7	75.2	73.4	-2.56
Secondary	7.1	9.6	7.9	8.7	9.9	12.7	16.5	13.4	9.07
Tertiary	5.1	5.3	5.5	5.6	6.5	7.6	8.3	13.2	13.59
Urban									
Primary	31.6	30.2	25.3	18.1	18.3	14.2	11.2	9.3	-17.47
Secondary	30	30.9	28.5	29	32.2	33	33.7	29.9	-0.05
Tertiary	38.4	38.9	46.2	52.9	49.5	52.8	55.1	60.8	6.56

Source: NSSO, 68th Round, Report No. 554, Employment and Unemployment Situation in India, 2011– 2012 and Periodic Labour Force Survey, 2017–2018

Figure 2: Trends of Sectoral share of Female Employment in India (Rural &Urban)

Source: Authors Calculation





Diversification of Occupations Among Female Workers in India (in Percentage).

Comprehending the occupational diversification in India is much complexed, as Indian economy being in a transitional phase and shift of employment from one sector to another sector indispensable and it leads to major reshuffle in employment. The present section explores, the occupational diversification of female workers in India. Results in table 4 below explores that in rural areas, it has been observed that during 1983 to 2017-2018, the proportion share of female employment has declined from 87.5 percent in 1983 to 73.2 percent in 2017-18. It has been also observed that the female employment in manufacturing sector increased slightly from 6.4 percent in 1983 to 8.1 percent in 2017-18.

Moreover, in construction sector the female employment is also showing positive improvement, the female employment in construction sector has increased from 0.7 percent in 1983 to 5.3 percent in 2017-18, but it has improved more significantly from 2009-2010 to 2017-2018 and was maximum 6.6 percent in 2011-2012. Nonetheless, similar trends have been observed in the Trade sector. Employment in the Trade sector has gradually increased from 1.9 percent to 4.0 percent, but it has increased by 1 percentage point from 2011-2012 to 2017-2018 respectively. However, the employment of female in other sector is also showing a significant increase from 2.8 percent in 1987 to 8.9 percent in 2017-2018, however, the most significant improvement in female

employment in other sectors was observed during 2011-2012 to 2017-2018. In this period, the female employment in other sectors has increased by 3.7 percentage point change.

Similarly, the female employment in urban areas is showing compressively different trend than urban areas. In urban areas, the female employment in the agricultural sector has experienced a significant decline from 31.0 percent in 1983 to 9.1 percent in 2017-2018. Nevertheless, in the manufacturing sector, the employment rate of urban females remained increased of 28.7 percent in 2011-2012, but its overall performance in-terms of female employment are significant as compared to other sectors. Employment of urban females in construction sector is showing a perpetual trend of 3 to 4 period in the recall period. Nonetheless, the trade sector is showing a notable expansion in the employment of urban females. i.e. the employment of females in trade sector has increased from 9.6 percent in 1983 to 13.1 percent in 2017-2018 and reached a maximum of 16.9 percent during the 1999-2000 period. During this span, it has risen by 6.9 percentage points. Employment in the transportation sector is also showing a steady improvement i.e. employment in transportation sector has increased from 1.5 percent in 1983 to 3.3 percent in 2017-2018. Employment in other services has risen significantly from 27.3 percent in 1983 to 43.4 percent in 2017-2018. The employment in other services has increased by 6.8 percentage points during 1987-1988 to 1993-1994. The compound annual growth rate

Table 4: Occupational Diversification of Female Workers (in Percentage).

Period/sectors	Agriculture	Mining	Manufac-turing	Electricity	Construc-tion	Trade	Transport	Other services
				RURAL				
1983	87.5	0.3	6.4	0	0.7	1.9	0.1	2.8
1987–1988	84.7	0.4	6.9	0	2.7	2.1	0.1	3.0
1993–1994	86.2	0.4	7.0	0	0.9	2.1	0.1	3.4
1999–2000	85.4	0.3	7.6	0	1.1	2.0	0.1	3.6
2004–2005	83.3	0.3	8.4	0	1.4	2.5	0.2	3.9
2009–2010	79.4	0.3	7.5	0	5.2	2.8	0.2	4.6
2011–2012	74.9	0.3	9.8	0	6.6	3.0	0.2	5.2
PLFS (2017–18)	73.2	0.2	8.1	0	5.3	4.0	0.3	8.9

ISSN Online: 3021-9604

URBAN								
1983	31.0	0.6	26.7	0.2	3.1	9.6	1.5	27.3
1987–1988	29.4	0.8	27.0	0.2	3.7	9.8	0.9	28.2
1993–1994	24.7	0.6	24.1	0.3	4.0	10.0	1.3	35.0
1999–2000	17.7	0.4	24.0	0.2	4.8	16.9	1.8	34.2
2004–2005	18.1	0.2	28.2	0.2	3.8	12.2	1.4	35.9
2009–2010	13.9	0.3	27.9	0.4	4.7	12.1	1.4	39.3
2011–2012	10.9	0.3	28.7	1.0	4.0	12.8	2.7	39.6
PLFS (2017-18)	9.1	1.2	25.2	0.6	4.1	13.1	3.3	43.4

Source: NSSO, 68th Round, Report No. 554, Employment and Unemployment Situation in India, 2011– 2012 and Periodic Labour Force Survey, 2017–2018

Unemployment Rate (in percent) in usual status (ps+ss)

UPSS is a more inclusive measure to identify the unemployed persons in the country. We have already defined the usual (ps+ss in above section) therefore, the present section explores the unemployment rate (in percent) in usual status (ps+ss) in India. It has been observed from table 5 that the unemployment in both rural and urban areas has declined drastically. The results reveal that the unemployment rate of rural male workers has significantly declined from 5.7 percent in 2017-18 to 3.7 percent in 2022-23. Similarly, among urban male workers the unemployment has also declined from 6.9 percent to percent in the recall period. However, among the rural females, the unemployment rate has been declined from 3.8 percent to 1.8 percent in 2022-23. Which is 1 percent and 2.9 percent lower than rural and urban male workers. Moreover, the unemployment among the urban female workers has also declined from 10.8 percent in 2017-18 to 7.5 percent in 2022-23. Although it is higher than the rural female workers, but it is declining drastically over the period. Therefore, the overall observation highlights that the rural female works are having better job opportunities now, compared to the past trends in the country.

ISSN Online: 3021-9604

Table 5: Unemployment Rate (in percent) in usual status (ps+ss)

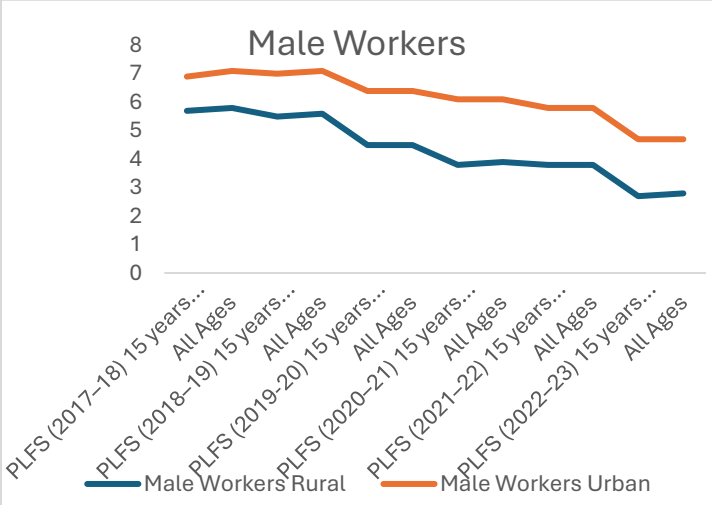
Survey Year/Age group	Male Workers		Female Workers	
	Rural	Urban	Rural	Urban
PLFS (2017–18) 15 years &above	5.7	6.9	3.8	10.8
All Ages	5.8	7.1	3.8	10.8
PLFS (2018–19) 15 years &above	5.5	7.0	3.5	9.8
All Ages	5.6	7.1	3.5	9.9
PLFS (2019-20) 15 years &above	4.5	6.4	2.6	8.9
All Ages	4.5	6.4	2.6	8.9
PLFS (2020–21) 15 years &above	3.8	6.1	2.1	8.6
All Ages	3.9	6.1	2.1	8.6
PLFS (2021–22) 15 years &above	3.8	5.8	2.1	7.9
All Ages	3.8	5.8	2.1	7.9
PLFS (2022–23) 15 years &above	2.7	4.7	1.8	7.5
All Ages	2.8	4.7	1.8	7.5

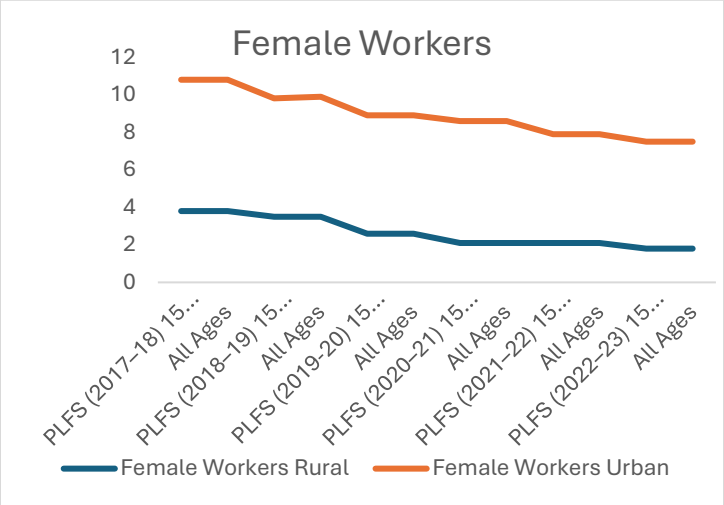
Source: PLFS (2017-18), PLFS (2018- 19), PLFS (2019-20), PLFS (2020-21), PLFS (2021-22) and PLFS (2022-23)

ISSN Online: 3021-9604

Figure 3: Unemployment Rate (in per cent) in usual status (ps+ss)

Source: Authors Calculation





Number of Women Entrepreneurs (Beneficiaries) under Prime Minister Employment Generation Program (PMEGP) in India

The present section explores the number of women entrepreneurs who were beneficiaries under Prime Minister Employment Generation Program (PMEGP) in India. It has been observed from the table 6 below that the number of women entrepreneurs who were beneficiaries under (PMEGP) in India has been significantly increased from 4930 beneficiaries to 39192 beneficiaries in 2021-22. The highest growth rate has been observed during 2009-10, in which the number of beneficiaries has jump from 4930 to 10845 beneficiaries with a growth rate of 219.98 percent respectively. After that the highest growth rate has been observed during 2018-19 in which the growth rate of beneficiaries has jumped from 15669 to 25434 beneficiaries with a growth rate of 162.32 percent. The overall compound annual growth rate has remained 13.50 percent from 2008-09 to 2022-23 respectively.

Table 6: Number of Women Entrepreneurs (Beneficiaries) under Prime Minister Employment Generation Program (PMEGP) in India

Year	Women Entrepreneurs	% Growth
2008-09	4930	-
2009-10	10845	219.98
2010-11	12072	111.31
2011-12	14299	118.45
2012-13	13612	95.20
2013-14	13448	98.80
2014-15	13394	99.60
2015-16	11356	84.78
2016-17	14768	130.05
2017-18	15669	106.10
2018-19	25434	162.32
2019-20	24720	97.19
2020-21	27285	110.38
2021-22	39192	143.64
2022-23	32626	83.25
CAGR	**13.50**	**-**

Source: Indiastat.com

Women Employment in Central Public Sector Enterprises (CPSEs) in India

Central Public Sector Enterprises are crucial in the advancement of the nation. The role of CPSEs in employment generation, economic growth, infrastructural development, market competition, regional balance, and price stabilization is highly acknowledged in India. In addition, the CPSEs are significantly contributing to fulfilling social responsibilities, including education, skill development, and healthcare. Nonetheless, over time, employment

generation in Central Public Sector Enterprises (CPSEs) has declined in India (PES Report 2016-17). Table 7 indicates that the overall number of management personnel in the public sector was 276,387 in 2012-13, decreasing to 269,135 in 2018-19. The overall number of supervisory staff positions has decreased from 139,966 individuals in 2012-13 to 106,123 individuals in the subsequent period.

Moreover, the workers employee jobs have also declined from 985,166 persons in 2012-2013 to 655,791 persons in 2018-2019 respectively. However, in case of female managerial employee jobs, it has been observed that the number of female managerial employee jobs have been increased from 26,506 persons in 2012-2013 to 27026 persons in 2018-19 and was highest in 2016-2017 i.e., 28,631 persons respectively. Although, the female managerial employees are quite low as compared to total numbers, but the trend is inclining among female managerial employees.

However, in the case of supervisor posts, the number of employees has declined drastically from 10,163 persons in 2012-2013 to 6720 persons in 2018-2019 and has declined more drastically in 2017-2018 and 2018-2019 respectively. Similar, trends are observed in among female workers employees, the number of employees has declined from 92,787 persons in 2012-2013 to 53921 persons in 2018-2019. The overall total female employees have declined from 129,456 persons in 2012-2013 to 87667 persons in 2018-2019. Moreover, the female employees as a percentage of total shows that, the female managerial employees have remained almost 10.0 percent from 2013-2014 to 2018-2019, except 2017-2018 and has remained highest as 10.82 percent in 2016-2017. In, case of female supervisors, as a percentage of total it trend has remained meandering and was highest i.e., 9.87 percent, in 2016-2017.

Table 7: Women Employment in Central Public Sector Enterprises (CPSEs) in India

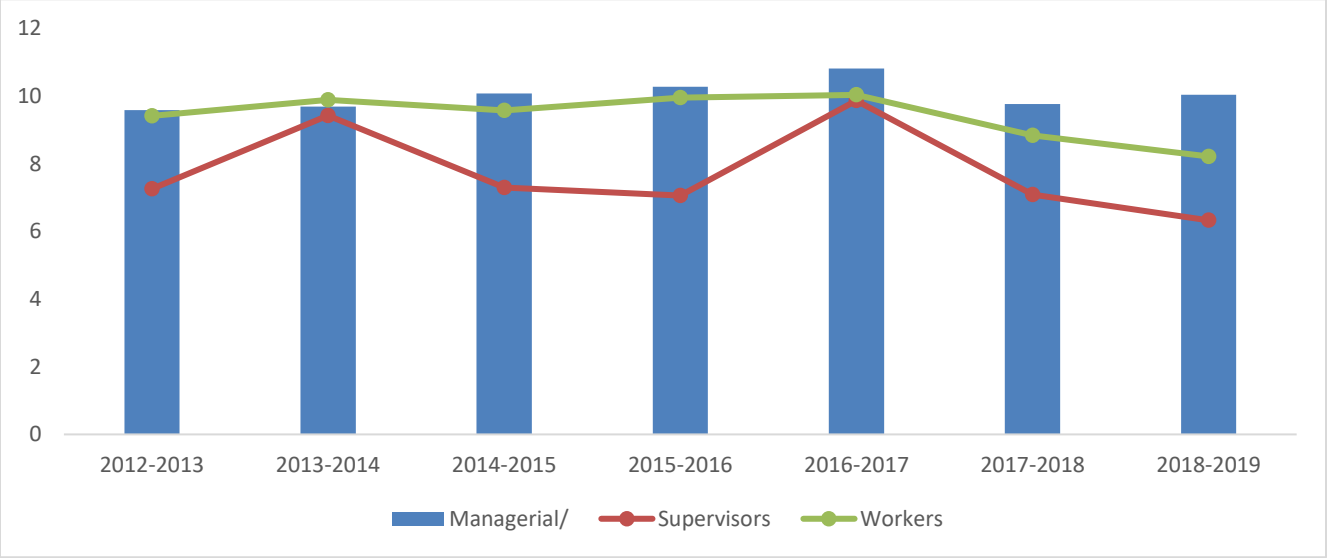
Year	Managerial	Supervisors	Workers	Total
Total Employees				
2012-2013	276387	139966	985166	1401519
2013-2014	270151	129173	949818	1349142
2014-2015	264497	130208	896469	1291174
2015-2016	262665	117487	803681	1183833

ISSN Online: 3021-9604

2016-2017	264648	104404	760209	1129261
2017-2018	265543	108622	712563	1086728
2018-2019	269135	106123	655791	1031049
Total Female Employees				
2012-2013	26506	10163	92787	129456
2013-2014	26186	12176	93931	132293
2014-2015	26661	9506	85907	122074
2015-2016	27010	8297	80011	115318
2016-2017	28631	10308	76299	115238
2017-2018	25931	7706	62968	96605
2018-2019	27026	6720	53921	87667
Female Employees as percentage a of total				
2012-2013	9.59	7.26	9.42	9.24
2013-2014	9.69	9.43	9.89	9.81
2014-2015	10.08	7.3	9.58	9.45
2015-2016	10.28	7.06	9.96	9.74
2016-2017	10.82	9.87	10.04	10.2
2017-2018	9.77	7.09	8.84	8.89
2018-2019	10.04	6.33	8.22	8.5

Indiastat.com

Figure 4: Women Employment in Central Public Sector Enterprises (CPSEs) in India



Conclusion

The overall results indicates that the employment proportion of rural females in the primary sector decreased from 87.8 percent in 1,883 to 73.4 percent in 2017-18. In the secondary sector, the employment proportion of rural females rose from 7.1 percent in 1,983 to 13.4 percent in 2017-18. In the Tertiary sector, the proportion of rural female employment rose from 5.1 percent in 1,983 to 13.2 percent in 2017-18. Comparable patterns have been noted among urban ladies. The proportion of urban female employment in the primary sector decreased from 31.6 percent in 1,983 to 9.3 percent in 2017-18. Whereas, in the Secondary sector, it is showing a meandering trend, i.e. its percentage share of employment has increased from 30.0 percent in 1983 to 30.9 percent in 1987-1988. However, in case of Tertiary sector, the proportion share of employment among urban females has sharply increased from 38.4 percent in 1,983 to 60.8 percent in 2017-18 respectively.

Moreover, the Periodic Labor Force Survey (PLFS) shows that the WPR of rural women of 15 years and above has increased from 23.7 percent in 2017-18 to 35.8 percent. Whereas, among urban female, it has been increased from 18.2 percent to 21.9 percent in the recall period. Therefore, results indicates clearly that the WPR of women has increased significantly from 2011-12 to 2021-22 in the country. Apart from this, results also reveal that the number of women entrepreneurs who are beneficiaries under (PMEGP) in India has been significantly increased

from 4,930 beneficiaries to 39,192 beneficiaries in 2021-22. So, the results conclude that the Women's involvement in the workforce is critical to a country's economic growth. In addition, women's labor force participation is critical for reaping the benefits of the demographic dividend and for economic empowerment.

Limitations of the Study

Due to data constraints, the study doesn't cover the sector wise trends and patterns of women employment in the organized sector in India. Therefore, more focus has been given to the trends and pattern of women employment in the informal sector. Moreover, the study explores, the overall trends of women employment in India and doesn't show the state wise scenario of women employment in India.

References

Akar, A., & Meshram, M. P. (2019). Power and Representation: Women Reservation Bill. *Probono India*.

Anant, T. C. A., Hasan, R., Mohapatra, P., Nagaraj, R., & Sasikumar, S. K. (2006). Labor markets in India: issues and perspectives. In *Labor Markets in Asia* (pp. 205-300). Palgrave Macmillan, London.

Behera., D.K. (2012). Economic Growth and Employment Trends in India: What does the latest Employment data reveal. *Indian Journal of Labor Economic*.

Bhalla, S., & Kaur, R. (2011). Labor force participation of women in India: Some facts. *Some Queries, LSE Asia Research Center Working Paper*, *40*.

Bhattacharya, J. (2023). Indian urban workers' labor market transitions. *The Indian Journal of Labor Economics*, *66*(2), 471-494.

Biswas, B., & Banu, N. (2023). Economic empowerment of rural and urban women in India: A comparative analysis. *Spatial Information Research*, *31*(1), 73-89.

Chakrabarti, S. (2023). *Factors Influencing Rural Non-Farm Employment and Quality of Employment* (Doctoral dissertation, ICFAI UNIVERSITY JHARKHAND).

Chand, R., & Srivastava, S. K. (2014). Changes in the rural labor market and their implications for agriculture. *Economic and Political Weekly*, 47-54.

Chatterjee, D., & Banerjee, P. (2023). Gender Inequality in India Intertwined Between Education and Employment. In *Gender Inequality and its Implications on Education and Health* (pp. 79-90). Emerald Publishing Limited.

Chatterjee, E., Desai, S., & Vanneman, R. (2018). INDIAN PARADOX: RISING EDUCATION, DECLINING WOMENS'EMPLOYMENT. *Demographic Research*, *38*, 855.

Chen, M. A. (2012). *The informal economy: Definitions, theories and policies* (Vol. 1, No. 26, pp. 90141-4). WIEGO working Paper.

Das, K., & Mahanta, A. (2023). Rural non-farm employment diversification in India: the role of gender, education, caste and land ownership. *International Journal of Social Economics*, *50*(6), 741-765.

Goel, R. (2023). Gender gap in mobility outside home in urban India. *Travel behavior and society*, *32*, 100559.

Goli, S., James, K. S., Singh, D., Srinivasan, V., Mishra, R., Rana, M. J., & Reddy, U. S. (2023). Economic returns of family planning and fertility decline in India, 1991–2061. *Journal of Demographic Economics*, *89*(1), 29-61.

Gupta, V. (2021). Female employment in India: tracking trends during 2005–2019. *The Indian Journal of Labor Economics*, *64*(3), 803-823.

ILO (2018). Women and Men in the Informal Economy: A Statistical Picture, (3rd edn.)

Kannan, K. P., & Raveendran, G. (2009). Growth sans employment: A quarter century of jobless growth in India's organized manufacturing. *Economic and Political weekly*, 80-91.

Kannan, K. P., & Raveendran, G. (2012). Counting and profiling the missing labor force. *Economic and Political Weekly*, 77-80.

Krishna, K. L., Aggarwal, S., Erumban, A. A., & Das, D. K. (2016). *Structural Changes in Employment in India, 1980-2011* (No. 262).

Kundu, A. (2015). Inclusive Growth and Income Inequality in India Under Globalization: Causes, Consequences and Policy Responses. In *Regional development and public policy challenges in India* (pp. 257-289). Springer, New Delhi.

Lahoti, R., & Swaminathan, S. (2013). Economic growth and female labor force participation in India (Working Paper No 414). *Bangalore: Indian Institute of Management Bangalore*.

Li, N. (2023). Women's work in India: Evidence from changes in time use between 1998 and 2019. *World Development*, *161*, 106107.

Lota, B. (2011). Women and the informal economy. A think piece by Lota Bertulfo. Office of Development Effectiveness. Australian AID.

Mahapatro, S. (2019). Female employment in India: determinants of choice of sector of activity. *Journal of Economic Studies*, *46*(3), 748-759.

Mammen, K., & Paxson, C. (2000). Women's work and economic development. *Journal of economic perspectives*, *14*(4), 141-164.

Mehrotra, S. (2019). Informal Employment Trends in the Indian Economy: Persistent informality but growing positive development. *International Labor Organization*.

Mehta, B. S., Awasthi, I., & Mehta, N. (2021). Women's employment and digital technology: A regional analysis in India. *Indian Journal of Human Development*, *15*(3), 427-442.

Menon, R., & Nath, P. (2022). A dynamic analysis of Women's labor force participation in urban India. *The Economic and Labor Relations Review*, *33*(4), 766-785.

Natarajan, R. R., Schotte, S., & Sen, K. (2020). *Transitions between informal and formal jobs in India*. WIDER Working Paper 2020/101. Retrieved from https://www. wider. unu. edu/sites/default/files/Publications/Working-paper/PDF/wp2020-101. pdf.

Nath, P., & Menon, R. (2024). Labor market flows and gender differentials in urban unemployment over the pandemic. *The Indian Journal of Labor Economics*, 1-24.

Pattnaik, I., & Lahiri-Dutt, K. (2020). What determines women's agricultural participation? A comparative study of landholding households in rural India. *Journal of Rural Studies*, *76*, 25-39.

National Statistical Office (2019). *Periodic Labor Force Survey 2017–2018*. Ministry of Statistics and Program Implementation, Government of India.

Prabha, T. P., Alok, S., Kumar, R., & Singh, S. (2023). The Digital Revolution–Implications of Digital Technologies on Women's Workforce Participation. In *Fostering Sustainable Development in the Age of Technologies* (pp. 303-318). Emerald Publishing Limited.

Sabreen, M., & Behera, D. K. (2021). Determinants of non-farm employment in rural Bihar. *Indian Journal of Economics and Development*, *17*(4), 831-839.

Sarkar, S., Sahoo, S., & Klasen, S. (2019). Employment transitions of women in India: A panel analysis. *World Development*, *115*, 291-309.

Sharma, V. (2023). The Status of The Women's Reservation Bill in The Indian Parliament: Investigate the Reasons for Delays, Opposition, Or Support from Different Political Parties. *Vidhigya: The Journal of Legal Awareness*, *18*.

Sudarshan, R. M., & Bhattacharya, S. (2009). Through the magnifying glass: Women's work and labor force participation in urban Delhi. *Economic and Political Weekly*, 44(48), 59–66

Sundari, S. (2020). Structural Changes and Quality of Women's Labor in India. *The Indian Journal of Labor Economics*, *63*(3), 689-717.

Thomas, J. J. (2012). India's labor market during the 2000s: Surveying the changes. *Economic and Political Weekly*, 39-51.

UN Women (2017). *Progress of the World's Women 2015-2016: TRANSFORMING ECONOMIES, REALIZING RIGHTS*. UN Women.

Verick, S. (2018). Female labor force participation and development. *IZA World of Labor*.