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Deori Language: A Historical Overview on its Contemporary Devolution

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Abstract

The Deori language, integral to the cultural identity of the Deori community of Northeast India, is definitely endangered, with only a few thousand speakers remaining. This research investigates the factors contributing to its decline, such as cultural assimilation, urbanisation, and the predominance of Assamese and other regional languages. It also examines the socio-cultural consequences of this endangerment, including the loss of traditional knowledge and the impact on community cohesion. The present study intends to highlight the challenges in revitalising the Deori language, such as limited educational resources, reduced intergenerational transmission, and lack of government support. The present paper aims to explore a comprehensive approach to preservation, including language documentation, community-driven efforts, and the incorporation of Deori into formal education. The study emphasises the importance of preserving the Deori language to maintain the region's cultural and linguistic diversity.

Historical Evolution of the *Deori* Language

The *Deori* language, known by its endonym *Jimosaya* (children of the sun and moon) is one of the lesser-known Tibeto-Burman languages. Historically spoken by the Deori community, Encyclopaedia of the World's Endangered Languages categorises Deorias a "severely endangered language" (Moseley 2010).The UNESCO (2009) has explicitly listed Deori as a "definitely endangered" language. The language is primarily spoken

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in the northeastern region of India- Assam and parts of Arunachal Pradesh, including *Lohit* and *Changlang* districts. According to,W.B. Brown,(1895), the Deori community originally inhabited territories beyond Sadiya before undergoing a series of migrations across the Brahmaputra Valley throughout the 18th, 19th and 20th centuries, driven by a mix of environmental disruptions and socio-political pressures (Deori, 2009). Though, presently, Sadiya is a town located in the Tinsukia district of Assam bordering Arunachal Pradesh, in the historical past (12th to 16th centuries), it referred to the Chutiya Kingdom which included the three districts of Lakhimpur, Dhemaji and Tinsukia. Today, Deoris are concentrated along both the banks of the Brahmaputra, particularly in the districts of Lakhimpur, Dhemaji, Sonitpur, Tinsukia, Dibrugarh, Sivasagar and Jorhat (all located in Upper or eastern Assam), with a cultural preference for riverine settlements along the tributaries of the Brahmaputra (Deori, 2009).

The Deori community divides itself into four historically significant sub-groups: *Dibongiya*, *Patorgoyan*, *Borgoyan*, and *Tengaponiya* (Goswami, 1994; Jacquesson, 2005; Deori, 2009; Saikia, 2013). These groupings are named after their original territorial locations—the *Dibongiya* near the *Dibang* river, the *Patorgoyan* in *Pat-Sadiya*, the *Borgoyan* by the *Brahmaputra* (*Borluit*), and the *Tengaponiya* near the *Tengapani* River (Saikia, 2013). Notably, the *Patorgoyan* subgroup has vanished, likely to be subsumed by other groups during migratory phases (Saikia, 2013). Meanwhile, the *Borgoyan* and *Tengaponiya* have largely transitioned to Assamese as their primary language, though they continue to perform social and religious rites in accordance with Deori traditions (Goswami, 1994; Deori, 2002).

The term *Deori* itself carries deep historical significance, referring to the community's longstanding priestly role within Assam's diverse ethnic landscape (Kakati, 1948; Bose, 1967). The Deoris were once designated as the "old priestly caste," administering sacrificial rites for Chutiya and Ahom rulers (Goswami, 1994). This priestly legacy persists, with the Deori community continuing to be distinguished by its religious zeal and adherence to animistic traditions (Deori, 2002; Deori, 2004). Although exposed to Hindu practices through sustained interaction with Assamese society, the Deoris have had retained a belief system that integrates animism with ritualistic practices rooted in their own cosmology (Deori, 2009). Their chief deity, *Kundimama*, is venerated as the ultimate force in nature, accompanied by secondary deities—*Gira-Girasi* or *Bura-Buri*, *Pisa-Dema,* and *PisasiDema*—revered by the *Dibongiya*, *Tengaponiya*, and *Borgoyan* sub-groups, respectively (Goswami, 1994; Deori, 2002; Deori, 2009).

Interestingly, early linguistic scholars (Brown, 1895; Brandreth, 1878; Grierson, 1909) positioned the *Deori* language in close relation to the Chutiya community, erroneously attributing it as the foundational language of Upper Assam (Brown, 1895). *Deori-Chutiya* was initially classified under the Bodo-Garo group, likely to be due to the Deoris' role as ritual specialists within the Chutiya Kingdom. However, recent studies dispel this notion, showing no linguistic or ethnic continuity between the two communities, with neither a shared vocabulary nor a visible socio-cultural link (Deori, 2002). Linguistically, *Deori* exhibits distinctive features indicative of its development

in northeastern Assam, especially around the *Dibang* Valley, an area historically outside Chutiya settlement zones (Jacquesson, 2008).

In terms of classification, Grierson (1909) contended that *Deori*, while generally classified within the *Bodo-Garo* family, retains an "archaic" syntactic structure, diverging sharply from other *Bodo-Garo* languages. Burling (2003) refined this classification by including *Deori* in the *Bodo-Koch* group, arguing that *Garo's* closer linguistic relationship to *Bodo* than to *Koch* justifies a more nuanced *Bodo-Koch* categorisation. Yet, Jacquesson (2005) upholds its *Bodo-Garo* identity, underscoring *Deori's* unique linguistic profile, which distinguishes it from other members of this family. This divergence in classification highlights *Deori's* complex linguistic identity and invites further exploration into its evolution within the Tibeto-Burman family.

Contemporary Dynamics of the *Deori* Language

The current state of the *Deori* language and its community is complex and multi-dimensional. While the 2011 census reported 32,376 speakers of *Deori* language within a population of 43,750, local estimates suggest the actual number exceeds 200,000. Many community members feel the official census fails to account for the full *Deori* speaking population, particularly in Assam.

Language transmission within families shows a mixed pattern: children typically learn *Deori* at home but switch to Assamese upon entering the education system. Inter-community marriages contribute to language shifts, with children often adopting Assamese if their *Dibongiya* mother marries outside the community. Conversely, if a non-*Dibongiya* woman marries a *Dibongiya* man, their children are more likely to learn *Deori*. The transmission of *Deori* is generally maintained by older generations, who emphasise the importance of passing the language on, although younger generations use it less frequently.

Apparently, the dominance of Assamese language, the majority and official language of the state, in the educational sphere exacerbates the decline of *Deori* language. Children primarily attend Assamese-medium schools, with wealthier families opting for English-medium institutions. In these contexts, the *Deori* language is often relegated to the home environment, with limited opportunities for its formal or institutional use. Despite this, the language persists in the religious domain, where it remains integral to rituals and ceremonies, including marriage, birth rites, and death rites. Religious hymns and prayers are conducted in *Deori*, and the *Deori Bisu* festival is marked by traditional songs in the language, reinforcing its cultural significance.

The Deori community has had some representation in new media, albeit limited. Two films in *Deori* language were produced in 1999 and 2006, but no new media initiatives have emerged since the 2000s, leaving a gap in its contemporary visibility. A brief radio programme aired in 2002 aimed at promoting the language was discontinued, and no television or radio programming in *Deori* language exists today. The language

also had limited success in print media, with a few initiatives like *Digezi* (a short-lived magazine) and bilingual dictionaries published by institutions like the Anundoram Barooah Institute of Language and Culture (ABILAC). The Deori Sahitya Sabha, a literary organisation, uses the Assamese script for writing in Deori, but the overall reach and accessibility of these publications are limited.

While there is a strong academic interest in *Deori* language, with notable works like Brown (1895), Goswami (1994), Jacquesson (2005), and various research projects documenting its grammar and socio-cultural aspects, the community still faces challenges in accessing these materials. Lack of awareness, inadequate dissemination, and limited interaction between language experts and community members contribute to this gap.

Nevertheless, on a positive note, this has been noticed of late that the Deori community has made some significant efforts to safeguard their language and culture. Organisations like the All Assam Deori Sanmilan, 1936, All Assam Deori Student's Union, 1959 and TheDeori Sahitya Sabha1965 have advocated for the recognition and promotion of the language. In 2005, the Deori Autonomous Council was formed as a result of the Deori Accord,2005 which aimed to protect the community's socio-cultural identity. While the community has lobbied for recognition under the Sixth Schedule of the Indian Constitution, which would grant greater autonomy, this request has yet to be fulfilled.

The Deori Sahitya Sabhahas also pushed for the inclusion of *Deori* language in school curriculam and the appointment of teachers teaching the language in schools. Although *Deori* was officially recognised as a language in Assam's educational system in 2005, its implementation has been hindered by a shortage of qualified teachers. Some years back,Dibrugarh University has taken steps to address this gap by offering a certificate course in *Deori* language which aims to teach young adults the language but it was discontinued due to lack of trained teachers.Community members emphasise that introducing *Deori* language in the school curriculum at an early age would be more effective for ensuring its long-term vitality.

Despite these challenges, the *Deori* language seems not to be on the verge of total extinction though. It is because of the community's positive attitude towards their language, coupled with their efforts to teach it to younger generations. Under these circumstances, this may be viewed that preservation is still possible. The qualitative data already points to a promising outlook if interventions rather encouragements are made at the right stage of education. The community's commitment to maintaining *Deori* as a living language depends on addressing the structural issues limiting its transmission and institutional support.

Factors Contributing to Linguistic Devolution

The *Deori* language, belonging to the Tibeto-Burman linguistic family, has undergone significant changes over time due to various historical, socio-political and migratory

factors. Once a thriving language spoken by all Deoris, its devolution can be traced through different phases of migration, political upheavals and cultural assimilation.

During the pre-colonial period, under Chutiya (1187 CE-1524 CE) and Ahom rule (1228 CE-1826 CE) respectively, the *Deori* language flourished as it was closely associated with religious and administrative functions. The Deoris, who served as temple priests, held a significant position. They were granted *Devottar* and *Brahmottar* lands during the Ahom rule, which allowed them to sustain their religious and linguistic traditions (Deori,1964). The language was widely used in temple rituals, social gatherings and everyday life within the community. However, this linguistic continuity appears to have first disrupted during the Moamoria rebellions (1769 CE-1805 CE) which almost shook the very foundation of the Ahom Kingdom, the political hub of medieval Northeast India. In fact, the very first phase of the rebellion (1769 CE-1770 CE) had greatly destabilised the Ahom kingdom, and it is well implied that this political debacle led to the initial displacement of several communities including the Deoris from their early settlements. Despite this, the community retained their language with their continued temple duties.

The 18th century brought further disruptions to the Deori settlements, primarily due to external invasions and internal conflicts. The Mishmi (a major tribe of Arunachal Pradesh) and Burmese invasions beyond the Patkai mountains, along with the incursions of the Khamtisand Singphos in the 19th century created instability in Sadiya region, the traditional stronghold of Deori community. One of the most devastating event was the assassination of the last *Bordeori* (chief priest) at the *Tameswari Mai* temple (attributed to the fierce goddess Tamreswari or Kechai-khati)in 1793, which marked a turning point in the decline of the Deori community as priests in religious institutions of Sadiya.Many people including the Deoris also fled from Sadiya to different places to save themselves from the Khamti onslaughts in the 19th century (Barua, 1972; Barua & Nath, 1990). This period evidently initiated the first stage of language shift, as displaced Deoris had to adapt to new linguistic environments.

With the advent of British rule following the treaty of Yandaboo (1826), the *Deori* language faced further marginalisation. The British administration introduced Assamese as the medium of governance and education, sidelining indigenous languages like *Deori*. The community's dispersal during the British period also played a crucial role in the decline of the language. As the Deoris migrated to different parts of the Brahmaputra Valley, the fragmentation of their settlements led to a breakdown in linguistic continuity. By the late 19th century, two of the three major clans *Borgoyan* and *Tengaponiyas* had abandoned the *Deori* dialect entirely, adopting Assamese as their primary language. Only the *Dibongiya* clan retained the dialect but even they faced pressure, of course unintentional, from the Assamese speaking population constituting the dominant class (Deori, 1964).

The mid-20th century brought another wave of challenges for the *Deori* language. The 1950 Assam earthquake along with subsequent floods and riverbank erosion, displaced

many Deori families, forcing them to migrate further into Assamese dominated regions. Economic survival became a priority and this further accelerated the linguistic shift, as younger generations found it more practical to communicate in Assamese language on a daily basis. By the late 20thcentury,the *Deori* language had become a language of ritual and ceremonial use rather than everyday communication.

Language Contact and Assimilation: The constant interaction between *Deori* and *Assamese* has profoundly impacted *Deori's* phonology and vocabulary. The language shift is evident in the younger generation's speech, which shows signs of tonal erosion—a consequence of the non-tonal nature of Assamese. As Assamese is the dominant language in education and administration, *Deori* speakers have become increasingly bilingual, often code-switching or entirely replacing *Deori* with Assamese in many contexts. This linguistic assimilation has further weakened *Deori's* status, contributing to its gradual decline.

Further, cultural assimilation, facilitated by inter-community marriages and the adoption of Assamese customs, has accelerated the decline of the *Deori* language. Education in Assam is primarily conducted in Assamese, with few opportunities for children to learn *Deori* formally. Consequently, younger generations are more fluent in Assamese, reserving *Deori* for interactions with older family members or for religious rituals. The limited use of *Deori* in everyday communication has led to a progressive loss of linguistic features and vocabulary.

The efforts to document *Deori* began in the late 19th and early 20th centuries. The works of Brown and Grierson provided early grammatical descriptions, but comprehensive documentation remained limited. In more recent years, the Deori Sahitya Sabha and other academic institutions have sought to preserve the language through compiling dictionaries, grammar books, and phonetic studies. Despite these efforts, the lack of widespread access to these resources remains a challenge. The language's phonological studies, particularly focusing on tonal variation among the different generations reveal the extent of linguistic erosion.

Revitalisation Efforts and Future Prospects

The Deori Accord of 2005 led to the establishment of the *Deori* Autonomous Council, aimed at preserving *Deori* culture and language. While the council has made some progress, such as supporting cultural events and publishing educational materials, more comprehensive measures are needed. For instance, appointing Deori teachers and incorporating the language into school curricula would be a significant step forward. The initiative undertaken by the Dibrugarh University in introducing a six-month certificate course in *Deori* language is a positive development in this direction; but broader educational reforms are equally required.

Certain community organisations like the Deori Sahitya Sabha and the All Assam Deori Students Union have already started playing a crucial role in language preservation.

These groups have organised cultural festivals, published literary works, and lobbied for governmental support. However, the lack of sustained funding and organisational coordination hampers their efforts. In this connection, the digital platforms may offer new opportunities for engagement, especially among the youth, who could be encouraged to use *Deori* in social media and content creation.

Reviving the critically endangered *Deori* language requires adopting strategies from successful global examples of language revitalisation. One of the most remarkable efforts in language revival is that of Hebrew, which was transformed from a liturgical language to a spoken one under the leadership of *EliezerBen-Yehuda*. Years ago, by integrating Hebrew into daily life, education, and governance, it became the cornerstone of modern Israel. Similarly, the *Deori* language can be revitalised by encouraging its use in everyday conversations, traditional ceremonies, and local governance. Promoting *Deori* as the language of communication in festivals, cultural gatherings, and community meetings can restore its relevance and utility in daily life.

The *Maori* revival in New Zealand highlights the power of immersive education. Through *Kohanga Reo* (language nests) and Maori-medium schools, young Maori children were immersed in their language, ensuring its transmission to future generations. This model can be adapted for *Deori* by establishing *Deori Bhasa Kendras*—community-based language immersion programmes for children. Schools in *Deori*-speaking regions can incorporate *Deori* as a medium of instruction alongside Assamese and English, fostering bilingual or trilingual proficiency while rooting students in their cultural heritage.

Legal recognition and media support have played a significant role in preserving Welsh in Wales. The Welsh Language Act (1993) and initiatives like Welsh-medium education, along with platforms such as S4C, a Welsh-language TV channel, have contributed to the growth of Welsh speakers. For *Deori*, similar steps can include legal recognition of the language within Deori-dominated areas and the establishment of *Deori*-language media platforms, such as radio programmes, TV shows, and social media channels. These initiatives would make the language visible, accessible, and appealing, especially to younger generations.

Ireland's efforts to revive Irish Gaelic underscore the importance of integrating language into education and cultural promotion. By making Irish a mandatory subject in schools, the Irish government ensured its systematic teaching. Likewise, introducing *Deori* as a compulsory subject in schools in *Deori*-speaking areas can institutionalise its learning. Organising cultural festivals, folk music programmes, and storytelling sessions in *Deori* can foster a deep emotional connection with the language, making it a source of pride and identity for the community.

The revival of the *Cornish* language (*kernewek*) is one of the most remarkable language revitalisation efforts in the United Kingdom. Although *Cornish* ceased to be spoken as a first language by the late 18thcentury, linguists successfully reconstructed it in 20th century using historical records and oral traditions. This model offers valuable insights

for the standardisation of the *Deori* language.By compiling existing manuscripts, oral traditions, and recorded phrases, linguists and community leaders can work together to develop a uniform script and grammar, ensuring consistency in teaching and usage.

It is a well-known fact that grassroots efforts have been pivotal in reviving languages like Hawaiian and Wampanoag. In Hawaii, the establishment of Hawaiian-medium schools and cultural programmes revitalised the language. The *Wopanaak* Language Reclamation Project has even enabled some tribal children to grow up as native speakers of *Wampanoag*. For *Deori*, grassroots initiatives led by the community, such as language workshops, teachers-training programmes, and family-based language use, can ensure its transmission to the next generation. Forming a *Deori* Language Revival Committee can help organise and implement these efforts effectively.

Likewise, cultural centres and classes have been instrumental in preserving endangered languages like Japan's *Ainu*. Establishing *Deori* language and cultural centres can provide spaces for teaching, research, and community gatherings. These centres could document and preserve oral traditions, folk songs, and rituals, ensuring that the rich cultural heritage associated with *Deori* language and the culture are not lost.

Reviving a language is not just about preserving words; it is about safeguarding the identity and pride of a community. Like other languagesundergoing revival, the *Deori* language holds deep cultural and historical significance. By fostering a sense of pride in their linguistic heritage, the Deori people can inspire the younger generation to embrace and use the language in their daily lives.

Lastly, the role of government and NGOs in language revival cannot be overstated. Financial and institutional support is crucial for implementing language programmes. Collaborations with universities and research institutions can help create digital resources like mobile apps, online dictionaries, and learning platforms for *Deori*. By combining community-driven efforts with institutional support, the *Deori* language can be revitalised, preserving its legacy for future generations.

Conclusion

The Deori language, though critically endangered, is not beyond saving and remains an integral part of the community's cultural heritage.This study has traced its historical evolution, examined the factors contributing to its decline, and explored the challenges of revitalisation. The forces of cultural assimilation, urbanisation and the dominance of Assamese have significantly eroded its usage, yet the resilience of the Deori people offers a path forward.

Preserving *Deori* requires a comprehensive approach that includes integrating the language into formal education, securing government recognition and support, and fostering community-led initiatives.Drawing from examples of successful language revitalisation, strategies such as immersive education, media representation and legal protections can play a crucial role in its survival. Strengthening intergenerational

transmission and expanding its presence in public life will be essential to reversing its decline.

Ultimately, safeguarding the *Deori* language is not just about linguistic preservation, it is about protecting the identity, traditions and collective memory of an entire community. With sustained commitment from both institutional and grassroots efforts, *Deori* can be revitalised, ensuring its continuity for future generations.

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Reform, Revival and Beyond

Snigdha Bhaswati[1]

Abstract

The attempt of this paper will be to understand the ideological developments in the socio-political spheres during the 19th-20th century, when multiple organisations, associations and groups were formed with their own articulations of religion and social practices in colonial India. The focus here will remain on the developments that were seen as occurring within the ambit of the category of 'Hinduism.' The paper will attempt to carefully study the conceptual frameworks used by scholars while analysing the developments of 'socio-religious movements' across India in the 19th-20th centuries. The emphases will be on the tropes of 'reform', 'revival', 'modern', 'traditional' and other such concepts frequently used in this context. Ultimately, the aim is to examine if these tropes of analyses can be applied in the context of the Srimanta Sankaradeva Sangha to understand its basic character as an organisation.

Introduction and Background

Sankaradeva was a 16th century saint-leader from Assam, who sought to make religion accessible to the people by bringing it outside the Brahmanical grasp. He promoted a brand of Vaishnavism in the region of present-day Assam, which was distinct from the existing veneration of Vishnu in the form of Vasudeva. Sankaradeva propagated the Ek-sharan-naam-dharma, focusing on the worship of the Krishna avatara of Vishnu, devoid of expensive rituals and the use of inaccessible Sanskrit. Devotion was expressed primarily through the repetition of Naam or prayers composed in a simple language comprehensible to the people. We find the word Naba-Boishnabbaad or Neo-Vaishnavism being used by scholars to refer to Sankaradeva's Vaishnavism.

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After Sankaradeva's demise in 1568, disagreements relating to the correct ways of propagating his faith, interpretations of his messages and questions of leadership, led to fissures among his disciples, creating the Brahma, Nika, Kaal and Purusha Samhatis. These can be perhaps understood crudely as branches of Naba-Boishnabbaad, each trying to exert its understanding of Sankaradeva and his messages. The Samhatis built a range of Satras, resulting in an increase in its numbers in the years after Sankaradeva. [2] The term 'Satra' was initially employed to refer to gatherings of people around Sankaradeva, and later came to denote elaborate structures following a standard layout of a prayer hall, a storage unit and housing spaces for monks. These structures were developed post Sankaradeva's demise by his disciples and eventually became a central part of the life of the followers - a space that signified community gatherings, spiritual contentment and cultural expression.[3]

According to Hiren Gohain, in the 17th century the Satras created a self-claimed egalitarian space, which proved to be compatible with the historically non-Hindu, tribal populace for accepting Brahmanism under the Ahom rule via Vaishnavism. The Ahoms, recently Brahmanised, naturally extended more favours and patronage to the Satras under the Brahma Samhati, which had Brahmans at the helm of affairs. The Satras that consistently engaged with the rulers, in return, adopted a royal conduct in their regular functioning. However, while some Satras became collaborators of the Ahoms in one sense, there were still crucial challenges from within Naba Boishnabbaad to Ahom authority, primarily posed by the Satras of the Nika Samhati.[4] For instance, the Moamariya Bidroh of the 18th century saw a tremendous articulation of protest against the Ahoms, led by the Moamariya Satra of the Nika Samhati. The Bidroh also highlighted the antagonism between the Satras that received state patronage and those that the State perceived as antithetical to its power.[5] Simashree Bora writes, in the 20th century, a 'new wave emerged within Vaishnavism challenging the Brahmanic practices and the hegemonic nature of the Sattras'.[6] Among the people of the village of Palashani in Nagaon, Ramakanta Muktiyar Aata and Loksevak Haladhar Bhuyan found a suitable crowd for starting a new discussion forum. In the Palashani Naamghar (Vashnavite prayer hall), the people had already started organising themselves against the objectionable practices of the Satra and it was here that Ramakanta Aata started the Dharmalochani Sabha in 1924. Similar initiatives were undertaken in Golaghat by Gopikaballav Goswami and others. These activities led to the formation of small associations or Sanghas, which ultimately resulted in the creation of a larger, unified institution in 1930 that came to be called the Srimanta Sankaradeva Sangha in 1940.

This institution sought to retrieve the true practices of Sankaradeva, and create a Vaishnavite society outside of the fold of the Satra. Structurally, the Sangha was organised along a hierarchical pattern with the *Prathamik* at the lowest rung. A few

[2] Sarma, *Neo-Vaishnavite Movement,* 71

[3] Nath, *Satra Society and Culture*, 107-108.

[4] Gohain, *Hiren Gohain Rachanavali,* 527-528.

[5] Mahanta, *Asomiya Madhyabitta Shrenir Itihaas*, 28-45.

[6] Bora, "Recurrence of neo-Vaishnava Faith", *Indian Anthropologist*, 55.

families comprised the *Prathamik* and a few *Prathamik*s together made an *Anchalik*, which were placed under the *zila* level committees. All the *zila* committees came together to form the *Mool* or the *Kendra*, the central platform of the organisation. Unlike the Satras, the Sangha functions along an extremely centralised decision making process, with the Kendra at the apex, taking all crucial decisions. It has also formulated clear objectives of becoming a global body propagating humanitarian values, and aims to work towards removal of untouchability in the daily lives of people.[7]

The attempt of this paper will be to understand the Sangha against the backdrop of the ideological developments in the socio-political spheres of 19th-20th century, when a large number of organisations, associations and groups emerged with their own articulation of religion and social practices in colonial India. This paper will attempt at analysing how scholars have looked at these developments and the conceptual frameworks used by them to understand the same, primarily focusing on the trope of 'reform' movements and those considered antithetical to it under the broad category of 'Hinduism'. Ultimately, the idea is to examine if these tropes, used largely for categorising the 19th-20th century socio-religious movements across India, can be applied in the context of the Srimanta Sankaradeva Sangha.

Understanding the Tropes of Classification

The 19th century has been understood by scholars of Indian history as a period which brought in immense changes in the social sphere of colonial India through constant interaction with colonial powers. These changes included the creation of a heightened sense of religious boundaries and constant efforts at negotiating the identity of communities. This further led to the emergence of various organisations along religious and caste lines in colonial India.[8] Words like 'reform', 'revival' 'Bengal Renaissance' 'Neo-Hinduism' and 'Socio-religious movements' are commonly used when describing the major developments unfolding in 19th-20th century India. The 'language of reform' that was articulated in this time was drawn from the ideas of what constituted 'modernity' as opposed to what was 'traditional'. There was an acceptance of the fixed notions of religion that was being forwarded by the colonial systems of knowledge and authority, among the proponents of social change.[9]

Charles Heimsath explains the term 'movement' in this context as actions that were undertaken with a particular goal in mind. However he hardly provides any concrete comprehension of key terms including 'Hindu' and 'Reform'. Heimsath, nevertheless, provides a broad definition of a 'reformer' as people who were "*advocates of alterations in social customs which would involve a break with the traditionally accepted patterns.*" The ambiguity of this statement does not forward any substantial theoretical understanding of the nature of alterations or the forms of traditional patterns the author is referring to.[10]

[7] Bhaswati, "(Re)Drawing Naba-Baishnavite Boundaries", *Aitihya: The Heritage*, 73-75.

[8] Metcalf and Metcalf, *A Concise History of Modern India*, 138.

[9] Snehi, "Situating Popular Veneration", *NMML Occasional Paper*, 20-21.

[10] Heimsath, *Indian Nationalism and Hindu Social Reform,* 1-10.

The one common thread for all reformers, as identified by Heimsath, is the influence of western thought that established their position in "*the mainstream of modern Indian intellectual development.*" Given, the author does not qualify this phrase, especially confusing here is the term 'mainstream', which indicates that Heimsath also identified certain thought processes that could be located outside of this mainstream. Heimsath uses the word 'anti-reformer', something that is in clear opposition to the reformer. At the same time, he also uses the word 'traditional' to contradict 'modern'. However, the confusion is with the use of the term 'traditional reformer'. If a common distinguishing factor of reformers was 'modern' thought process, the term 'traditional reformer' sounds like an oxymoron. Also, did the 'traditional reformers' and 'anti-reformers' fall under the same category, as opposed to the reformers? Were these terms used synonymously or did they have distinct connotations?[11]

Kenneth Jones provides clearer definitions, and explains socio-religious movement as one that "*advocated modifications in social behaviour, justified such advocacy by one or another form of religious authority, and then built an organizational structure it maintained over time.*" However, Jones does not particularly consider 'reform' as a conceptual category, and uses it simply as a synonym for change. He, nevertheless, identifies two distinct kinds of movements that emerged in colonial India, 'transitional' and 'acculturative', depending on their interaction with and response to British culture. While the transitional movements were seen as rooted in the pre-colonial times, in the 'indigenous forms of socio religious dissent', the acculturative movements were understood to be produced by individuals who were 'products of cultural interaction' with the British.[12] Similarly, Anderson and Damle also identified "two broad movements among the Hindus", i.e. 'modernist' and 'revivalist'- the former looked upon 'western patterns' to find the inspirations for social change, whereas the latter looked to 'Hindu antiquity' for the same. Noteworthy here is that the authors of this book seem to have used the terms 'reformer' and 'revivalist' somewhat synonymously.[13]

Christophe Jaffrelot understands 'Hindu nationalism' in the 19th century as 'an ideological reaction to European domination'. Jaffrelot is not identifying the terms 'reform' and 'revival' as identical, and more importantly, he observes a shift from 'reform' to 'revival' in the course of the 19th century.[14]

> *"Yet most members of this intelligentsia also regarded the West as a threat. They were inclined to reform their traditions along modern lines but not to the extent that they would abandon or even disown them; in fact they often wanted to reform these traditions in order to save them. Reformists, therefore, became revivalists by pretending that, in emulating the West, they were only restoring to pristine purity their own traditions via eliminating later accretions."*[15]

[11] Ibid. 2-39.

[12] Jones, *New Cambridge History of India*, 1-6.

[13] Anderson and Damle, *The Brotherhood in Saffron*, 10-11.

[14] Jaffrelot, *Hindu Nationalism: A Reader*, 1-7.

[15] Ibid. 7.

Even more interesting is that Jaffrelot says this shift can be understood if one looks at the contrast between the Brahmo Samaj and the Arya Samaj. Thus, he is identifying the Arya Samaj as having 'revivalist' tendencies.[16] This 'revivalist' tag is unlike the usual 'reformist' categorisation of the Arya Samaj as we will see eventually.

Vasudha Dalmia questions the categories of 'reform' and 'revival' for comprehending the 'Hindu' responses to colonial influence. 'Revivalist' tendencies have often been understood in opposition to the 'modernising' influence of colonialism. Dalmia argues, while it is true that *"the sanatana dharma movements propagate concepts and practice rooted in Sanskritic traditions"* and 'deliberately' set themselves 'off from the modern', it would be incorrect to assume that there was an absolute absence of interaction with western thought and missionaries. In fact, on various social issues, the proponents of Sanatana Dharma were seen sharing common stances as the 'reformists' advocating social change.

Dalmia expresses her disagreement with the term 'revival' or 'revivalist', which she saw as 'misleading' and averse to 'any possibilities of change'. She instead proposes the term 'traditionalist' for understanding the Sanatana dharma movements as these talked about a consistency of sanatana traditions 'rather than a breach with some original, more pristine past'. Unlike Jaffrelot, Dalmia is putting both the Brahma and Arya Samaj together in one category of reform movement.[17] Thus, we can understand Dalmia's categorisation as 'traditionalist' versus 'reformist', with the ambiguity of whether the term 'traditionalist' could be understood only in the context of the Sanatana Dharma movements or was it a general category that included any movement opposed to the 'modernist', 'reformist' fold.

Amiya Sen provides writes about the evolving nature of the categories of 'reform' and 'revival'. He observes, the 'world of reform' was not marked by homogeneity, rather was divided on questions of what was to be reformed and how. However, there were certain similarities that bound these movements together, including the western-educated middle class location of the leadership, the attempts at making accommodations and adjustments within the existing societal structure rather than attempting a complete reorganisation. The idea was to bring about a 'qualitative improvement' in the lives of people. Sen writes, the increasing reliance on religion by the late 19th century, signified a desire to recover 'authentic' practices from the past, which could be used in the face of colonial emphasis on rationality, utility etc. The 'past' that they referred to was also not everything that preceded the advent of the modern, rather a specific period depending upon what the movements were trying to reform.[18]

Sen writes, the word 'revival' has commonly been understood as a counter reaction to the extreme reformist enthusiasm and also as a force against the idea of change. According to him, however, the 'revivalist' was not opposed to change. They were

[16] Ibid. 1-8.

[17] Dalmia, *The Nationalization of Hindu Traditions*, 1-7.

[18] Sen, *Social and Religious Reform*, 6-17.

proposing change in terms of reviving something that was under the process of becoming irrelevant. He further adds, with the growing focus on nationalism, the difference between the 'reformists' and the 'revivalists' diminished, given the fact that ultimately they originated from a common class background and were capable of changing their locus standi as per the demands of the situation.[19]

Evaluating the Applicability of the Given Frames of Classification in the Context of the Srimanta Sankaradeva Sangha

The discussion above brings to the fore a few observations. All scholars agree upon one basic notion that there were varied responses emerging from within the people to the western forms of knowledge and authority, especially through the 19th and the early 20th century colonial India. The scholarly studies mentioned above have attempted to distinguish these responses into different types of binary categories. It is interesting that none, apart from Amiya P. Sen, tries to opt for a structure of explanation outside of this binary. Sen also only briefly suggests the existence of a third category of 'reactionaries' as distinct from 'revivalists' and 'reformists'. The 'reactionaries', Sen believed, saw their practices not with reference to a glorious past, rather as a present entity.[20]

For us, one thing becomes that evident is the leaders and organisations that belonged to what Jones defined as 'socio-religious movements' espoused some form of change in the society, though they had distinct ideas of this change and different methodologies for achieving it. However, there is no clear agreement among the scholars while distinguishing and classifying these movements. One of the factors for this overlap of the different classifications forwarded by the scholars while understanding the 'socio-religious movements' and their resultant organisations is perhaps the differential understanding of the concepts of 'tradition' and 'modernity' on the part of the scholars themselves. With the given background of historiography, the idea is to now look at how the Sangha has been analysed.

Scholarly attention towards historically analysing the emergence and nature of the Sangha is next to none. Audrey Cantlie mentioned the Sangha in her work on an Assamese village named Panbari. Cantlie understood the Sangha as a 'reform movement' that emerged originally in response to colonialism.[21] Simashree Bora, whose work on the emergence of the Sangha is nuanced and detailed, critiques this classification by pointing out that there was change within Vaishnavism even before the advent of the British in Assam.[22] Simashree Bora herself classifies the Sangha as 'revivalist' trying to recover the untainted teachings of Sankaradeva rather than 'reforming' 'the entire paradigm of monastic order of Vaishnavism'. This is with reference to the Satras, and thus she attempts to explain the creation of an institution of Naba-Basishnobaad

[19] Ibid. 33-36.

[20] Ibid. 35.

[21] Cantlie, *Caste and Sect in an Assamese Village*, 271-273.

[22] Bora, "*Recurrence of neo-Vaishnava Faith", Indian Anthropologist*, 37.

in the form of the Sangha, outside the domain of the Satras.[23] However, this definite classification based only on the said criterion may seem problematic, after one analyses the various parameters that have been used by scholars to describe these categories in the general sense of the terms.

While the Sangha may not have been trying to 'reform' the Satras, they were aiming at a 'reform' (used in the sense of 'qualitative improvement') of the society, based on the messages of Sankaradeva. The fact that the institution of the Sangha was marked by various characteristics that were inspired by missionary forms of functioning, like an elaborate, hierarchical structure with a strong, central decision making body, regular meetings, clear, written objectives etc. is indicative of influence of colonialism. This has been highlighted by many scholars as a basic character of 'reform movements' and might problematise the simple classification forwarded by Bora. We also need to bear in mind Amiya P. Sen's argument that over time, with the increasing influence of nationalism, the difference between the categories of 'reform' and 'revival' (or any other terminology used to indicate differential activities of the movements) tends to diminish. [24]

Given that the Sangha was not a 19th century institution, rather it was formed in the 1930s, its emergence coincided with the heightened sense of articulation of what constituted a nation, nationalism and nationalist identity. The questions of regional and linguistic identities of the people and their connections with the larger notions of a nation were also being debated upon and developed now. Thus, if one were to agree with Sen's observation, the whole question of whether the Sangha was 'reformist' or 'revivalist' or any other category of classification may not bear much significance while trying to understand its character or functioning. This is in addition to the fact that the categories of classification, forwarded by different scholars remain ambiguous and confusing when seen together. Thus, the applicability of using these categorisations while analysing the Sangha becomes questionable.

Concluding Remarks

This paper approached the whole discussion by accepting the definition of 'socio religious movement' as forwarded by Kenneth Jones, partly because it provides a comprehensive understanding and partly because no other scholar has in fact provided a word by word explanation of the phrase or any other that they suggested in its stead. The main focus of the paper was on the tropes used by the scholars to distinguish these movements.

A basic study of this suggested the overlapping nature of the categories of classification and the diverse characteristics of the movements that eluded any standard form of categorisation. It also indicates that the scholars, located in the late 20th and 21st century, were employing their own understanding of what constituted 'modern' and what could

[23] Ibid. 57.

[24] Sen, *Social and Religious Reform,* 36.

be perceived as a counter to it, while studying these movements. Additionally, most scholars have tended to focus on the more popular or well-known movements, for instance the Brahmo and Arya Samaj, and formulated categorisation through a study of their nature. This might make the applicability of these conceptual frameworks on the lesser known or more local movements difficult.

The above mentioned observation appears to hold true in the case of the Srimanta Sankaradeva Sangha, for the analysis of which the existing categories and definitions, as has been used by both Audrey Cantlie and Simashree Bora, seem inadequate. The study of the Sangha, while taking into consideration the existing conceptual frameworks, calls for an exploration of possible alternative structures of analysis in the future that may prove to be more applicable to its context.

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Assessment of Female Activities in Harnessing the Demographic Dividend in the North-eastern States of India

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Abstract

The study attempts to present a picture of the opportunities and challenges of the demographic dividend in the states of northeast India. It examines the disparities in male and female working age participation in light of the changing population structure. It also aims to demonstrate demographically dependent and other types of more nuanced alternative dependency rates, as well as the associated gender disparities. The census single-age data and working data for the states of northeast India from 1991, 2001, and 2011 were used for analysis. More precise and alternative metrics for dependent ratios such as activity-based dependency rate, employment-based dependency rate, and activity-based economic dependency rate have been used in the analysis. The study found that the female work participation rate (WAP) in the states of northeast India surpassed the all-India level. Thus, the higher female work participation rate (WAP) in the northeast states contributes to a lower employment based dependency rate (EbDR) in each state in the region corresponding to the national level. Reducing the gender gaps in education and the job market, breaching the contextual patriarchal society, or improving employment opportunities for female WAP may enable to grasp the demographic dividend and achieving gender equality of the Sustainable Development Goal target 5.

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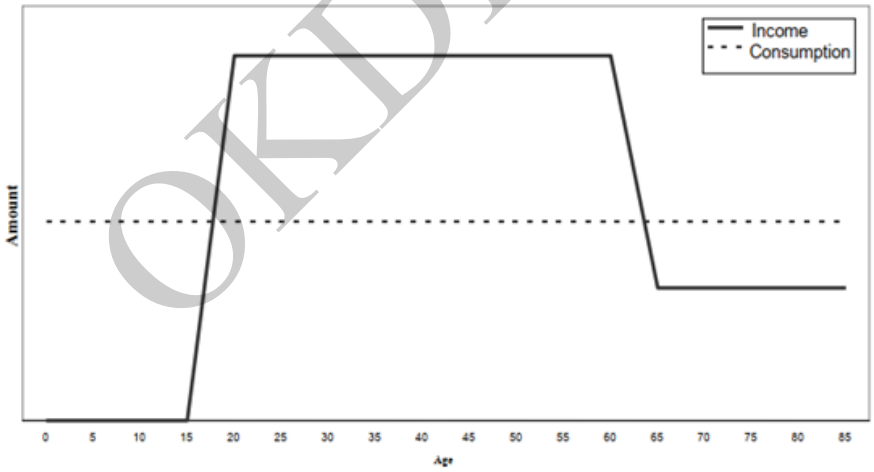
Introduction

While examining the relationship between population and economic growth, economists are conventionally categorized into two groups based on the classical debate between Marx and Malthus.Population "pessimists" contend that rapid population growth hinders development by lowering capital per worker and limiting productivity (Coale and Hoover, 1958). Population "optimists" assert that rapidly growing populations may generate more human and intellectual assets while providing larger markets, resulting in economic growth (Kuznets, 1967; Mankiw *et al*., 1992;Kelley and Schmidt 1996). A third approach "neutralist" has emerged in recent years, arguing that population composition is more important than population size. Based on the experiences of East Asian economies, this line of research contends that fertility decline reduces the number of children while increasing the worker-to-nonworker ratio for a few decades.

During the demographic transition process, the population's age structure changes. This shift in population distribution across age groups, as well as its implications for economic growth, is now widely recognized as an emerging issue for developing countries (Bloom and Williamson, 1998 a ; Mason, 2005). However, the demographic transition process began when the situation of high mortality and high fertility changed to one of low fertility and low mortality. As a result, developing countries are going through demographic transitions at different stages in terms of fertility and mortality rates.

Figure 1: Life Cycle Income and Consumption



Source: Adapted from Bloom et al. (2001).

Over time, as fertility rates have declined, developing countries have seen a decrease in the number of young dependent age groups and an increase in the working-age population. This increased working-age population creates a potential opportunity for rapid economic growth, known as the demographic dividend (Bloom *et al*., 2002; Gribble and Bremner, 2012). The life cycle income and consumption model advocates that the different age groups in a population have their economic implications. The

young age group, 0-14, needs investment for their health and education. The adults or the workable population age group enter the labour force, generate income, and save for their future. At the same time, the old-age group needs retirement income and investments for their health. A schematic representation of the life cycle income and consumption that embedded the impact of the economic behaviour for the different age groups is shown in Figure. 1.

Given the definition of the demographic dividend, the demographic dividend is delivered through the interplay of interconnected mechanisms of labour supply, savings, and human capital (Bloom *et al.,* 2001 a).

Labour Supply

With the decline in mortality rate, morebaby boomers enter the working-aged group, resulting in a decline in the ratio of dependents to non-dependent. Thus, providing an effective and efficient labour market can absorb a more significantnumber of workers per-capita increases. Again, with the decline in family size, women are more likely to be educated and enter the workforce. This increases their productivity and makes them a more robust workforce.

Savings

The demographic transition also promotes the growth of a country's savings. It outlines the country's investment and growth prospects. The young and old consume more than they produce, while working-age people have higher economic outputs and savings (Higgins, 1998). So, when more baby boomers enter the working age group, the country will tend to have higher savings.

Human Capital

In the process of demographic transition, significant effects exist on the investment in human capital. The mortality rate changes,resulting in a society's population living longer and healthier. Thus, a longer life expectancy for a society causes fundamental changes like attitudes to education, family size, retirement, the role of women, and the workforce. Jamison*et al.* (1996) expressed the changein parental choice to educate their children to a more advanced level on account of the increases in life expectancy. Again,Bloom *et al*.(2001 b) expressed that parents with fewer children, devoting more time to invest in each child, know there is a good chance that each child will benefit from investing in their education over a more extended period.Thus, the labour force as a whole can be more productive and can also promote higher wages.

However, the Asian Development Bank (2011 a) observed that the demographic dividend is not an automatic consequence of demographic change. It is a condition of how the economy productively accesses its changing working age group- the East Asian Miracle is an example.Harnessing the working-age group and reaping the potential demographic dividend become a concern for a populous and diverse country like India.

Related Literature

Most empirical research attempts to measure the effects of the demographic transition on economic growth. It emphasizes the decline in dependency ratios and its subsequent rise in the ratio of the working age to non-working age for a given population (Bloom and Williamson 1998 b; Bloom, Canning, and Malaney 2000; Bloom, Canning, and Sevilla 2002; Bloom and Canning 2005; Cai and Wang 2005; Bloom *et al*., 2007 a).

Total fertility rates (TFR) in India were 3.4, 2.9, and 2.7, respectively, according to the National Family Health Survey (NFHS)-1 (1992-93), NFHS-2 (1998-99), and NFHS-3 (2005-06). However, in the NFHS-3, many large populous states such as Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh had more than three (3) children per woman. As a result of the disparity in fertility levels, the rate of demographic transition varies across India's states (Kumar, 2014). It allows Indian states to benefit from demographic dividends in their capacity. James (2008) also revealed that India will continue to reap the benefits of the demographic dividend for several decades. This is because the southern and western states and West Bengal of India had attained the early fertility transition, and the northern states were still yet to reach the demographic dividend. India's 'window of demographic opportunity' has been passing through since the 1980s (Aiyer and Modi, 2013; Mitra and Nagaranjan, 2005). The first demographic dividend for India will prevail up to 2035 onwards, and afterward, it will shrink, and the second demographic dividend will prevail up to 2070 (Ladusingh and Narayana, 2012). According to the Asia Development Bank (2011 b), India was still in the early stages of demographic transition. She had 7.7% of old-aged dependency in 2010 and was projected to rise to 9.4% in 2020 and 12.2% in 2030.As a result of the demographic change, India could increase prospective future real per capita income in the next two decades (Goley and Tyres, 2012).

India has come to enjoy a distinct advantage in the labour market compared to most developed and less developed countries due to the fast-changing age distribution of the population. These fast-changing age distributions need total absorption in the employment scenario. Rural people with variations in their attributes has the problem of boom or boon given by the demographic transition. Loichinger*et. al*. (2017 a) measured the demographic dependency ratio, economic dependency ratio based on labour market participation, economic-based dependency ratio based on income, consumption, and asset-based reallocation (NTA dependency ratio), and public sector dependency ratio. Thus, they suggest that there could be an increase in the employment levels among the working-age population.

Analysing the reasons for the decline in the rural married female labour force, Afridi *et al*. (2015) concluded that their education and the education attained by their male partners contributed to the decline of female labour force participation. The rising male incomes and the education attained by both males and females on the supply side and the changing sectoral structure of employment scenarios on the demand side constitute a reduction in the female labour force participation by Indian women (Klasen and Pieters, 2015; Kapos *et al*., 2014 a). Kapos *et al*. (2014 b) further exclaimed that

the long-term lack of employment opportunities for women and measurement issues regarding the differentiating between domestic duties and the contributing family work (from the rounds of NSSO) constitute the factors in declining the women labour force in India. Desai and Joshi (2019) express that India must prioritize increasing female labour force participation and reducing disadvantages in the labour market.Arif and Chaudhry (2008) show the gap in labour force participation between urban and rural and between male and female labour force participation. However, higher education attained by the women in urban areas tincreased the attainment of the labour force. So, the rising youth shares in the total population were less converted to developing the human capital and productive absorption in the labour force. Lau and Tsui (2020), comparing the economic-demographic dependency ratio (EDDR) with the conventional demographic dependency ratio (DDR) of the USA over the period 2010 to 2060, found that the expected increase of EDDR by 0.015 and the conventional DDR by 0.105 which was 86% over projected.

The paper explored the nature of the changing age structure for the north-eastern states of India. It gives a clear picture of the actual working population and how those working-age populations were engaged. It also explored whether the states of north-eastern states have the potential to reap the demographic dividend through work participation. Further, it also analysed the work participation of men and women since the equity in work participation by both males and females has been a prerequisite not only for harvesting the demographic dividend but also for achieving gender equality of the Sustainable Development Goals target 5.

Study Area

The states of North East India comprise Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. These states together covered a land area of about 2.6 lakh sq. km. which is about 7.9% of the total geographical area of the Indian subcontinent (Registrar General of India). This region is extraordinarily diverse, distinct, and indeed distinguished by its nature of topography and demography. Topographically, except for the Assam Valley, the region is hilly, covering70% of the entire landscape. However, the population distribution is highly skewed and primarily accommodated in the valley areas. The region, however, is characterized by the heterogeneity of its inhabitants. The hill tribes, the plains tribes, and the non-tribal population are the major inhabitants. Based on the Indian census (2011),the northeast region has a 27.2% scheduled tribe (ST) and 6.6% scheduled caste (SC) population compared to the national average of 8.6% ST and 16.6% SC population, respectively. Among the eight states, Arunachal Pradesh, Meghalaya, Mizoram, and Nagaland have a predominantly tribal population, ranging from almost 69%in Arunachal Pradesh to 95% in Mizoram. The northeast region hasasex ratio of 956 per 1000 males and a literacy rate of 74.48% compared to India's average of 940 and 74.04%, respectively(Census, India 2011). The northeast region is economically the least developed region of the Indian subcontinent,with a per capita income of Rs. 49,959 at the current price against Rs. 68,747 for the all-India average (2013-14) (NEDFi Data Bank).

Material & Method

Data Source

The secondary data particularly the Indian census data of 1991, 2001, and 2011 available publicly from the Registrar General of India's official website were used for the present study. Further, single-age datasets such as single-age data, B-1 and B-10 for 1991 series data and B-13 series data for the 2001 and 2011 census year were also used for the analysis.

Statistical Analysis

All of the working-age population (15-59 years) were not part of the workforce or were seeking some job (labour force). Some may still be students, some may not take to work for various reasons, or some may be differently abled. Again, some of the population below 15 years and above 60 years old may also be workers. As a concern for these problems, the study measured some alternative, dependent ratios at par with the definitions from Harasty and Ostermeier (2020 a). The conventional measures of working age population rate and demographic dependent ratio were shown in the paper to highlight how far the broad distribution of the population had been subsumed in addressing the demographic transition. In short, those engaged in economic activities, irrespective of age, are used to calculate the work participation rate.

Accordingly, two alternative dependent ratios proposed by Harasty and Ostermeier (2020 b)- Activity-based Dependency Rate and Employment-based Dependency Rate and Employment-based Economic Dependency Rate (Loichinger *et al*., 2017 b) were employed. Here,

Activity-based Dependency Rate (AbDR) =

$$\frac{[(0-14)Population + (15-59)Nonworking\ Population + 60and\ above\ \ Population]}{Labour\ Force} * 100$$

Employment-based Dependency Rate (EbDR) =

$$\frac{[(0-4)Population + (5\ \&\ above)NonWorking\ Population}{Work\ Force} * 100$$

Activity-based Economic Dependency Rate (AbEDR) =

$$\frac{(Number\ of\ Students\ +\ Household\ duties +\ Dependents\ +\ others) * 100}{Total\ Workers}$$

Here,

Labour Force indicates the number of workers and seeking for work from the persons of WAP.

Work Force indicates the number of workers from the WAP

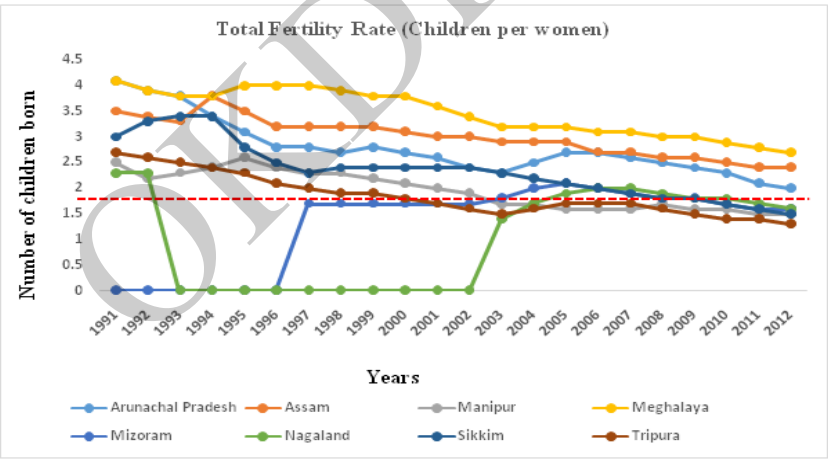
And, Total Workers indicates the total number of workers irrespective of age.

As per the Census of India's definition, household duties include daily household chores such as cooking, cleaning utensils, caring for children, fetching water, and so on. They are not helping in the unpaid work on the family farm or cultivation or mulching. Dependents are those infantsor elderly persons not included in the worker category. Others comprise pensioners, beggars, vagrants, and others. Pensioners refer to individuals who receive a pension after retiring and are not involved in any economic activity. Beggars, vagrants, prostitutes, and people with unspecified forms of income and subsistence who were not involved in any economically productive work during the studied period. Furthermore, Others are non-workers who do not fall into one of the groups listed above, such as rentiers, people living on remittances, agricultural or non-agricultural royalty, convicts in jails, or inmates of penal, mental, or charitable institutions doing no paid or unpaid work, and persons who are seeking/available for work.

Results

Demographic Structure and Work Participation

Figure 2: Total Fertility Rate in the States of Northeast India



Source:Computed from the Compendium of India's Fertility and Mortality Indicators 1971-2013, SRS, Registrar General of India.

Note(s).

1. 1991,1992,1993,1994, 1995 & 1996 data for Mizoram were unavailable.

2. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001 & 2002 data for Nagaland were unavailable.

3. Data for all the states except Assam were adjusted from the three-year moving average of fertility indicators.

Figure 2 depicted the trend in the number of children born per woman (TFR) during her reproductive years. Based on the graph, Meghalaya and Arunachal Pradesh had more than four children born per woman of reproductive age in 1990, and all states of northeast India were above the replacement level TFR of 2.1 children per woman. The least was Nagaland, which experienced a significant shift with TFR 1 in 1997. However, in 2013, Tripura received the greatest benefit, with 1.3 children per woman. Manipur, Mizoram, Nagaland, and Tripura, on the other hand, achieved the replacement level TFR of 2.1 children per woman in the 2000s. Assam and Meghalaya had yet to reach their replacement level. The primary source of concern is the rapid decline in TFR in all of the states of northeast India.

Figure 3 illustrated the age distribution of the population of states in India's northeast by broad age group from 1991 to 2011. In 1991, the percentage of the population in these states comprised of young people (0-14 years old) was very high. Except for Manipur, other states exceeded the national level of 37.24 % constituting nearly 40 % and more in 1991. It had decreased slightly between the census years 1991 and 2011. Between 1991 and 2011, Sikkim and Tripura observed a significant decrease, accounting for more than 10% of the total. During this period, the working-age population (15-59 years) had increased significantly in both Sikkim and Tripura while the state of Manipur (57.57%, 60.46% & 62.55%) had consistently increased at a steady rate surpassing all India level (55.43%, 56.93% & 60.29%) throughout the three census years. Further, except for Meghalaya, the working-age population contributed nearly 60% or more of the total population in all the states of northeast India.

Table 1. Percentage of Male and Female Working Age Population (WAP) for the States of NE India in 1991, 2001 & 2011.

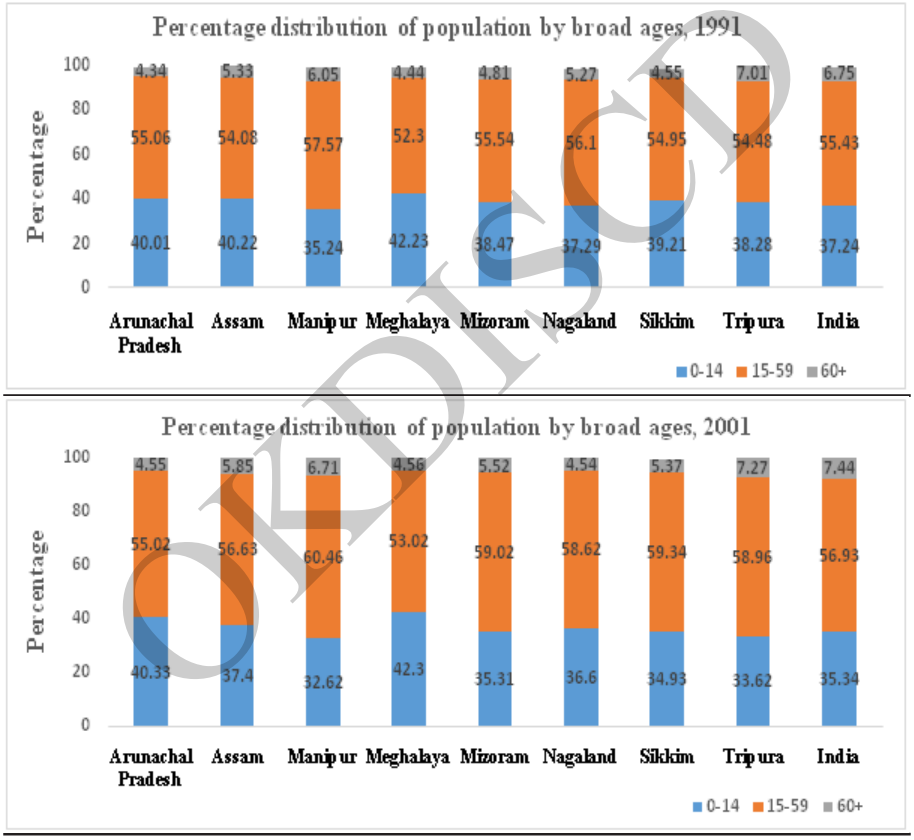
	1991		2001		2011	
State	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Arunachal Pradesh	56.94	52.88	56.39	53.49	60.27	58.96
Assam	54.67	53.44	57.08	56.16	60.50	60.36
Manipur	57.65	57.64	60.16	60.77	61.90	63.21
Meghalaya	52.64	51.94	53.02	52.99	55.28	55.56
Mizoram	56.89	54.07	59.75	58.38	61.16	61.32
Nagaland	57.10	54.99	58.98	58.22	60.30	60.54
Sikkim	56.44	53.25	60.69	57.80	66.74	65.07
Tripura	54.97	53.96	59.55	58.34	64.64	64.08
India	55.39	53.75	57.01	56.85	60.24	60.35

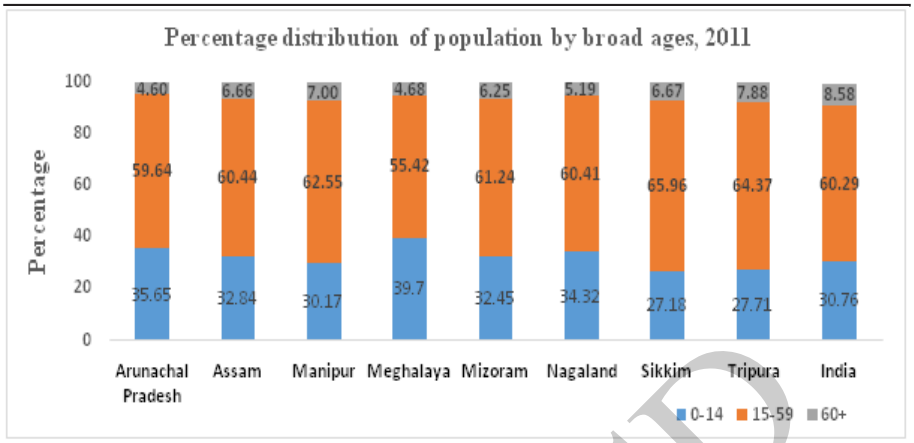
Source: Calculated from the Census Single Age Data

Table1 shows the percentage of male and female Working Age Population (WAP), i.e., people aged 15 to 59 years, in states of India's northeast from 1991 to 2011. During the three census periods, the working-age population in these states increased steadily. The majority of working-age males in all states reached 60% or higher in 2011, except

for Meghalaya. Sikkim and Tripura had surpassed the national level for both males and females, with a 10% increase. Meghalaya and Arunachal Pradesh had a female working-age population of less than 60%, indicating a younger non-working population.The working-age population (WAP) in eight states increased, indicating the potential for more opportunities and a larger labor force. In theory, an increase in the working-age population with the right educational background and skills could lead to more people entering the labor force, benefiting these states. However, the majority of the working-age population did not participate in the labor force. Table no.2 details the number of people who worked, remained unemployed, and dependent on others.

Figure 3: Broad Age Distribution in the States of Northest India 1991-2011





Source: Computed from Census Single Age Data

Table 2. Percentage of Work Participation Rate (WPR) for the NE states, Census of India, 1991, 2001, 2011.

	1991			2001			2011		
States	**Person**	**Male**	**Female**	**Person**	**Male**	**Female**	**Person**	**Male**	**Female**
Arunachal Pradesh	46.24	53.76	37.49	43.98	50.63	36.54	42.47	49.06	35.44
Assam	35.89	49.11	21.57	35.78	49.87	20.71	38.36	53.59	22.46
Manipur	42.18	45.27	38.96	43.62	48.12	39.02	45.68	51.40	39.88
Meghalaya	42.67	50.07	34.93	41.84	48.34	35.15	39.96	47.17	32.67
Mizoram	48.91	53.87	43.52	52.57	57.29	47.54	44.36	52.35	36.16
Nagaland	42.68	46.86	37.96	42.60	46.70	38.06	49.24	53.42	44.74
Sikkim	41.51	51.26	30.41	48.64	57.44	38.57	50.47	60.16	39.57
Tripura	31.14	47.33	12.68	36.25	50.62	21.08	40.00	55.77	23.57
India	37.46	51.55	22.25	39.10	51.68	25.63	39.80	53.26	25.52

Source: Calculation from the Census B-1 Series Data

Table 2 analyzed the work participation rate (WPR) in northeast (NE) India from 1991 to 2011. Work participation rates fell in Arunachal Pradesh, Meghalaya, and Mizoram, while they rose marginally in the other states; male WPR in Assam, Manipur, Nagaland, Sikkim, and Tripura rose marginally but not significantly. Female WPRs in Manipur, Nagaland, Sikkim, and Tripura have marginally increased. However, the WPRs in Arunachal Pradesh, Assam, Meghalaya, and Mizoram fluctuated. Generally, female WPR was lower than male WPR. The greatest WPR disparity was found in Assam and Tripura, with a margin of around 30%. In 1991 and 2011, male WPR in Tripura was 35 percentage points higher than female WPR by 32 points. In Assam, male WPR was 29% higher than female WPR, with a 31% difference. Subsequently, the table demonstrated that the number of female work participation was increasing.

The difference in the proportion of the working-age population and the work participation rate can be seen from the comparison between Table1 and Table2. Taking the proportion of workers from the WAP table, it can be seen that a good number of both the male and female working age population were not working. For example, Sikkim had 66.74% male and 65.07% female WAP, the highest WAP among the NE states of India in 2011,while 60.16% and 39.57%were male and female WPR respectively. Here, 6.59% of male and 25.50% of female were not working. Again, Meghalaya had the lowest WAP- 55.28% of male and 55.56% of female,with 47.17%of male and 32.67% of female WPR, respectively. Assam in 2011witnessed 37.91% of the female WAP were not working, the worst state among the NE states.

Table 3. Percentage of the Demographic Dependency Rate (DDR) for the NE States of India, Census of India 1991, 2001, and 2011.

	1991			2001			2011		
States	**TDR**	**CDR**	**ODR**	**TDR**	**CDR**	**ODR**	**TDR**	**CDR**	**ODR**
Arunachal Pradesh	80.6	72.7	7.9	81.6	73.3	8.3	67.5	59.8	7.7
Assam	84.2	74.4	9.9	76.34	66.1	10.3	65.4	54.3	11.0
Manipur	71.6	61.1	10.5	65.1	53.9	11.1	59.4	48.2	11.2
Meghalaya	89.2	80.8	8.5	88.4	79.8	8.6	80.1	71.6	8.5
Mizoram	77.9	69.3	8.7	69.1	59.8	9.3	63.2	53.0	10.2
Nagaland	75.9	66.45	9.4	70.2	62.4	7.7	65.4	56.8	8.6
Sikkim	79.7	71.4	8.3	67.9	58.9	9.1	51.3	41.2	10.1
Tripura	83.1	70.3	12.9	69.4	57.0	12.3	55.3	43.1	12.2
India	79.2	67.0	12.2	75.2	62.1	13.1	65.2	51.0	14.2

Source: Calculated from the Census Single Age Data

Table 3 shows the percentage of Demographic Dependency Rate (DDR). The Child Dependency Rate (CDR) revealed that the percentage of children under the age of 15 is determined by the Working Age Population (WAP), which includes people aged 15 to 59. The Old Aged Dependency Rate (ODR) was calculated as the percentage of people aged 60 and above out of 100 WAP. The Total Dependency Rate (TDR) is the total percentage of both children and elderly dependents on the 100 WAP. During these census periods, Sikkim and Tripura experienced the greatest change in TDR. Between 1991 and 2011, 79 to 51 and 83 to 55 people in Sikkim and Tripura, respectively, were economically dependent on 100 numbers of WAP. The high change in the TDR was attributed to a decline in the CDR from 71 to 41% in Sikkim and 70 to 43% in Tripura. This demonstrated that these two states had a greater potential for capitalizing on the demographic dividend. Meghalaya had the highest TDR between census years, with more than 80 people per 100 working-age people. This was due to the slow rate of change in the CDR, which went from 80 people in 1991 to 71 people in 2011. However, all states witnessed a faster decrease in TDR. The decline in CDR was far greater than the increase in ODR over census periods. As a result, lowering the CDR has resulted in a lower TDR. The change from 2001 to 2011 was greater than the change between

1991 and 2001. It indicated that the WAP's burden of supporting child education and pensions for the elderly was lessening.

Demographic Dependent and its Alternative Measures

Table 4 illustrated the percentage of dependency based on activity among various population groups, which was a more accurate measure of economic dependency than the Activity-based Dependency Rate (DDR). It comprised dependents such as children, nonworkers, and the elderly. Between 1991 and 2011, Arunachal Pradesh, Meghalaya, and Mizoram experienced an increase in dependents. Sikkim and Tripura experienced significant population declined, from 146 and 213 in 1991 to 111 and 128 in 2011. Female dependency outnumbered male dependency, indicating that a large number of women did not enter the labor force. Female dependency was greater in Assam and twice as high in Tripura.

Table 4. Activity-based Dependency Rate (AbDR)

	1991			2001			2011		
States	**Person**	**Male**	**Female**	**Person**	**Male**	**Female**	**Person**	**Male**	**Female**
Arunachal Pradesh	119.0	102.1	189.5	141.6	111.5	186.8	141.4	113.7	179.3
Assam	180.0	121.5	379.5	177.3	111.4	312.1	155.6	97.2	263.5
Manipur	145.9	144.6	170.3	136.4	119.3	156.9	125.4	105.8	149.1
Meghalaya	140.1	123.9	207.3	159.4	128.9	200.0	161.0	127.1	206.4
Mizoram	110.5	103.9	138.5	111.3	94.1	133.2	133.3	102.2	176.2
Nagaland	149.0	141.4	189.6	148.7	129.45	174.2	123.4	107.4	143.4
Sikkim	146.9	112.8	256.7	125.8	93.3	178.3	111.1	81.1	158.1
Tripura	213.0	126.8	536.1	158.1	103.8	251.2	128.5	85.3	191.9
India	174.6	112.6	370.3	167.7	108.4	284.0	161.7	103.3	273.1

Source: Calculated from the Census Single Age Data and B-1 Series Data

Table 5 gave a more detailed picture of the economically dependent population, focusing on the percentage of the population who relied on employed individuals. Economically dependent regions (EbDR) were more accurate as they incorporated the exact number of non-workers and workers of all ages. Arunachal Pradesh, Meghalaya, and Mizoram saw a surge in EbDR, with Assam experiencing the highest rate among the north-eastern states. In 2011, Assam had 200 people economically dependent on 100 employed people, resulting in two non-working people for every one working person. Other states had more than 100 people who relied on the 100 employed individuals. In 2011, EbDR was higher than AbDR in Arunachal Pradesh, Assam, Meghalaya, Mizoram, Tripura, and at the national level due to a lower number of WAP entering the labour force. A significant difference in EbDR was observed between males and females. Assam and Tripura saw more differences, with evidence indicating that there were more than three women dependent on each worker. Table 6 confirmed how this happened.

Table 5. Employment based Dependent Rate (EbDR).

	1991			2001			2011		
States	**Person**	**Male**	**Female**	**Person**	**Male**	**Female**	**Person**	**Male**	**Female**
Arunachal Pradesh	109.6	93.3	179.0	141.6	107.6	195.5	149.6	114.4	201.8
Assam	175.8	113.5	390.6	200.6	112.7	424.2	178.4	96.4	380.3
Manipur	136.0	133.3	162.5	146.3	123.0	175.3	133.8	106.7	168.9
Meghalaya	128.2	110.9	197.3	158.4	121.9	209.7	167.8	125.0	230.4
Mizoram	99.6	93.0	127.7	102.3	84.2	125.8	137.6	99.9	193.6
Nagaland	136.0	128.2	177.0	154.6	130.8	187.1	119.9	100.9	144.4
Sikkim	137.0	102.6	247.9	120.4	83.9	183.6	109.5	73.9	170.3
Tripura	224.6	122.4	677.7	195.2	108.4	413.3	163.8	86.8	351.8
India	168.0	103.2	377.2	174.5	104.6	326.0	170.1	98.5	328.8

Source: Calculated from the Census Single Age Data and B-1 Series Data

Table 6 and 7 depicted the percentages of male and female economic dependents in India's northeast states, with most transitioning from dependent to student during census years. States like Manipur, Mizoram, Nagaland, and Sikkim had a higher number of AbEDR engaged as students, while Arunachal Pradesh, Assam, Meghalaya, and Tripura had a higher proportion of non-working people engaged in dependent activities. These states had an advantage in receiving the demographic dividend, as their children were accumulating human capital. However, there was a large gender gap, with Assam, Sikkim, and Tripura having a larger gap among students who were dependent and engaged in household duties. Manipur, Mizoram, and Nagaland had a lower gender gap among student dependents and narrowed the gap between male and female engaged in household duties. In 2011, all north-eastern states increased their non-working dependent on students while decreasing non-working dependent activity on dependents. The higher the gender gap among students, the higher the gap between the dependents engaged in household duties.

Table 6. Percentage of Total Activity-based Economic Dependency Rate (AbEDR)

1991					
	AbEDR	**Components**			
States	**Total**	**Students**	**Household**	**Dependents**	**Others**
Arunachal Pradesh	116.3	35.5	15.7	64.3	0.7
Assam	177.1	53.9	41.3	77.6	4.2
Manipur	137.1	66.0	13.2	55.9	2.0
Meghalaya	134.3	40.5	16.7	76.1	1.0
Mizoram	104.5	48.3	11.4	43.3	1.5
Nagaland	134.3	65.5	11.2	56.1	1.5

Sikkim	140.9	58.8	23.2	56.8	2.1
Tripura	221.2	67.4	56.1	90.5	7.1
India	166.9	47.1	43.7	72.3	3.9
2001					
Arunachal Pradesh	127.4	51.2	13.5	58.1	4.5
Assam	179.4	59.9	37.6	68.5	13.4
Manipur	129.2	69.9	15.2	35.8	8.4
Meghalaya	139.0	56.6	15.0	62.5	4.9
Mizoram	90.2	43.3	9.6	33.8	3.5
Nagaland	134.7	71.8	12.6	42.9	7.4
Sikkim	105.6	52.9	15.1	33.1	4.5
Tripura	175.9	67.6	30.3	58.6	19.4
India	155.7	55.4	34.0	57.2	9.1
2011					
Arunachal Pradesh	135.5	72.4	14.4	41.1	7.5
Assam	160.7	61.3	35.7	47.6	16.0
Manipur	118.9	63.1	15.9	29.2	10.8
Meghalaya	150.0	75.6	18.0	49.8	6.9
Mizoram	125.4	62.8	20.3	34.0	8.3
Nagaland	103.1	56.9	10.0	28.6	7.6
Sikkim	98.2	55.9	16.3	18.9	7.1
Tripura	150.0	61.4	24.1	36.3	28.2
India	151.3	63.3	34.4	41.9	11.6

Source: Calculation using Census of India, B-1 and B-13.

Table 7. Percentage of Male and Female Activity-based Economic Dependency Rate (AbEDR)

1991										
State	**Total**		**Student**		**Household Duties**		**Dependent**		**Others**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Arunachal Pradesh	86.0	166.7	33.8	38.3	1.1	40.1	50.1	88.0	1.0	0.3
Assam	102.2	362.7	42.2	82.7	3.7	134.8	52.2	140.7	4.1	4.5
Manipur	120.9	156.7	65.4	66.6	3.5	25.0	49.5	63.6	2.5	1.4
Meghalaya	99.7	186.3	34.4	49.8	1.7	39.1	62.5	96.6	1.1	0.9
Mizoram	85.6	129.8	44.30	54.1	2.7	23.0	37.3	51.4	1.6	1.3
Nagaland	113.4	163.4	61.6	71.0	1.9	24.2	48.0	67.2	1.9	0.9
Sikkim	95.1	228.8	48.5	78.5	1.9	64.0	42.2	84.8	2.5	1.5
Tripura	110.3	626.6	47.9	138.5	0.8	258.4	54.9	220.9	6.7	8.7

India	94.0	349.3	40.0	64.8	1.3	149.6	48.5	131.5	4.1	3.4
2001										
Arunachal Pradesh	97.5	173.7	46.7	58.3	1.3	32.4	45.8	77.3	3.7	5.7
Assam	100.5	382.8	44.1	100.8	3.1	126.5	43.7	132.4	9.6	23.1
Manipur	107.8	156.3	65.7	75.1	2.1	31.8	30.8	42.0	9.2	7.4
Meghalaya	106.9	184.5	48.2	68.5	1.7	34.0	52.4	76.7	4.5	5.4
Mizoram	74.6	110.4	39.7	48.0	1.4	20.1	29.8	39.0	3.6	3.2
Nagaland	114.2	162.8	66.6	78.9	1.9	27.2	37.2	50.7	8.5	6.0
Sikkim	74.1	159.3	43.0	69.8	1.4	38.4	25.6	45.8	4.1	5.3
Tripura	97.5	374.4	50.3	111.3	1.1	104.5	36.2	115.4	10.0	43.2
India	93.5	290.2	45.5	76.8	1.6	103.8	38.9	96.8	7.4	12.8
2011										
Arunachal Pradesh	103.8	182.2	63.0	86.3	1.5	33.4	33.0	53.1	6.3	9.4
Assam	86.6	345.3	43.9	104.8	2.5	118.4	31.0	88.9	9.1	33.3
Manipur	94.6	150.7	58.1	69.6	1.8	34.4	24.9	33.7	9.8	12.1
Meghalaya	112.0	206.1	63.1	93.7	1.7	41.9	41.5	62.0	5.7	8.6
Mizoram	91.0	176.5	54.0	76.0	2.0	47.6	28.1	42.7	6.9	10.3
Nagaland	87.2	123.5	52.4	62.7	1.3	21.2	25.7	32.3	7.8	7.3
Sikkim	66.2	152.7	44.6	75.4	1.5	41.5	14.3	26.7	5.9	9.1
Tripura	79.3	324.2	45.1	101.7	0.7	81.5	23.1	69.0	10.5	72.1
India	87.8	291.9	49.4	94.2	1.7	106.6	28.5	71.6	8.1	19.5

Source: Calculation using Census of India, B-1, and B-10 series Data for 1991 and B-13 series Data for 2001 and 2011.

In short, it revealed that in all states, the number of non-working dependents engaged in Dependent, Household duties was decreasing, while the number of dependents engaged as Students increased. More females were participating in student activities and fewer dependents performing household duties. It implied that the majority of the women had accumulated human capital. Again, there were fewer males than females who completed their education. Females were systematically excluded from non-working dependent ratios such as student and household responsibilities, and they aggressively entered the workforce.

Discussion

The changing fertility constituted a shift in population structure. The decline in fertility not only slows population growth but also increases the proportion of working-age people in the total population and increases female labour force participation (Bloom *et al*., 2007 b). These age-structure changes, which correspond to economic outcomes, result in a demographic dividend. According to Golley and Tyer (2013), India is moving forward with its demographic transition, and the country has declared its first demographic

dividend until 2035. However, the WAP demonstrated that the demographic transition did not result in a complete engagement in the workforce. Meghalaya and Assam remain the north-eastern states with higher TFR than the replacement level. In 2013, the TFRs for Meghalaya and Assam were 2.7 and 2.3, respectively. The high fertility rate has an impact on the number of WAP. Between 1991 and 2011, the WAP in Meghalaya rose from 52.3% to 55.42%. Sikkim and Tripura, which achieved replacement level fertility in the early 2000s, witnessed WAP rise dramatically from 54.95 and 54.48% in 1991 to 64.37 and 64.37% in 2011, respectively.

However, the work participation rate for Tripura in 1991 was the lowest among the 8 states of northeast India. This was due to the high gap in work participation between the male and the female. Nagaland attaining the replacement level in the early 2000's had observed the least gap between the male and female work participation among the states during the census years. As a result, higher fertility states like Assam and Meghalaya have a larger gender gap in terms of labour participation. Whenever the working-age population grows, the rate of work participation declines. These findings were consistent with ILO research conducted in 2008, which revealed that nearly half of women's productive capacity (48.4%) was unutilized, compared to 22.3% for men. Another finding by Kuhn (2019) was that female labour participation was 47.2% compared to 74.2% for males, resulting in a 27% disparity. Further similar finding of the most significant gender gap was also observed among the developing countries of Northern Africa, Southern Asia, and the Arab countries.

Women have significantly lower rates of work participation than men. This missing working-age population was a significant hurdle in realizing the demographic dividend potential. To benefit from the demographic dividend, equitable work participation is required. It is worth to remember Wodon *et al.,* (2020) "If women were earning as much as men, women's human capital wealth could increase by more than half globally…….". Women have historically played an important role in economic development. The greater the number of women in the labour force, the more developed an economy. Marone (2016) estimated that closing the gender gap in labor force participation contributed approximately 12.2% to CaboVarde's GDP. Hence, the level of work participation by women is critical in unlocking the demographic dividend for states in India's northeast. The existing patriarchal social setup has an impact on women's economic contributions since women, willing or unwilling, do not engage in gainful activities. On the other hand, there are no job vacancies for either men or women. The discouraged worker hypothesis may also apply in areas where women may sacrifice for their male counterparts due to long-held gender stereotypes. There is speculation that the additional worker hypothesis also applies in regions where women enter the labor force while their husbands are unemployed.

As the working-age population grows and the dependency ratio remains high, the question of how to address it persists. All of India's north-eastern states had WAP levels of more than 60%. However, many of them were unable to enter the workforce. This results in fewer WAP supports. This was demonstrated by the high fertility states of

Assam and Meghalaya, which had higher rates of EbDR. However, Tripura, despite having a lower fertility rate, had a higher EbDR. This was due to the lower rate of female work participation. This was evident from the wide disparity between the male and female EbDR. Moreover,the larger number of non-working females engaged in Student and Household duties constituted a higher difference in the dependent and work participation between the males and females.

The Indian government has implemented various skill development programs and employment generation initiatives to combat youth unemployment, including the Prime Minister's Employment Generation Programme (PMGEP), the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA), Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY), and the National Urban Livelihoods Mission (NULM). Other measures include encouraging the private sector, increasing public expenditure on employment enhancement projects, and promoting sectors like manufacturing, tourism, and agro-based businesses.However, a lesser number of WAPs in India participated in the workforce. The reasons could be categorized into supply-side and demand-side factors. On the supply side (Parida and Madheswaran, 2023) revealed that as many young people—boys and girls alike—were pursuing higher education, stagnating real wages and the negative income effect brought on by rising living standards and a decline in the prevalence of income poverty—as well as other factors—may deter many young people from entering the workforce (Chauhan *et al*., 2016). Conversely, the lack of industrialization and the manufacturing sector's slow growth, the infrastructure sector's declining investment and output growth, skill mismatch issues (NSDC, 2013; Mitra, 2013; Mehrotra, 2014; Singh & Parida 2020), the growing mechanization and automation in agriculture (Mehrotra *et al*., 2014), etc., were some of the demand side factors were the policymaker face to un-accommodate the increasing number of young people entering into the workforce.

Conclusion

The population structure of states in Northeastern India has been changing.The results of this study revealed that the Indian states in the northeast are more likely to experience the demographic dividend. Their reliance was notable even though their WAP accounted for more than 60% of the population as a whole. WAP for women needs to increase, and there should be more avenues for women to pursue careers. Desai (2010) noted that without more job opportunities and fewer barriers to entry into the labour market, which may compel more women to enter the workforce, India's demographic dividend will not be fully realized. The only way to capitalize on the demographic dividend is to close the gender gap in dependents and pursue them into the labour force.Why housework should be reserved for "women" is a moot point. The marriage's relationship between housework among partners and income distribution among wives is consistent with economic exchange principles. The more financially dependent a husband is on his wife, the less housework she does. Economically dependent spouses appear to "do gender" less housework (Brines, 1994). The increase of this household domestic work for women due to the contextual patriarchal society, which makes women confined in the

household sphere or the changing economic system that women should not work outside of the limiting employment opportunities given to them must be restrained in getting the opportunity to grasp the demographic dividend. Gender equality/equity in education and job market, opening and effective implementation of start-ups or entrepreneurship to absorb the working age population irrespective of gender, women-specific avenues must be set up so that women can come out to manifest their contribution to reap the dividend.

Limitation

The paper's employment data were sourced solely from the Registrar General of India's most recent 2011 census. To measure the demographic dividend, the paper focused solely on measures of labour participation rather than economic growth. The study confirms gender disparities in work participation. It implies that increased economic growth would be possible if more workers emerged from the expanding working-age population.

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Household Energy Transition in India: Is the Recent Expansion in LPG use Inclusive?

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Abstract

The recent expansion in LPG connections has generated curiosity whether it transformed the Indian households towards using clean cooking fuel. This study evaluates the progress in LPG use as a primary source of cooking fuel in India, especially in rural landscapes. Employing the long-term data provided by NSSO, we find that the use of LPG has witnessed an appreciable improvement in rural India after 2014. However, this improvement is limited to the economically well-off section of the society. Households belonging to lower consumption quintile and lower social hierarchy in economically poor states are far from reaping the benefits of this expansion. Interestingly, the use of LPG among the poor households is high in relatively developed states than the non-poor households in relatively underdeveloped states. This suggests that the distributive policy focus should be on the poor and non-poor households in economically backward states to realise the universalisation of LPG use.

Introduction

Each year across the globe, around four million people die prematurely from illnesses attributable to indoor air pollution. Indoor air pollution is caused by inefficient cooking practices using traditional fuel[3]in polluting stoves(World Health Organization [WHO],

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[3]The traditional cooking fuel includes kerosene, biomass (wood, animal dung, and crop residues) and coal. The burning of these fuels emits CO2, and this causes noncommunicable diseases including stroke, ischemic heart disease, chronic obstructive pulmonary disease and lung cancer (WHO, 2018).

2018). The use of traditional fuel and resultant emission within the household causes the loss of around 0.5 million lives in India every year (India State-Level Disease Burden InitiativeAir Pollution Collaborators, 2019). To control indoor air pollution and its associated health hazards, the Union Government of India encouraged the households to transitfrom traditional to clean fuel (mainly, Liquified Petroleum Gas [LPG]) for cooking.[4] Between 1965 and 1970, only a few lakhs registered LPG connections were given in India. After the economic reforms, the number of LPG connections increased to around 60 million in 2001. The number of households connected to LPG further increased to 264.26 million in 2014-15. The gradual expansion of LPG connections, however, has occurred largely among the middle income and an upper-income group of households in urban areas, and there is no real transition to clean cooking fuel among low-income groups in the rural population (Ramji et al., 2012; Aggarwal et al., 2018).[5]

To increase the penetration of LPG among the economically poor and marginalized in rural areas, the central government of India launched a flagship program- Pradhan Mantri Ujjwala Yojana (PMUY) in May 2016. The PMUY,with a focused vision to universalize clean cooking among Indian households, also aims to fulfill its commitment towards Sustainable Development Goals (SDG-7)[6]and the Paris Agreement of Climate Change.[7] To realize its goal, the scheme provides a subsidy and loan to reduce the upfront cost of the LPG connection.[8] The government also provides direct cash subsidy transfer to the consumer's bank account against every LPG cylinder refilled to improve affordability and incentivizes the regular use of clean fuel (Chindarkar et al., 2021). These incentives have increased the number of registered LPG connections and the number of active LPG consumers. In 2016, only 56% of Indian households had access to LPG, which has significantly increased to about 80% at the end of 2018.Similarly, the total number of active LPG consumers has increased by 31%between April 2016 and January 2018 (Dabadge et al., 2018; Chaudhury, 2019). However, there has been a concern whether this increase in the number of connections and the number of active users of LPG is an indication of the actual use of clean cooking fuel among the Indian households as households use alternative fuel for cooking depending on the type of food (Jeuland et al., 2015; Brooks et al., 2016). Therefore, it is crucial to understand the ground reality of the actual usage of LPG as the primary source of cooking fuel in Indian households. Against this, we examine the use of LPG as a primary source of fuel for cooking among Indian households. The analysis will give a clear picture of the actual usage of clean fuel among Indian households. This study assumes a particular significance as PMUY was considered a transformative policy to secure energy efficiency and improve

[4] Using a clean cook stove (mainly LPG) is associated with daily reductions of about 4.5 kg of biomass fuel, 160 fewer minutes cooking on traditional stoves, and 105 fewer minutes collecting biomass fuels (Brooks at el., 2016).

[5] The use of LPG among lower-income households is constant at about 6-8 kg per month between 1999-00 and 2009-10; the medium-income households consume about 7-10 kg per month; and the high-income households consume about 10-11 kg per month (Ramji et al., 2012).

[6] India needs to provide access to affordable, reliable, sustainable, and modern energy (both cooking and lighting) to all households by 2030 (Chaudhury, 2019).

[7] It emphasizes the substitutions towards low-carbon energy sources (Vandyck et al., 2016).

[8] The expenditure increases by 3.6-8.8 folds for transition from traditional fuel to LPG cooking fuel in India (Sankhyayan& Dasgupta, 2019).

the household's health. We use households' energy use information provided by the National Sample Survey (NSS), Ministry of Statistics and Program Implementation, Government of India for the analysis.[9]

Recent Improvements in LPG Benefited Rural Households

The primary source of energy used for cooking by the Indian households has witnessed a massive change during 1983-2018 (Table 1).

Table 1: Primary Source of Energy used for Cooking by the Indian Household

Items	January - December 1983	July 1987 -June 1988	July 1993 -June 1994	July 1999 -June 2000	July 2004 -June 2005	July 2009 -Jun 2010	July 2011 -June 2012	January -June 2014	July 2017 -June 2018	July - December 2018
Rural										
Coke/coal	2.4	1.9	1.4	1.5	0.8	0.8	1.1	1.1	0.5	-
Firewood & chips	77.0	79.0	78.2	75.5	75.0	76.3	67.3	69.9	49.6	44.5
LPG	0.2	0.8	1.9	5.4	8.6	11.5	15.0	18.4	42.7	48.3
Dung cake	14.5	13.8	11.5	10.6	9.1	6.3	9.6	8.1	5.0	5.5
Kerosene	0.8	1.5	2.0	2.7	1.3	0.8	0.9	0.4	0.3	-
No cooking arrangement	5.4	3.1	0.7	1.1	1.3	1.6	1.3	0.1	0.7	0.6
Other sources				3.1	3.8	2.7	4.9	2.0	1.2	1.1
All	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Urban										
Coke/coal	16.6	10.7	5.7	4.1	2.8	2.3	2.1	2.1	0.6	-
Firewood & chips	46.0	37.0	29.9	22.3	21.7	17.5	14.0	15.6	6.2	5.6
LPG	10.3	22.3	29.6	44.2	57.1	64.5	68.4	75.0	86.4	86.6
Dung cake	2.9	3.1	2.4	2.1	1.7	1.3	1.3	1.4	0.5	0.5
Kerosene	16.7	19.2	23.2	21.7	10.2	6.5	5.7	3.9	0.8	-
No cooking arrangement	7.6	7.3	6.3	4.3	4.9	6.5	6.9	1.2	5.1	4.1
Other sources			3.0	1.3	1.6	1.5	1.5	0.8	0.4	3.2
All	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' computation using various rounds of NSS surveys

[9] The energy use informationis available in 50th (1993-94), 55th (1999-2000), 61st (2004-05), 66th (2009-10), and 68th (2011-12) rounds of consumer expenditure survey of NSSO. The information on the primary energy source for cooking during the last 30 days in the household is also available in 71st (Jan-June 2014) and 75th (July 2017-June 2018) rounds of NSS entitled 'Social Consumption: Health.' The question on the primary source of energy used for cooking by the Indian household is identical across the various rounds of the NSS survey. Therefore, we do not notice a technical barrier in using different rounds of NSS for inter-temporal comparisons.

Among the different types of traditional fuels, firewood and chips were widely used cooking fuels among the rural(77%) and urban (46%) households in the 1980s. Dung cake (14.5%) was another major source of energy for cooking in rural households, while kerosene (16.7%), coal (16.6%), and LPG (10.3%) were employed as other sources of fuel for cooking in urban households. Initially, the use of cooking fuel was highly diversified in urban areas. However, LPG use has increased and substituted traditional cooking fuel in urban areas. A similar expansion in the use of LPG was not experienced in rural areas till 2014, making clean cooking fuel use in India an urban phenomenon as it registered a meager improvement from 0.2% in 1983 to 18.4% in 2014. The use of LPG has witnessed an upsurge by about 30 percentage points in the rural areas after 2014 and reached 48.3% in 2018. This recent expansion in the use of LPG in rural areas after 2014 could be attributed to a concerted effort by the government through its flagship PMUY policy(Dabadge et al., 2018; Chaudhury, 2019; Sharma et al., 2019; Shankyayan & Dasgupta, 2019; Swain & Mishra, 2020; Chindarkar et al., 2021).

Widening Regional Disparity in LPG Use

The recent expansion in the use of LPG in rural areas as a primary source of fuel for cooking varies across the states. In 2018, the use of LPG was highest in Tamil Nadu (83.8%), conversely, the lowest use of LPG was recorded in Jharkhand (21.5%).

This gap of more than 62 percentage points between the best and worse-off state indicates a large development divide in LPG use among the Indian states. In 2018, Tamil Nadu, united Andhra Pradesh, Punjab, Maharashtra, and Jammu & Kashmir had more than 60% households using LPG. In contrast, Jharkhand, Chhattisgarh, Odisha, and West Bengal had less than 30% LPG users. In 2014, some poor-performing states (Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Odisha, and West Bengal) had less than 10% LPG users, which increased up to more than 20% in 2018. Despite this improvement, these states are still among those at the bottom of the LPG use. LPG use among the relatively better performing states (united Andhra Pradesh,Maharashtra, Punjab, Tamil Nadu, and Uttarakhand) was more than 30% in 2014, expanding even faster to achieve more than 60% in the year 2018.

Table 2: LPG as a Primary Source of Energy used for Cooking by Rural Indian Households across the States

State	July 1993 -June 1994	July 1999 -June 2000	July 2004 -June 2005	July 2009 -June 2010	July 2011 -June 2012	January -June 2014	July 2017 -June 2018	July -December 2018
Andhra Pradesh + Telangana	2.3	6.3	14.4	19.4	28.9	35.6	77.2	83.1
Assam	1.1	5.6	6.9	14.2	17.2	23.8	42.9	53.5
Bihar (BH)	-	-	1.7	3.5	5.9	5.5	36.5	44.2
Jharkhand (JH)	-	-	1.4	2.5	2.9	2.8	16.8	21.5

BH+JH	0.3	0.6	1.6	3.3	5.2	4.9	31.9	38.8
Gujarat	4.9	10.2	10.5	10.6	13.9	22.8	54.6	50.1
Haryana	3.6	18.4	19.1	21.4	26.7	22.3	42.9	54.2
Karnataka	1.7	4.3	6.5	10.7	14.7	24.5	62.9	72.2
Kerala	4.1	11.6	18.2	26.5	30.8	24.3	48.0	50.7
Madhya Pradesh (MP)	-	-	3.8	5.5	6.2	5.5	29.7	33.1
Chhattisgarh (CH)	-	-	1.5	2.0	1.5	5.5	26.5	29.4
MP+CH	0.5	1.7	3.1	4.5	4.8	5.5	28.7	32.0
Maharashtra	3.5	9.1	14.9	17	23.1	31.3	57.4	65.8
Odisha	0.3	0.8	2.9	3.7	3.9	5.8	18.1	23.8
Punjab	5.1	14.2	24.2	33.7	30.5	37.5	69.8	77.4
Rajasthan	2.0	2.9	5.1	5.6	8.9	11.4	24.5	33.7
Tamil Nadu	3.1	6.7	13.4	25.4	37.2	46.7	75.1	83.8
Uttar Pradesh (UP)	-	-	4.8	5.8	6.7	11.8	31.9	37.8
Uttarakhand (UK)	-	-	18.3	17.8	28.8	30.6	64.3	58.5
UP+UK	1.2	3.6	5.5	6.5	8.2	12.7	33.7	38.9
West Bengal	0.3	1.7	4.3	4.8	6.6	7.2	20.0	24.5
Himachal Pradesh	5.0	20.6	20.6	26.3	25.2	23.4	36.7	47.5
Jammu and Kashmir	5.2	7.8	14.7	24.6	26.5	26.8	39.0	61.2

Source: Authors' computation using various rounds of NSS surveys

The Social Disparity in LPG Use

Like in many other development indicators, the use of LPG illustrates the social hierarchy in India (Table 3). The LPG use is lowest among under privileged- SCs/STs, followed by OBCs and Others. The difference in the use of clean cooking fuel is the highest between SCs/STs and OBCs. We notice that this social hierarchy is prevalent across all states except in Assam and Jammu & Kashmir. In Assam, LPG use is highest among SCs/STs, while in Jammu & Kashmir, it is highest among OBCs.

Table 3: Percentage of Rural Indian Households using LPG as a Primary Source of Energy for Cooking Across Social Groups

State	SC+ST		OBC		Others		All	
	2014	2018	2014	2018	2014	2018	2014	2018
Andhra Pradesh	21.0	68.2	33.8	81.5	55.2	90.5	35.6	79.2
Assam	19.4	58.0	29.9	57.9	22.8	48.4	23.8	53.6
Bihar	01.8	34.0	04.1	44.8	15.7	61.5	05.5	44.5
Chhattisgarh	01.5	24.6	08.8	34.1	25.6	49.5	05.5	29.4
Gujarat	07.3	35.7	15.2	51.9	58.8	72.4	22.8	50.3
Haryana	10.1	52.6	22.2	53.7	32.5	56.7	22.3	54.4
Himachal Pradesh	20.3	34.7	27.7	47.8	23.5	55.8	23.4	47.5

Jammu & Kashmir	21.4	36.2	07.6	85.1	31.6	62.1	26.8	61.2
Jharkhand	01.6	13.0	01.3	28.1	34.0	38.8	02.8	21.5
Karnataka	13.1	68.5	26.4	71.5	32.3	79.0	24.5	72.2
Kerala	12.3	24.9	23.5	49.7	32.3	63.4	24.3	50.7
Madhya Pradesh	02.9	27.6	06.3	36.2	12.2	45.1	05.5	33.5
Maharashtra	17.3	54.3	33.8	69.8	42.7	71.6	31.3	65.8
Odisha	01.9	12.9	09.1	32.2	09.7	38.8	05.8	23.8
Punjab	26.2	70.9	41.5	82.9	50.0	82.7	37.5	77.4
Rajasthan	05.1	32.3	12.3	30.3	27.6	51.4	11.4	33.7
Tamil Nadu	29.2	80.0	54.9	85.8	17.6	92.3	46.7	83.8
Telangana	19.1	89.7	50.5	89.6	64.2	98.5	44.1	90.6
Uttarakhand	17.0	37.9	10.5	75.2	40.4	62.1	30.6	58.5
Uttar Pradesh	05.4	31.9	11.3	36.1	23.7	55.9	11.8	37.9
West Bengal	05.7	20.4	03.4	21.9	09.2	28.4	07.2	24.5
India	09.7	39.3	20.1	51.7	27.8	56.4	18.4	48.5

Source: Authors' computation using various rounds of NSS surveys

The SCs/STs are the worst-off while the category 'Others' is the best among all social categories in LPG use for the year 2018. However, the difference between these groups widely differs across the states (Table 3). It is observed that this disparity is highest in Kerala (38.5%) and Gujarat (36.7%). Both Kerala and Gujarat have experienced nearly similar mid-level (50%) overall achievements but have high levels of social disparity (refer to Table 4). This disparity among worst-off and best social groups is less in Haryana (4.1%), West Bengal (8%), and Telangana (8.8%). These three states represent different scenarios. Haryana is among the states with mid-level achievement (54.4%) but has low-level social disparity. The overall use of LPG is highest in Telangana (90.6%) among all the states, and therefore the social disparity is not apparent. Though West Bengal has a low level of social disparity, it has the lowest level of overall achievements (24.5%). The achievements and social disparity in LPG use are presented in table 4.

All social groups registered similar levels of progress in LPG use at the national level during 2014 and 2018. However, this pattern is different across states. As a result, the disparity in some states has increased, while it has reduced in some others (Table 3). For example, in Andhra Pradesh, the progress in the use of LPG as a primary source of fuel for cooking among SCs/STs (47.2 percentage points) and OBC (47.7 percentage points) is higher than the Others (35.3 percentage points). Such progress where the underprivileged sections of the society progress faster than the privileged ones reduces the disparity between them. On the other hand, in Odisha, the progress in the use of LPG among SCs/STs (11 percentage points) is much lower than the OBCs (23 percentage points) and Others (29.1 percentage points). This indicates disproportionate progress in clean cooking fuel among the deprived and an increase in disparity among different social categories.

Table 4:Association between Achievement and Disparity in LPG use, 2018

Achievements→ Gaps ↓	Less than 30%	30-45%	45-60%	More than 60%
Lowest Less than 10 percentage points	West Bengal (24.5) [8]	--	Assam (53.6)[-9.6] Haryana (54.4)[4.1]	Telangana (90.6) [8.8]
10-20 percentage points	--	Madhya Pradesh (33.5) [17.5] Rajasthan (33.7) [19.1]	--	Karnataka (72.2) [10.5] Punjab (77.4) [11.8] Tamil Nadu (83.8) [12.3] Maharashtra (65.8) [17.3]
20-30 percentage points	Chhattisgarh (29.4)[24.9] Jharkhand (21.5)[25.8] Odisha (23.8)[25.9]	Uttar Pradesh (37.9) [24] Bihar (44.5) [27.5]	Himachal Pradesh (47.5) [21.1] Uttarakhand (58.5) [24.2]	Andhra Pradesh (79.2) [22.3] Jammu & Kashmir (61.2) [25.9]
More than 30 percentage points	--	--	Gujarat (50.3)[36.7] Kerala (50.7)[38.5]	--

Notes: *Achievements refer to proportion of households using LPG. Gaps refers to percentage point difference in LPG use between worst-off (SC/STs) and best-off (Others) households. Figures in round brackets are achievements while figures in box brackets are gaps.*
Source:*Authors'computation using NSS data*

The Higher Disparity among the Lower-performing States

The use of LPG is higher among the high-income groups than their counterparts in lower-income (Table 5). At the national level, the use of LPG among the upper consumption quintile is about 2.5 times larger than the lower consumption quintile in 2018. This means that the lower quintile households are not able to reap the benefits of the recent expansion in clean cooking fuel. This pattern of LPG use is observed across all the states. However, the disparity between the lower and upper quintile varies widely. It is observed that the disparity is highest in Odisha, whereas it is lowest in Telangana. The states with a high level of LPG use (Telangana, Andhra Pradesh, Tamil Nadu, and Punjab) witness a low disparity. In contrast, the states (West Bengal, Jharkhand, Chhattisgarh, Uttarakhand, and Kerala) with low LPG use experience a high level of disparity.

Table 5:Percentage of Rural Indian Households using LPG as a Primary Source of Energy for Cooking across the Consumption Quintiles Class, July-December 2018

State	00-20	20-40	40-60	60-80	80-100	All	Disparity
Andhra Pradesh	65.7	70.5	80.6	84.6	89.5	79.2	01.36
Assam	32.0	42.3	50.9	58.8	73.8	53.6	02.31
Bihar	33.8	35.1	38.1	46.1	59.9	44.5	01.77
Chhattisgarh	19.4	22.7	23.1	33.1	44.5	29.4	02.29
Gujarat	41.3	48.5	44.7	48.6	62.0	50.3	01.50
Haryana	36.6	41.6	49.4	55.8	76.2	54.4	02.08
Himachal Pradesh	24.1	38.3	45.1	41.7	75.1	47.5	03.12
Jammu & Kashmir	59.3	47.4	67.5	45.3	83.4	61.2	01.41
Jharkhand	11.5	14.0	16.5	23.7	35.7	21.5	03.10
Karnataka	56.5	65.7	70.2	79.8	80.4	72.2	01.42
Kerala	27.6	41.2	45.7	58.1	67.8	50.7	02.46
Madhya Pradesh	27.2	27.5	29.3	35.7	42.7	33.5	01.57
Maharashtra	43.3	59.1	66.8	70.8	82.1	65.8	01.90
Odisha	10.8	14.5	20.4	24.8	44.6	23.8	04.13
Punjab	52.7	77.4	82.0	81.7	86.8	77.4	01.65
Rajasthan	24.1	26.7	35.6	33.7	44	33.7	01.83
Tamil Nadu	72.8	82.2	85.8	87.6	88.4	83.8	01.21
Telangana	87.8	85.3	91.7	90.8	95.8	90.6	01.09
Uttarakhand	25.9	51.7	65.7	63.1	72.8	58.5	02.81
Uttar Pradesh	26.5	33.4	34.5	39.4	49.6	37.9	01.87
West Bengal	12.2	16.9	17.1	26.1	43.8	24.5	03.59
India	28.3	35.8	43.7	54.3	69.2	48.5	02.45

Note: Disparity is measured as a ratio of high quintile to low quintile

Source: *Authors' computation using various rounds of NSS surveys*

Income is one of the crucial factors determining the demand for LPG in Indian households (Sankhyayan& Dasgupta, 2019; Sharma et al., 2019; Chindarkar et al., 2021). However, a threshold level of income of the household is required to access and use LPG. Therefore, to provide the poor with the threshold level of income and meet the upfront cost of LPG, the government initiated the PMUY. The welfare impact of this policy on the poor is evaluated by comparing the use of LPG between poor and non-poor households[10](Table 6). It is observed that there is a sizable difference between the poor and non-poor in LPG use. At the national level, 32.1% of poor

[10] Poor and non-poor households are classified on the basis of state specific poverty line suggested by Rangarajan Report (2014). Estimation of Rangarajan Poverty line is based on Consumer Expenditure Survey, NSS 68th round (July 2011- June 2012). Poverty line for 2014 and 2018 is obtained by deflating Rangarajan poverty line with state specific Consumer Price Index of agricultural labour.

households and 56.3% of non-poor households used LPG in 2018. In Andhra Pradesh, Jammu & Kashmir, Karnataka, Tamil Nadu, Telangana, Maharashtra, and Punjab, more than 50% of poor households use LPG as a primary source of energy for cooking. In contrast, less than 40% of the non-poor households use LPG in Jharkhand, Odisha, Rajasthan, West Bengal, and Chhattisgarh. The poor households perform better in the former group of states (which are relatively developed) than the non-poor in the latter group of states (which are relatively underdeveloped). It is surprising that despite the concerted effort in implementing the PMUYto expand the use of LPG among the poor in rural areas, the actual use of LPG is still less among these categories, especially in relatively underdeveloped states.

Table 6: Use of LPG Among the Poor and Non-poor Household in Rural India

States	Percentage of poor household using LPG		Percentage of non-poor household using LPG	
	2014	2018	2014	2018
Andhra Pradesh	24.7	64.7	44.3	81.6
Assam	20.0	35.8	28.0	60.2
Bihar	3.1	35.1	10.8	51.1
Chhattisgarh	5.7	22.0	5.0	37.0
Gujarat	13.6	43.4	28.5	51.9
Haryana	4.9	35.5	32.5	57.5
Himachal Pradesh	5.4	25.3	31.2	50.3
Jammu & Kashmir	14.7	62.5	40.9	61.0
Jharkhand	0.2	14.0	9.5	26.7
Karnataka	15.0	59.6	32.1	76.2
Kerala	7.9	21.4	27.0	52.8
Madhya Pradesh	3.9	27.7	7.4	37.0
Maharashtra	20.5	51.9	41.0	74.2
Orissa	0.9	14.5	18.2	33.3
Punjab	15.6	54.8	45.8	78.3
Rajasthan	4.1	24.9	17.1	36.1
Tamil Nadu	37.5	76.9	52.5	87.1
Uttar Pradesh	4.1	30.1	20.5	41.7
Uttarakhand	6.9	23.5	60.7	63.2
West Bengal	2.5	11.6	11.4	26.8
All India	7.8	32.1	28.7	56.3

Source: *Authors' computation using from70th and 76th rounds of NSS surveys*

Conclusion and Implications

Using the long-term data provided by NSS surveys, it has been observed that LPG as a primary source of cooking fuel has continuously increased in urban India from 1983-2018. However, this expansion in the use of LPG is relatively less in rural areas. The use of LPG in a rural areas, nevertheless, has witnessed an appreciable improvement after 2016 and these recent improvements in LPG use have replaced the traditional fuels in urban and rural areas. This remarkable transition towards clean cooking fuel use in rural areas after 2016 could be attributed to the flagship initiative- PMUY. However, this improvement is limited to the economically well-off section of the society. Households belonging to lower consumption quintile and lower social hierarchy in economically poor states are far from reaping the benefits of the recent expansion in LPG use. Interestingly, the use of LPG among the poor household is high in relatively developed states than the non-poor households in relatively underdeveloped states. These findings raise pertinent questions about the objective and outcome of a centrally sponsored scheme that aimed for universal benefit across all households across the states. Therefore, we if India aims to realize universal use to LPG, the focus of the policy should be on both the poor and non-poor households in economically backward states.

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Evaluating the Impact of Skill Development Initiatives on the Wages of Construction Workers: A Case Study in Assam

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Abstract

The Assam Building & Other Construction Workers' Welfare Board initiated a Skill Training Program (STP) to enhance the capability of registered construction workers, aiming to boost their skills, income and job prospects. This study investigates the impact of the STP on construction workers in terms of wages from 13 districts in Assam covering occupations like plumbing, carpentry, masonry, electrical and painting. The central emphasis of the study revolves around determining whether there has been a rise in wages subsequent to the implementation of the STP. The findings reveal a significant rise in wages among trainees compared to non-trainees, with notable variations across occupations. Painters and plumbers experienced the highest wage gains, while masonry workers showed no significant improvement examined using Difference in Difference (DiD) method. Regression results further confirm that the program effectively boosts wages and enhances real purchasing power, with trainees'current (2023) wage exceeding inflation-adjusted wages. The study also highlights disparities based on gender, religion, social groups, and education, emphasizing the dynamic nature of wage determination.

Introduction

The Indian construction industry plays a pivotal role in the national economy, contributing significantly to GDP and employment. As one of the largest employers in the country, it

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sustains millions through job creation, with an estimated 50 million workers employed in the sector (Gandhi et al., 2013). The construction sector's market size is projected to grow substantially, reaching an estimated Rs. 2,48,000 crores by 2025, and positioning India as the third-largest construction market globally (Ahuja et al., 2020). Given its contribution to both economic growth and employment, particularly in states like Assam, the sector's importance in national development cannot be overstated. In Assam, for instance, the number of workers employed in construction increased from 6.62 lakh in 2011 to 8.66 lakh by 2018, accounting for nearly 50% of the state's total employment (Hira, 2021).

Despite the sector's critical role, challenges related to productivity, efficiency, and quality persist. One of the main issues plaguing the construction industry is the shortage of skilled labour, which exacerbates inefficiencies and delays in construction projects (Agrawal and Agrawal, 2017; Wang et al., 2008). While advanced technologies have the potential to improve productivity, their high initial costs and limited access in developing nations hinder their widespread adoption (Durdyev and Mbachu, 2017; Ofori, 2007). Consequently, the construction industry in India remains heavily reliant on manual labour, with workers often lacking the necessary technical skills to meet the evolving demands of the sector.

In this context, training programs, particularly Skill Training Programs (STP), have become essential in enhancing the competency of workers. These programs are crucial for equipping workers with the necessary technical and vocational skills, thereby improving their job prospects and overall competitiveness in the labour market. Furthermore, STPs play a significant role in improving workplace safety, as workers trained in hazard recognition tend to contribute to safer work environments, thereby reducing the risk of accidents and injuries (Noghabaei & Han, 2020). These programs not only enhance job retention but also improve overall job satisfaction, leading to higher long-term earnings (Froyland & Terjesen, 2020). Moreover, vocational training is particularly beneficial for dislocated workers, as it increases their chances of reemployment in better-paying positions (Tang, 1993).

While the benefits of training on productivity and safety are well-established, the impact of such training on wage outcomes has received less attention. This research aims to address this gap by exploring whether the STP contributes to an increase in the real wages of trained construction workers. This research contributes to the literature by providing empirical evidence, specifically examining the effects of STPs on wage outcomes for construction workers in Assam. It evaluates whether trained workers experience real wage increases, taking into account socio-economic factors.

Skill Enhancement and Upgradation by ABOCWWB

Given the pivotal role of construction workers in the infrastructural progress of emerging and developing economies, the emphasis on their education and training cannot be overstated. Therefore, to address these challenges, the government and various stakeholders have introduced various programs at the national and regional

levels. At present, India has three different training schemes to provide skills to construction workers. These are the Craftsman Training Scheme (CTS), Apprenticeship Training Scheme (ATS), and Skill Development Initiative Scheme (SDIS). The SDIS is the most recent and advanced training scheme for workers in India. Under the SDIS, training is imparted for more than 90 trade disciplines (occupations), which is far larger than the previous training schemes (Johari & Jha, 2019). Through these, workers are immersed in comprehensive training modules, culminating in the acquisition of skill certificates that validate their expertise. Such initiatives are not merely about addressing skill gaps but are fundamental steps toward dignifying the profession and ensuring sustainable growth for the construction workforce. In short, the goal is to empower them, enhance their job prospects, and ensure their overall welfare. On a similar note, a similar initiative was led by the Assam Building and Other Construction Workers Welfare Board (ABOCWWB), whereby Government of Assam initiated a Skill Training Programme (STP) in the year 2018-19 in two phases covering 30 districts of Assam. STP was an attempt to ensure better work opportunities and wage-earning sources for registered construction workers.

The Government of Assam constituted the ABOCWWB in 2008. One of the features of the Act is to create a welfare fund whereby benefits are open to all registered eligible construction workers. These include medical assistance, maternity assistance, death benefits, funeral assistance, marriage assistance, educational scholarships to the children of registered construction workers, loans, general, disability and family pensions, job oriented technical and vocational training to the eligible children of the registered construction workers with skill development training for the eligible registered construction workers. The Government of Assam under this board initiated the skill training program for the registered workers who got skill-based formal training and received a skill certificate after successful completion of the training. The skill development initiative is implemented through a well-designed format whereby training and assessment partners along with industry partners are involved in providing the requisite skill training. The overall architecture for this skill enhancement process includes four steps: Assessment, Skills Training, Final Assessment and Certification, and Tracer Study.

The STP was initiated in two phases. The first phase was initiated covering 13 districts of Assam: Barpeta, Nalbari, Baksa, Chirang, Bongaigaon, Darrang, Kamrup, Dibrugarh, Tinsukia, Dhemaji, Sivasagar, Jorhat and Udalguri. In the second phase, the remaining districts were covered under the Programme with 99 training centres utilised by 13 training partners selected for the purpose. However, the study is completely based on the first phase of the program.

A total of 30607 construction workers are registered for the STP out of which 28118 (92 percent) completed the programme. The STP programme was launched with a duration of two months in each of the districts under both phases with eight (8) hours of training sessions per day. The trades (occupations) included under the STP are plumbing, masonry, painting, carpentry, bar bending, and electrician. Each of the participants of the STP was provided with a stipend of Rs 280 per day (subject to a minimum attendance of 50% i.e., 30 days).

Literature Review on the Determinants of Wage Rates

The determination of wage rates is a central issue in labour economics, influencing both policy decisions and labour market efficiency. Various factors, including individual characteristics, institutional frameworks, and macroeconomic conditions, shape wage rates. This literature review examines the primary determinants of wage rates, offering insights from microeconomic and macroeconomic perspectives, with key theoretical frameworks and empirical findings.

The neoclassical theory of labour markets highlights supply-side factors, emphasizing that wages are determined by labour supply and demand. According to this theory, wages reflect workers' skills, education, and experience. The human capital theory (Becker, 1964; Mincer, 1974) extends this view, suggesting that investments in education and training enhance productivity, leading to higher wages. Wage disparities arise from differential investments in human capital, with more educated or skilled workers commanding higher wages. However, the theory has been critiqued for overlooking issues such as wage inequality, unemployment, and discrimination, which led to the development of alternative models (Leontaridi, 1998).

Segmented labour market theory (Leontaridi, 1998) challenges the neoclassical model by introducing labour market segmentation. It argues that labour markets consist of distinct segments with different rules, often influenced by institutional and social factors. Certain segments may disproportionately reward specific skills, while others offer limited access to well-paying jobs despite similar qualifications. This theory emphasizes the importance of institutional and structural factors in wage determination and suggests that segmented labour markets perpetuate wage inequality.

Recent empirical studies also highlight the influence of personal characteristics and socio-political factors on wage outcomes (Bhattarai, 2017). International perspectives on wage determination have been explored by Perry et al. (1975), who noted significant wage variations across countries due to both domestic factors and global conditions like foreign trade. Their research, building on William Nordhaus's work, found that no single theory could explain wage behavior across all nations, underlining the need to consider both local and global factors when analyzing wage rates.

Labour market dynamics are shaped by broader economic conditions, including demographic trends and labour market mobility. Sarycheval& Shvetsov (2015) analyzed the relationship between labour supply and demand, highlighting how aging populations are leading to labour shortages in certain sectors. Their study emphasizes the need for a rational distribution of labour and greater workforce mobility to address these imbalances. By using regression models with panel data, they assessed the effects of various factors on labour market trends, providing insights into structural factors that influence employment and wage outcomes at national and regional levels.

Another key approach to wage determination is the earnings function model, which regresses wage rates on personal, market, and environmental variables. Willis (1986)

offers a comprehensive review of this model, which has been used to study issues like wage discrimination and the impact of education and training on wage outcomes. The human capital earnings function, in particular, has been pivotal in understanding how investments in education and training influence wages over an individual's career. This approach has been central in testing wage determination theories and providing empirical evidence of the significant role of education in explaining wage disparities.

Methodology and Analytical Framework

Sampling Methodology

This study is conducted across 13 districts of Assam namely Barpeta, Nalbari, Baksa, Chirang, Bongaigaon, Darrang, Kamrup, Dibrugarh, Tinsukia, Dhemaji, Sivasagar, Jorhat and Udalguri, aiming to address crucial inquiries by gathering insights from both registered trainee and non-trainee construction workers through a carefully designed sample survey. The study involves 1890 registered construction workers, chosen from a total pool of 30,607, with a 2% margin of error and a 95% confidence interval. The sample is stratified into two groups: 945 trainee workers and 945 non-trainee workers for the primary survey[3], which is carried out through a randomized control experiment spanning a variety of occupations including plumbing, carpentry, masonry, electrical, bar bending, and painting.

To ensure equitable representation of workers across districts, the sample is distributed proportionately to the total number of registered workers in each district. Mitigating potential bias, sample units are randomly selected without replacement, allowing for flexibility in cases where a particular unit is unavailable or unwilling to participate in the survey. This approach is undertaken to enhance the reliability and comprehensiveness of the study's findings.

Analytical Methodology

The study utilises two distinct approaches to examine the impact of STP on the wage rate of workers. In the first approach Difference-in-Differences (DiD) technique is used which delves into the program's impact on wages. In the second approach, two regression models are used to examine whether the change in wage rate after a period of time (4 years) aligns with inflation or not.

Difference in Difference Approach

Initially, 1075 observations are collected for each group: trainees and non-trainees. However, within 4 years, a majority portion of individual shifted their occupations.

[3] Statistically the estimated sample beneficiary size (with the above-mentioned configuration vis confidence interval, margin of error and sample proportion) is 1890 (945 trainee beneficiaries and 945 non-trainee workers respectively). However, in order to enhance the certainty and reliability of the research outcomes, the number of beneficiaries are purposively increased to 2150: 1075 trainee beneficiaries and 1075 non-trainee workers respectively.

Although this shift is not largely different from the previous occupations[4] but the wage rate somehow is different for each occupation. Hence, the wage rate of two different occupations in two different time intervals cannot be compared to assess the change. Thus, only those observations having the same initial and current occupations at the time of the survey are taken into consideration. To examine, a total of 199 individuals for each group (199 trainees and 199 non-trainees) are filtered out. Due to two time periods (before and after), the final observations become double. In the final stage, 398 observations are gathered for each group (398 trainees and 398 non-trainees).

Counterfactual trend analysis for a DiD (Difference-in-Differences) is a statistical method used to estimate the causal effect of a treatment or intervention by comparing the change in outcomes over time between a treatment group and a control group. The basic idea is to estimate what would have happened to the treatment group in the absence of the intervention and then compare it to what happened with the intervention. The formula for the Counterfactual outcome of the treatment group in a Difference-in-Differences (DiD) analysis is:

Counterfactual outcome of treatment group = Pre-treatment Outcome of Treatment Group -Observed Change in Control Group.

1. "Pre-treatment Outcome of Treatment Group" represents the average or observed outcome of the Treatment Group during the period before the treatment or intervention.
2. "Observed Change in Control Group" represents the change in the Control Group's outcome from the pre-treatment period to the post-treatment period.

This formula represents the counterfactual scenario by assuming that, in the absence of the treatment, the outcome of the treatment group would have followed the same trend as the outcome of the control group.

Regression Models and Variable Specification

The Difference-in-Differences (DiD) model examine if there are any differences between daily wages of trainee and non-trainee workers after STP. However, it is crucial to note that wage rates are influenced not only by skill levels but also by broader economic factors such as inflation, productivity, and the supply and demand for labour. Capturing all these external factors simultaneously is difficult. In this study, inflation is specifically considered to examine an alternative scenario that adjusts the wage rates for inflation, assessing whether the increases in wages for both trainee and non-trainee workers are meaningful after accounting for inflation. The findings from previous empirical studies show that the real wage gap between workers in the public and private-informal sectors is significant, with informal sector workers earning 3.8 times less (Glinskaya and Lokshin, 2007). Furthermore, there is a lack of monitoring and enforcement of minimum wage laws in the unorganized sector, and anecdotal evidence suggests that

[4] Different occupation implies someone who initially was a mason or other construction worker and later works as painter or plumber etc. .

minimum wage standards are rarely followed. Within this sector, the most significant factor determining wages is productivity, which shows the strongest correlation with wage levels.

To evaluate whether STP training has helped construction workers secure better wages and if the current wages (2023) align with inflation, two regression models were employed in the study.

1. First Model:

Dependent Variable: Monthly wage rate of all construction (Trainee+ non-trainee) workers.

Null Hypothesis (H_0):STP training does not have a significant effect on improving wages across the workforce.

2. Second Model:

Dependent Variable: Monthly wage rate of construction workers who have received STP training.

Null Hypothesis (H_0): The current wage (2023) is less than the inflation adjusted wage

The regression models used in the analysis are as follows:

Model – 1:

$$Y = \beta_0 + \beta_1 Time + \beta_2 Trainee + \beta_3 STP\ time + \beta_4 Age + \beta_5 Sex + \beta_6 Religion + \beta_7 ST + \beta_8 SC + \beta_9 OBC + \beta_{10} Primary + \beta_{11} Middle + \beta_{12} High\ school + \beta_{13} HS + \beta_{14} Graduation\ \&\ above$$

Model – 2:

$$Y = \beta_0 + \beta_1 Time + \beta_2 Age + \beta_3 Sex + \beta_4 Religion + \beta_5 ST + \beta_6 SC + \beta_7 OBC + \beta_8 Primary + \beta_9 Middle + \beta_{10} High\ school + \beta_{11} HS + \beta_{12} Graduation\ \&\ above$$

Where,

Y is the dependent variable, β_0 is the intercept term and through are the coefficients for each independent variable where *n denotes 1, 2, 3,……*

Independent Variables

Time:

First Model: A dummy variable where:1 = Year 2023; 0 = Year 2019

Second Model: A dummy variable where:1 = Inflation-adjusted monthly wage rate in 2023; 0 = Current monthly wage received by workers in 2023.

STP (Skill Training Program):A dummy variable where:1 = Trainee workers; 0 = Non-trainee workers

STP Time (Interaction Term):A dummy variable representing the interaction of STP and Time, where:1 = Wage of trainee workers in 2023; 0 = Wage of all workers (trainee + non-trainee) in 2019

Age: Measured in years | Sex: Male = 1, Female = 0 | Religion: Hindu = 1, Muslim = 0

Social Group: Dummies for ST, SC, and OBC, with General (reference category) = 0

Education attainment: Dummies for Primary, Middle, High school, Higher Secondary, and Graduation and above, with literate but no formal education (reference category) =0

The second model is specially constructed for trainees only, hence, the variables "STP" and "STP time" are excluded from the model.

Adjustment of Wage Rate Using Cumulative Inflation Factor

The study utilizes the cumulative inflation factor to adjust the wage rate of construction workers over the study period. The cumulative inflation factor accounts for the compounding effect of annual inflation rates, ensuring an accurate adjustment of wage values over time. This approach is critical because inflation does not impact prices independently each year; rather, it builds on the price levels of previous years. By incorporating the cumulative effect, the method reflects the actual changes in purchasing power and cost of living more precisely. For instance, when calculating inflation-adjusted wages, the annual inflation rates are converted into factors and multiplied sequentially to obtain a cumulative value. This ensures that the adjusted wage accounts for the compounded nature of inflation, providing a more realistic representation of workers' economic conditions over time.

The study considers the Consumer Price Index (CPI) for the working-class population under the base year 2016, specifically for Assam. This is due to the fact that the workers under study belong to Assam, and their workplace is also within the state. Therefore, the CPI of Assam is more relevant for this analysis compared to the All-India CPI. The data for CPI was gathered from the *Assam Statistical Handbook* for the respective years. However, the CPI data for the year 2020 is not available due to disruptions caused by the COVID-19 pandemic. To address this gap, the CPI value for 2020 was estimated

using the method of linear interpolation, based on the available CPI values for 2019 and 2021. The calculated CPI values, along with the corresponding inflation rates, are presented in the Table 1.

Table 1: CPI and Inflation Rate of Working-class Population

Year	CPI (base 2016)	Inflation rate
2019	112.10	6.52
2020	119.75	6.82
2021	127.40	6.39
2022	138.90	9.03
2023	144	4.10

Source: Authors' calculation using Statistical Handbook of Assam

Sample Profile

Table 2 illustrates the distribution of sample beneficiaries across districts, categorizing them into trainee, non-trainee, and overall groups. Dibrugarh emerges as a focal point, contributing significantly with 17.6% of trainees and non-trainees each. Districts like Jorhat, Chirang, Sivasagar, Udalguri, and Bongaigaon have a lower representation of sample beneficiaries which is lower than 5.0%.

Table 2: District-wise Distribution of Sample Trainees and Non-trainees (In %)

District	Trainee	Non-trainee	Overall
Baksa	8.0	8.0	8.0
Barpeta	10.1	10.1	10.1
Bongaigaon	2.5	2.5	2.5
Chirang	1.0	1.0	1.0
Darrang	11.6	11.6	11.6
Dhemaji	5.5	5.5	5.5
Dibrugarh	17.6	17.6	17.6
Jorhat	1.0	1.0	1.0
Kamrup	15.6	15.6	15.6
Nalbari	12.6	12.6	12.6
Sivasagar	2.5	2.5	2.5
Tinsukia	9.1	9.1	9.1
Udalguri	3.0	3.0	3.0
Total	**100**	**100**	**100 (n=398)**

Source: Primary Survey, 2023

Table 3 presents the demographic and socio-economic characteristics of construction workers, showing the mean or percentage distribution across various variables. The findings show that the workers' average age is 40 years (*Table 2*), indicating a relatively

mature workforce. It is found that the construction workers include people from various castes and religions but is primarily gender specific with majority male workforce.

Table 3: Descriptive Statistics of the Sample (n=398)

Variables	Mean/Percentage	Std. Dev.	Min	Max
Time				
Year 2019	50	NA	0	1
Year 2023	50	NA	0	1
STP				
Trainee	50	NA	0	1
Non-trainee	50	NA	0	1
STP time				
Trained + non-trained workers in 2019	75	NA	0	1
Trained workers in 2023	25	NA	0	1
Age	40	9.78	16	62
Sex				
Male	99.8	NA	0	1
Female	0.3	NA	0	1
Social group				
ST	14.6	NA	0	1
SC	15.6	NA	0	1
OBC	35.2	NA	0	1
General	34.7	NA	0	1
Religion				
Hindu	93.0	NA	0	1
Muslim	7.0	NA	0	1
Education				
No formal education	7.8	NA	0	1
Primary	10.6	NA	0	1
Middle	36.9	NA	0	1
High school	24.9	NA	0	1
Higher secondary	16.1	NA	0	1
Graduation and above	3.8	NA	0	1

Source: Primary Survey, 2023

However, the significantly low representation of women (0.3%) is a worrying trend with regard to gender balance. When looking at the educational attainment of construction workers, it can be seen that many of the workers only have basic or secondary education (96.2%), the low share of higher education attainment among the construction workers

(3.8%) and vocational training is an indication of the need to re skill the workforce to be relevant in the current and future construction industry.

Results and Analysis

Comparison of Average Wages of the Trainee Workers Before and After STP

Table 4 presents a gender-wise breakdown of the average daily wage of the trainees engaged in various occupations before and after the Skills Training Program (STP). Before STP, the average daily wage for all trainees was Rs 341, with males earning Rs 343 and females earning Rs 100. After STP, there was a notable increase in average daily wages, reaching Rs 487 for all trainees, Rs 488 for males, and Rs 150 for females respectively. Across specific occupations like Carpenter, Electrician, Mason, Painter, and Plumber, similar patterns of improvement are observed.

Table 4: Gender-wise Composition of Average Daily Wage of the Workers from their Primary Occupation before as well as after STP (Those Who are Currently Engaged in the Trained Occupations)

Name of Occupation	Average daily wage (in Rs.)					
	Before STP			After STP		
	All	Male	Female	All	Male	Female
Carpenter	321	327	100	454	462	150
Electrician	350	350	-	505	505	-
Mason	342	342	-	470	470	-
Painter	359	359	-	521	521	-
Plumber	333	333	-	567	567	-
Total	341	343	100	487	488	150

Source: Primary survey, 2023

However, market forces and economic factors such as inflation can play a role in determining wages. While the STP may contribute to improved skills and productivity, external factors in the broader economic environment can also influence the overall compensation levels. Therefore, to find whether this increase in wages is due to STP or due to external factors, DiD method is employed which is discussed in the subsequent sections.

Impact of STP on Workers' Wages using DiD Method

Table 5 demonstrates that both non-trainee and trainee workers observed improvements in their average wages after the introduction of STP. Non-trainee workers experienced an average wage increase of Rs. 132, while trainee workers had a larger increase of Rs. 145. Consequently, the Difference-in-Differences (DiD) estimates of Rs. 13 indicate that, after the implementation of the STP, trainees, on average, earned Rs. 13 more than their non-trainee counterparts. This shows a favourable impact of the Skill Training Program on trainees' wages compared to what would have transpired in the absence of the program.

Table 5: DiD Estimates of Workers for Combining all Occupations

Group	Average wage		
	Pre-STP	**Post-STP**	**Difference (Post-Pre STP)**
Non-trainee (NT)	341	473	132
Trainee (T)	342	487	145
Difference (T - NT)	1	14	13
Counterfactual trend	341	474	-

Source: Authors' calculation using primary survey data, 2023

However, the impact of STP varies across occupational levels, and the following section will delve into the specific variation in STP's effects across different occupational categories.

Impact of STP on each Occupation

The Difference-in-Differences (DiD) analysis across five occupations as shown in Table 6 provides nuanced insights into the impact of STP on wage outcomes. For carpenters, the initial wage disparity of Rs. -17 between trainees and non-trainees narrowed to Rs. -9 post-STP, yielding a DiD estimate of Rs. 9, demonstrating a modest but positive impact of the program on carpentry trainees' earnings.

Among electricians, the DiD analysis revealed an Rs. 5 increase in wages for trainees, indicating a favorable yet modest effect of the STP on this occupation. In contrast, masonry workers experienced no discernible wage benefits from the program, with DiD estimates remaining at Rs. 0. Painters, however, witnessed a more substantial impact; while non-trainee painters saw an average wage increase of Rs. 137, trainee painters experienced a larger rise of Rs. 162, resulting in a DiD estimate of Rs. 25, highlighting the program's efficacy in significantly boosting their earning potential. Plumbers benefitted the most, with their initial wage gap of Rs. -17 widening to Rs. 42 post-STP, and the counterfactual trend suggesting that trainees would have earned Rs. 508 without the training. The resulting DiD estimate of Rs. 58 shows a substantial positive impact of the STP on plumbers' wages. Collectively, these findings emphasize the varying degrees of STP effectiveness across different professions, with notable successes in enhancing wages for painters and plumbers.

Table 6: DiD Estimates of Workers for Each Occupation

Group	Average wage (Rs.) Carpenter		
	Pre-STP	**Post-STP**	**Difference (Post-Pre STP)**
Non-trainee (NT)	339	463	124
Trainee (T)	321	454	133
Difference (T - NT)	-17	-9	9
Counterfactual trend	321	445	

Group	Average wage (Rs.) Electrician		
	Pre-STP	Post-STP	Difference (Post-Pre STP)
Non-trainee (NT)	365	515	150
Trainee (T)	350	505	155
Difference (T - NT)	-15	-10	5
Counterfactual trend	350	500	
Group	**Average wage (Rs.) Mason**		
	Pre-STP	**Post-STP**	**Difference (Post-Pre STP)**
Non-trainee (NT)	332	460	128
Trainee (T)	342	470	128
Difference (T - NT)	11	10	0
Counterfactual trend	342	471	
Group	**Average wage (Rs.) Painter**		
	Pre-STP	**Post-STP**	**Difference (Post-Pre STP)**
Non-trainee (NT)	357	493	137
Trainee (T)	359	521	162
Difference (T - NT)	2	28	25
Counterfactual trend	359	495	
Group	**Average wage (Rs.) Plumber**		
	Pre-STP	**Post-STP**	**Difference (Post-Pre STP)**
Non-trainee (NT)	350	525	175
Trainee (T)	333	567	233
Difference (T - NT)	-17	42	58
Counterfactual trend	333	508	

Source: Authors' calculation using primary survey data, 2023

Result from the Second Approach

In order to examine multicollinearity Variance inflation factor (VIF) is calculated. The VIF results show that there is no multicollinearity in the model (annexure 1).The results of the regression are shown in Table 7.

Table 7: Imact of STP on Wage Rate– Outputs from Linear Regression

	Model 1		Model 2	
Variables	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**
Time (Year 2019®in first model) (Current wage® in second model)				

Year 2023 in first model; Inflation adjusted wage in second model	2903.62***	265.51	-1348.20***	357.08
STP (Non-trainee®)				
Trainee	-596.50**	250.11	NA	
STP time (Trained + non-trained workers in 2019®)				
Trained workers in 2023	956.25**	415.23	NA	
Age	15.48	11.45	7.21	22.91
Sex (Female®)				
Male	5951.95***	1054.75	6486.08***	536.43
Religion (Muslim®)				
Hindu	-1632.91***	439.87	-2939.12**	1148.08
Social Group (General®)				
ST	487.21	375.03	1488.15**	601.82
SC	489.03	322.84	447.46	552.98
OBC	558.74**	246.47	823.85**	423.29
Education (Below Middle®)				
Primary	804.37**	401.05	212.44	730.91
Middle	1247.19***	331.75	1281.31**	701.37
High school	1162.35***	356.37	964.47	645.27
HS	1061.87***	388.98	1084.22	707.19
Graduation and above	1715.23**	808.90	827.27	937.01
_cons	971.16	1254.01	5208.51***	1782.27
	Number of observations	787	Number of observations	389
	F(14, 772)	23.51***	F(12, 376)	24.53***
	R-squared	0.28	R-squared	0.14

Source: Authors' calculation using primary survey data, 2023

Interpretation of Results

The first model explores the determinants of monthly wages for construction workers, revealing significant insights into the role of training, demographic factors, and occupational differences. The coefficient for Time (2903.62, significant at 1%) indicates that controlling for other variables, wages increased by an average of Rs. 2,903.62 from 2019 to 2022. However, the negative coefficient for Trainee (-598.45, significant at 5%) suggests that workers who received STP training earn Rs. 598.45 less on average than those without training in the initial period, possibly due to differences in job roles or experience levels. Interestingly, the interaction variable STP Time (957.83, significant at 5%) shows that STP-trained workers experienced a wage increase of Rs. 957.83 in

2022 compared to other workers, indicating a delayed benefit of training. These result leads to accept the alternative hypothsis for the first model.

Among demographic factors, Male workers earn Rs. 5,985.69 more than females (significant at 1%), highlighting a gender wage gap. Hindu workers earn Rs. 1,732.17 less than Muslims (significant at 1%), suggesting potential socio-cultural wage differences. Social group coefficients for ST, SC, and OBC are positive but only OBC (601.42, significant at 5%) shows statistical significance, indicating higher wages relative to the general category.

The second regression analysis focuses on trainee construction workers in 2023, examining the determinants of their current and inflation-adjusted wages. The inclusion of the Time variable allows an assessment of whether current wages align with inflation-adjusted wages. The significant negative coefficient for Time (-1348.20, significant at 1%) indicates that the current wage is on average Rs. 1348.20 greater than inflation-adjusted wages, suggesting that the wages of trainee workers have kept pace with inflation, reflecting a real increase in their purchasing power. Based on this result alternative hypothesis is accepted for the second model.

Among demographic factors, Male workers earn Rs. 6486.08 more than females (significant at 1%), reinforcing the presence of a gender wage gap. Hindu workers earn Rs. 2,939.12 less than Muslims (significant at 5%), pointing to a socio-cultural disparity in wages. Among social groups, ST workers earn Rs. 1488.15 more (significant at 5%), while OBC workers earn Rs. 823.85 more (significant at 5%), compared to the general category, suggesting that certain groups may benefit from higher wages relative to the baseline group.

Discussion

The analysis of wage dynamics among construction workers using both the Difference-in-Difference (DiD) approach and regression models provides a comprehensive understanding of the impact of Skill Training Programs (STP). The DiD approach reveals a general positive effect of STP on wages, with trainees experiencing an average post-training wage hike of Rs. 13, surpassing the gains of non-trainees. However, the impact varies across occupations. For instance, painters and plumbers observed the largest post-STP wage increases of Rs. 58 and Rs. 26, respectively, highlighting the program's effectiveness in these fields. Carpenters and electricians also benefitted, with wage hikes of Rs. 9 and Rs. 5, respectively, while masonry workers showed no discernible change, indicating that certain occupations may require targeted interventions to enhance the effectiveness of training. These findings highlight the varied impacts of skill development initiatives across different occupations.

The regression analysis adds rigor to the findings by examining wage increases through two distinct models. The first model confirms that STP participation significantly raises wages compared to non-trainees, aligning with the DiD results. The second model

provides deeper insights by distinguishing between current and inflation-adjusted wages. It reveals that the current wage is greater than inflation adjusted wage of trainees as indicated by the negative and significant coefficient of the inflation-adjusted wage variable. This improvement in current wages demonstrates that STP not only enhances earnings but also strengthens purchasing power, benefiting workers amidst inflationary pressures. A notable proportion of the wage increase can be attributed to productivity gains facilitated by training, as also highlighted by Dearden et al. (2006). The remaining increment, driven by inflationary pressures. Collectively, these insights highlight the dynamic role of STPs in boosting wages and empowering construction workers in the informal sector.

However, the analysis also reveals wage disparities across genders, with female workers earning less than their male counterparts, a trend consistent with findings by Shrestha et al. (2022) in the informal sector. This disparity may stem from differences in work experience, which were not accounted for in this study. Furthermore, educational attainment is found to have a significant influence on wage rates, though its effect may not be direct. Instead, education enhances workers' productivity, as suggested by Kampelmann et al. (2018), enabling them to utilize their skills more effectively and systematically. These findings highlight the factors influencing wage dynamics in the informal sector and show the need for holistic strategies to address wage inequalities and maximize the benefits of training programs.

Conclusion

This study investigates the impact of the Skill Training Program (STP) on the wages of construction workers in India using two distinct analytical approaches: Difference-in-Difference (DiD) and regression analysis. The findings consistently highlight the positive role of STP in enhancing workers' earnings and purchasing power, with variations across occupations and demographic groups.

The DiD analysis demonstrates that, on average, trainees experience a higher post-STP wage increase compared to non-trainees, with the magnitude of impact differing by occupation. Painters and plumbers showed the largest wage gains, while masonry workers exhibited no significant wage changes, indicating the need for occupation-specific interventions.The regression models provide further insights into wage dynamics. The first model establishes that participation in STP significantly boosts monthly wages for trainees. The second model reveals that current wages have increased beyond inflation-adjusted wages, signifying an improvement in the real purchasing power of trainee workers. These results underline the dual benefits of STP in not only raising wages but also shielding workers against inflationary pressures.

Appendix

The VIF results are shown in annexure 1.

Variables	VIF	1/VIF
Time	1.98	0.51
Trainee	2.3	0.43
STP time	3.03	0.33
Age	1.29	0.77
Male	1.02	0.98
Hindu	1.27	0.78
ST	1.37	0.72
SC	1.34	0.74
OBC	1.46	0.68
Primary	2.20	0.45
Middle	3.99	0.25
High school	3.62	0.27
HS	3.03	0.32
Graduation and above	1.59	0.63
Mean VIF	2.10	

Source: Authos's calculation

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Infilling of Urban Wetlands Due to Urban Housing Projects: An Analysis and Prediction of Water Quality Parameters of Konnagar-Hindmotor Wetlands, West Bengal using Multilayer Perceptron Model

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Abstract

Wetlands have a unique property of undergoing changes due to natural factors as well as anthropogenic factors. Their uses are altered for agriculture, constructing residential projects etc leading to pollution and modification of the hydrological regime. Urban wetlands and Geographical Isolated wetlands are undergoing transformation at an alarming rate owing to unsustainable progress in the name of development. The Konnagar-Hindmotor wetland being an Urban Geographical Isolated Wetland in Hooghly district of West Bengal is facing severe infilling owing to construction activity in the name urban housing projects. The paper aims to measure the present condition of the water quality parameters and estimate the future health of the water of the wetlands by predicting through multilayer perceptron model using artificial neural networks. Water samples were collected from the wetlands by dividing the wetlands into environmental impact units considering the extent of the human disturbances to understand the present status. The results showed that the water quality of the wetland is at huge risk and it is predicted to deteriorate further leading to complete disruption in the normal functioning of the ecosystem of the area.

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Introduction

The definition of Wetlands owing to its extremely dynamic nature has been extremely debatable since ages. Wetlands still continue to be a debatable topic wherein because of its diversity in its nature and type, there has not been any universal single definition. The Convention On Wetlands (Ramsar, Iran, 1971) have come up with the criterias for identification of wetlands mainly on the basis of criteria based on rare or unique types of wetland, as sites of biological importance Apart from the definition given by Ramsar convention, there are several types of wetlands which are not as popular as the wetlands classified under Ramsar convention. Geographically Isolated Wetlands (GIW)'s are defined as wetlands which have no apparent surface water connectivity to perennial rivers, streams, seas or ocean. They are mostly surrounded by drier pastures. Differences in regional geography, slope, hydrology, climatic conditions have led to the formation of these wetlands (Aich Chaudhury, 2022). Wetlands have a unique property of undergoing changes continuously due to natural factors. Apart from the natural factors causing changes in wetlands, anthropogenic factors are also causing deterioration in the extent of wetlands. This is mainly due to ignorance about the value of wetlands. Even though the total loss of wetlands across the globe is difficult to determine, Mitsch (2015) recorded that more than half of the world's wetlands is lost. Wetlands were converted to agricultural fields and commercial or residential spaces. They were altered for agriculture, highway construction, mining, constructing residential or commercial buildings etc leading to pollution and modification of the hydrological regime. Urban wetlands and Geographical Isolated Wetlands are amongst the most efficient socio-ecological hotspots in the cities. With flood control, they also secure the food supply chain to the city in events of disrupted rural-urban connectivity during floods.

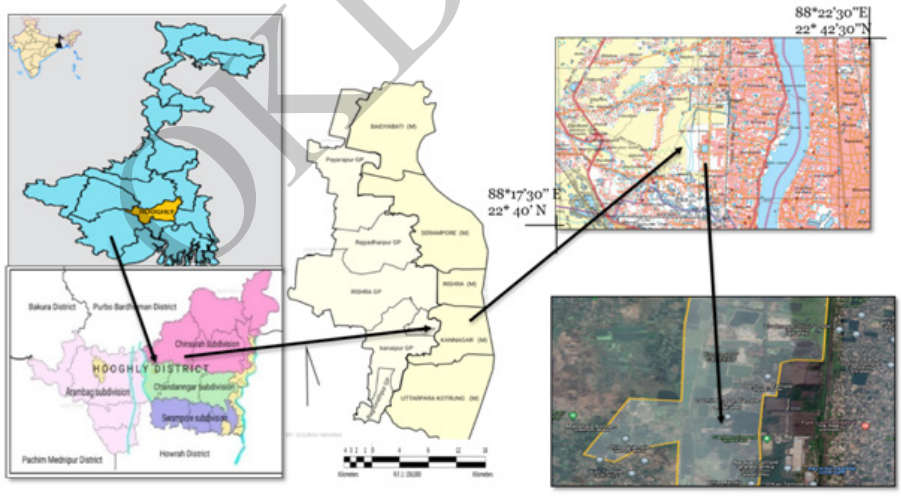
With the changing face of the wetlands owing to anthropogenic factors namely infilling of wetlands in the name of development is also leading to a drastic change in the overall parameters of water quality of the wetlands, thereby disrupting the entire ecosystem. Due to various pollution sources and other factors, humans have exploited aquatic habitats particularly wetlands over the ages to the point where very few of the wetlands in their original form continue to exist (Ngoye & Machiwa, 2004). A catchment plays an important role as it is responsible for the quality and quantity of runoff generated during and after an event of rain and storm. Hence, land use type within a catchment is extremely important for estimating water quality of the water resources (Richards & Host, 1994). Therefore, as human activities rise, many of the problems associated with water contamination are caused by changes in the type of land use within a catchment (Gikas et.al, 2006). Among various aquatic ecosystems, wetlands are important for improving the water quality of other bodies of water, like rivers, at the catchment-scale. However, it is also impacted by change in the land use, composition of their catchments as a result of human activity (Plameri & Treppel 2002). Significant researches conducted have inferred that there exists a negative effect on water quality owing to a relationship between impervious cover of urban areas and sources of non-point pollution which inturn results in the degradation of wetland ecosystems caused by changes in the composition of land use of their catchments (Papastergiadou et.al

2008). While impermeable coverings do not cause pollution, they do cause hydrological changes that are the source of many physical and biological effects that degrade the quality of water bodies, including wetlands and streams (May et.al, 1997).

Urban environments are more hydrologically active due to their imperviousness, and even little rainfalls can carry accumulated pollution into bodies of water (Basnyat et.al 1999). A connection between impermeable cover and in-stream water quality degradation has been proposed by a number of authors (Helms et.al 2009), with regard to the evaluation of the water quality characteristics of streams.

Recent urbanization and suburbanization in the regions of Sreerampore, Uttarpara belt has led to construction of innumerable high rises owing to the close proximity to Kolkata. Few of them are constructed at the cost of infilling Wetlands. The study area Konnagar-Hindmotor wetland (22°40'2 0''N to 22°42'30'N, 88°22'30''1E to 88°17'30''E) is an Urban Geographical Isolated Wetland, situated in the Hooghly district of West Bengal. The wetlands have been formed due to sluggish streams and many saucer shaped depressions in a flat alluvial plain forming massive creeks and marshes. The Konnagar-Hindmotor wetlands is a 280 acre waterbody which is facing threat of infilling due to massive urbanisation surrounding the waterbody in the form construction activity for housing development. The wetland serves as an important source of livelihood for the local fisherman, fruit growers. It serves as an important function like entire stormwater passage from Chapdani, Baidyabati, Konnagar, Rishra is being fed into the wetland

Figure 1. Showing Location of Study Area (Konnagar-Hindmotor Wetlands)



Source: Author's own

Objectives

1. To analyse the present status of the parameters of water quality of the Konnagar-Hindmotor Wetlands

2. To predict the future health of the water of the wetlands from the present parameters of water quality.

Materials and Methodology

To analyse the status of the parameters of water quality, the study area was de-lineated on the basis of distance from the construction site. Water Samples were collected by partitioning the study area into environmental impact units' inconsideration of the extent of the human disturbances

A. Core Construction environmental impact unit site just adjacent to the construction site designated as Site A.

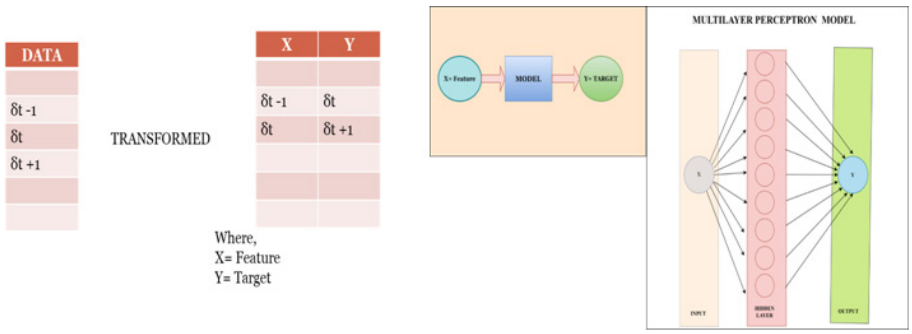
B. Semi-Core construction environmental impact units approximately 50 meters away from construction site designated as Site B.

C. Partially- construction environmental impact units approximately 100 meters away from construction site designated as Site C

D. Buffer environmental impact units approximately 150 meters away from construction site designated as Site D.

For measuring the water quality and the ecological health of the wetlands, the water from the wetlands was tested by collecting water samples in the time periods namely in the month of May designated as Pre monsoon (PRM), Monsoon months of July-September designated as MON, and post Monsoon months of February designated as POM. The water samples were tested in laboratory under specific test methods for different parameters within 12 hours from the collection of the samples. The means of the three time periods were taken to determine the present water quality were: Total Dissolved Solids (TDS), Chloride, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Electrical conductivity, Ammonia, Nitrate, Fecal streptococci and Fecal Coliform Bacteria. The means of the four sites were compared with increase in distance to estimate the impact of construction activity on the water quality parameters with the increasing distance from core construction site.

Figure 2: Methodology of Multiple Perceptron Model using Artificial Neural Network



Source: Author's own

Based on the results, the data was trained using machine learning, and Multilayer Perceptron Model was used using Artificial Neural Network (fig 2) to predict the future health of the water of the wetlands.

Results and Discussion

The site-specific results are as follows. For Site A and Site B (table 1) i.e. in the Core Construction environmental impact unit and Semi-Core construction environmental impact units, Total dissolved Solid (TDS) content is very high and in Site B TDS is lesser to Site A. Chloride content is also very high in both the units suggesting construction activities. Ammonia content is very high which clearly indicates high fecal contamination. Nitrate content in site A and in site B is also high which is rare for public utility.

Table 1: Water Quality Parameters for Site A and Site B

Site A			
Parameters	**Mean**	**Test Method**	**Unit**
Total Dissolved solid (TDS)	1401	IS:3025(Part-16):1984	mg/l
Chloride	358	IS:3025(Part-32):1988	mg/l
Dissolved Oxygen (DO)	5.3	IS:3025(Part-38)	mg/l
Biological Oxygen Demand (BOD)	65	IS:3024(Part-44):1993	mg/l
Chemical Oxygen Demand (COD)	232	APHA 23rd Edition 5220B	mg/l
Conductivity as 25*c	1921	IS:3025(Part-14):1984	
Ammonia (NH3-N)	29	IS:3025(Part-34)	mg/l
Nitrate as NO3	47	IS:3025(Part-34):1988	mg/l
Fecal Streptococci	1103		MPN/CFU per 100 ml
Fecal Coliform Bacteria	2112		MPN/CFU per 100 ml
Site B			
Total Dissolved solid (TDS)	701	IS:3025(Part-16):1984	mg/l
Chloride	112	IS:3025(Part-32):1988	mg/l
Dissolved Oxygen (DO)	5	IS:3025(Part-38)	mg/l
Biological Oxygen Demand (BOD)	11	IS:3024(Part-44):1993	mg/l
Chemical Oxygen Demand (COD)	38	APHA 23rd Edition 5220B	mg/l
Conductivity as 25*c	826	IS:3025(Part-14):1984	
Ammonia (NH3-N)	12.1	IS:3025(Part-34)	mg/l
Nitrate as NO3	51.2	IS:3025(Part-34):1988	mg/l
Fecal Streptococci	710		MPN/CFU per 100 ml
Fecal Coliform Bacteria	1112		MPN/CFU per 100 ml

Source: Laboratory experiments by Author

It is carcinogenic in nature. The Biological Oxygen Demand is very high (moderately polluted waters have a range between 2–8 mg/l) which suggests that is not suitable for aquatic elements. The normal values of COD incase of surface water ranges from 5 to

20 mg/l. High levels of COD indicates dissolved oxygen depletinghigh concentrations of organic and inorganic pollutants leading to negative environmental imbalance. Dissolved oxygen concentrations above 6.5-8 mg/L is important for sustaining good aquatic life.Dissolved oxygen plays an important role in the sustenance and survival of aquatic life. Here, Dissolved Oxygen rate is also very low. There is presence of fecal coliform bacteria and fecal coliform streptococci which suggests open defecation or mixing with human fecal matter in the wetland water owing to human intervention during construction activity.

For site C and Site D i.e. Partially- construction environmental impact units and Buffer environmental impact units (table 2), Nitrate content is also high which is rare for public utility. It is carcinogenic in nature. The Biological Oxygen Demand is very high which suggests that is not suitable for aquatic elements. Dissolved Oxygen rate is also very low.

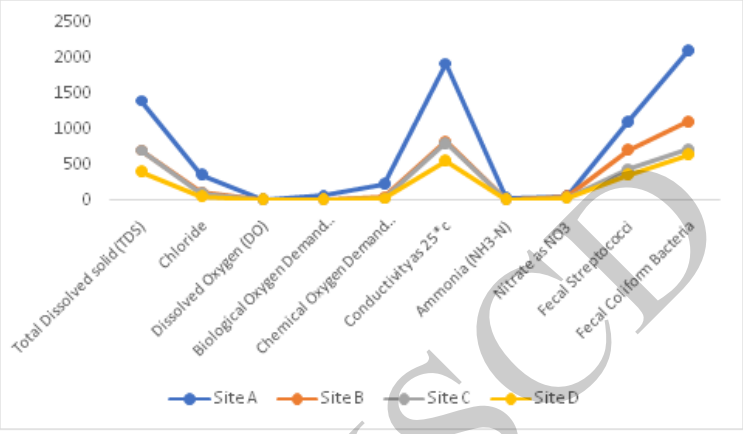
Table 2: Water Quality Parameters for Site C and Site D

Site A			
Parameters	**Mean**	**Test Method**	**Unit**
Total Dissolved solid (TDS)	583	IS:3025(Part-16):1984	mg/l
Chloride	99	IS:3025(Part-32):1988	mg/l
Dissolved Oxygen (DO)	4.2	IS:3025(Part-38)	mg/l
Biological Oxygen Demand (BOD)	9.4	IS:3024(Part-44):1993	mg/l
Chemical Oxygen Demand (COD)	25	APHA 23rd Edition 5220B	mg/l
Conductivity as 25*c	810	IS:3025(Part-14):1984	
Ammonia (NH3-N)	6.7	IS:3025(Part-34)	mg/l
Nitrate as NO3	31.5	IS:3025(Part-34):1988	mg/l
Fecal Streptococci	440		MPN/CFU per 100 ml
Fecal Coliform Bacteria	720		MPN/CFU per 100 ml
Site B			
Total Dissolved solid (TDS)	401	IS:3025(Part-16):1984	mg/l
Chloride	43	IS:3025(Part-32):1988	mg/l
Dissolved Oxygen (DO)	4	IS:3025(Part-38)	mg/l
Biological Oxygen Demand (BOD)	5.2	IS:3024(Part-44):1993	mg/l
Chemical Oxygen Demand (COD)	18.5	APHA 23rd Edition 5220B	mg/l
Conductivity as 25*c	550	IS:3025(Part-14):1984	
Ammonia (NH3-N)	2.2	IS:3025(Part-34)	mg/l
Nitrate as NO3	28.6	IS:3025(Part-34):1988	mg/l
Fecal Streptococci	351		MPN/CFU per 100 ml
Fecal Coliform Bacteria	642		MPN/CFU per 100 ml

Source: Laboratory experiments by Author

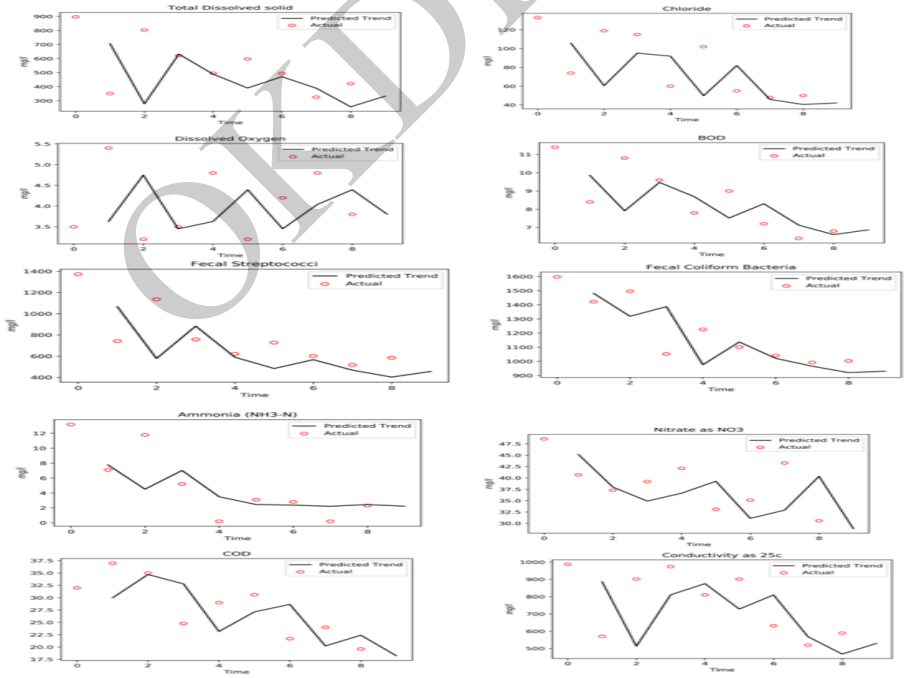
However, the values of the parameters of water quality of the wetland sites improves with increase in distance from the core construction area, thereby suggesting the core construction area is the worst affected part of the wetland (Fig 2.).

Figure 2. Relationship between Parameters of Water Quality and Distance from Core Construction Area



Source: Author's own calculation

Figure 3. The Predicted Trend of Water Quality Parameters Using Multilayer Perceptron Model



Source: Author's own

Given the status of the quality of water it is of utmost importance to ascertain the future of the wetlands assumes critical importance so that timely measures could be taken. The Multilayer Perceptron Model predicted a further deterioration in the parameters of measuring water quality (figure 3). It has been predicted by machine learning model that there will be further increase in the levels of TDS, chloride, BOD, Conductivity of water, fecal streptococci and fecal coliform bacteria in the water of the wetlands in the near future. At the same time, there will be decline in DO levels, COD and Ammonia and Nitrate levels, thus the water health of the wetlands will be compromised.

Conclusion

The results obtained shows that the infilling of the Konnagar-Hindmotor in Hooghly district of West Bengal wetlands owing to the upcoming real estate projects has adversely affected the quality of water of the wetlands. The deterioration of the water health is directly related to the health of the wetland's ecosystem. The direct and indirect stakeholders of the wetlands are affected by this deterioration in water quality and are likely to be affected in more severe ways as the predicted results of the model indicate. This would further aggravate and lead to deterioration in the quality of water is likely to disrupt the normal functioning of the wetland ecosystem. There is an urgent need for sustainable management of the wetlands. It requires adoption of a comprehensive policy with focus on greater protection of the wetlands and securing the rights of the various stakeholders who can contribute in ensuring sustainable managment of the larger ecosystem in the area to protect the wetlands.

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Balancing Plates and Planet: The Sustainability-Nutrition Nexus

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Abstract

This paper explores the vital relationship between sustainable agriculture and nutrition security amid global hunger, malnutrition, and environmental degradation. As billions face the spectre of food insecurity and hidden hunger, the paper emphasises the need for comprehensive policies and programs at global and national levels. These initiatives should promote sustainable agricultural practices that ensure food availability and prioritise nutrition security by providing access to a balanced diet rich in essential nutrients. The paper emphasises the pressing issue of poverty, particularly in rural areas, and fosters social equity while promoting local food systems that reduce reliance on global supply chains. The paper explores the shift in societal perceptions of sustainable agriculture and nutrition, which has led to behavioural changes among consumers and producers. The paper also focuses on the global population increase and the urgency to achieve sustainable development goals; policymakers must prioritise sustainable agriculture to simultaneously address food and nutrition security, environmental sustainability, and social equity.

Introduction

In an era marked by unprecedented challenges in environmental sustainability and global food security, the interplay between what we put on our plates and the health of our planet has become a focal point of concern and discourse. Good health is directly associated with a healthy diet. For the physical growth and cognitive development of the

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human being, it is the most imperative question at present whether the food consumed by the man is nutritious. Billions of people across the globe face the persistent spectre of hunger, malnutrition, and food insecurity, even as ample food resources are produced. Simultaneously, we confront the ecological consequences of unsustainable agricultural practices that strain our planet's resources, threatening the very foundation of our food systems. In this delicate equilibrium, a crucial paradigm emerges: sustainable agriculture and its pivotal role in addressing nutrition security with food security and environmental sustainability is also inextricably linked to reducing hunger and poverty as a social problem.

Over 2 billion individuals globally experience hidden hunger, surpassing the 805 million who lack access to sufficient calories. Countries such as Sub-Saharan Africa and South Asia are particularly affected, with high prevalence rates (FAO, IFAD, and WFP, 2014). While hidden hunger is prevalent in developing nations like India, micronutrient deficiencies, notably iron and iodine, are widespread in developed regions. To alleviate this problem, in India, the Government has started the distribution of fortified rice (rich in iron, zinc, folic acid, and Vitamin B12) through the Public Distribution System. It means that nutrition security is a much broader concept than food security in recent times; it not only ensures access to sufficient calories but also emphasises the importance of a balanced diet rich in essential nutrients for physical and cognitive well-being.

The paper underscores the critical requirement for global and national level adoption of policies and programs to meet global nutrition targets. This involves advocating for sustainable agricultural practices aimed at addressing all aspects of malnutrition in humans while also safeguarding the environment through conscientious food production and food systems.

Principles and Basis of Sustainable Agriculture

The term began gaining traction in the United States during the 1980s, receiving formal recognition in US legislation for the first time in 1985. This paved the way for establishing the Low Input Sustainable Agriculture (LISA) program. By 1990, the US Congress officially addressed and defined 'sustainable agriculture' within the legal framework. Since then, various stakeholders, including civil society, the private sector, multilateral institutions, and different levels of government, have embraced the concept of sustainable agriculture. In India, the national government launched the National Mission for Sustainable Agriculture in 2014-15, providing a formal definition of sustainable agriculture within the Indian context and identifying its ten key dimensions (NMSA, 2014). The Food and Agriculture Organization defines sustainable agriculture as the strategic management and preservation of resources, coupled with the direction of technological and institutional advancements, to guarantee the fulfilment of current and future human needs. Consequently, sustainable agriculture constitutes the segment of agricultural progress that is environmentally sustainable, utilises appropriate technology, remains economically feasible, and is socially embraced (FAO, 1991).

Sustainable agriculture is a vital remedy for addressing the ongoing challenges within our food systems. It covers various agricultural approaches crafted to meet present requirements while ensuring the capacity of future generations to fulfil their necessities. It emphasises the enduring well-being of the environment. Their objective is to mitigate the adverse effects of agriculture on ecosystems, including but not limited to soil erosion, water pollution, and habitat destruction. During the 1960s, Rachel Carson's book, "Silent Spring" (1962) presented the initial conclusive proof of ecological harm caused by the overuse of chemicals and pesticides in agriculture. Carson demonstrated the correlation between the decline of raptor birds and the thinning of eggshells, directly attributed to the growing dependence on synthetic pesticides (Madden, 1998a). Hence, various techniques like crop rotation, organic farming, natural farming, agroforestry, etc., enhance soil fertility and reduce the need for harmful chemical inputs. Sustainable farming methods encourage biodiversity by preserving natural habitats, using cover crops, and avoiding monoculture farming. This method not only benefits local wildlife but also makes the agricultural system more resilient to pests and disease.

Sustainability involves meeting our present needs while ensuring that future generations can meet their own, considering both natural resources and social and economic factors. Recognising sustainability as a concept shaped by society (Webster, 1999) and still in the process of full realisation (Webster, 1997; Rasul and Thapa, 2003) highlights the role of sociology in substantially advancing agricultural sustainability. Essential to grasping the sociology of sustainable agriculture is a clear comprehension of agriculture and its sustainable counterpart. India is primarily an agricultural country and plays a crucial role in increasing food availability by supporting livelihoods and contributing to India's economic growth. Livelihood refers to the sufficient provision of food and financial resources for an individual or family to fulfil basic requirements. Security in this context implies stable ownership or access to resources and income-generating endeavours, encompassing reserves and assets to mitigate risks, manage unexpected challenges, and address contingencies (Acharya, 2006). It means that it is not only a primary source of food production but also a foundation for rural economies. Beyond nourishing communities, agriculture generates income by selling crops and livestock, fostering economic stability and reducing poverty. Moreover, it sustains rural communities by offering employment opportunities, preserving cultural traditions, and supporting social cohesion. Agriculture's multifaceted role extends food security, economic growth, and promoting environmental sustainability, making it an indispensable component of livelihood systems worldwide.

Socio-Economic and Environmental Elements of Sustainable Agriculture

An intricate interaction of socioeconomic and environmental factors significantly shapes the sustainability of Agriculture. Socio-economic factors include access to resources, education, and market opportunities. In developing nations where agriculture is a significant contributor to livelihoods, access to land and credit are crucial. For instance, approximately 1.5 billion people worldwide depend on smallholder farming, but often, they lack access to adequate resources, limiting their capacity to adopt sustainable

practices. In parallel, education and training programs are pivotal in disseminating knowledge about sustainable farming techniques, like organic farming or crop rotation. By reducing production costs and enhancing yields through sustainable practices, it can increase income and job opportunities. This, in turn, helps alleviate poverty and fosters social equity in rural areas. Rural areas experience a heightened prevalence of poverty, with 75 per cent of the global impoverished population residing and labouring in these regions. The vast majority, nearly 90 per cent, of impoverished individuals are concentrated in Asia and Sub-Saharan countries. Specifically, Asia hosts around two-thirds of the world's impoverished population, with South Asia alone representing 43 per cent of this demographic (IFPRI, 2001). Sustainable agriculture also promotes local food systems, reducing the reliance on the global supply chain and bolstering regional economies.

Environmental determinants are equally vital. Climate change, land degradation, and water scarcity are significant challenges to sustainable agriculture. The impact of climate change is evident with changing rainfall patterns and increased extreme weather events. According to the World Bank, by 2015, it was projected that as many as 86 million individuals in Sub-Saharan Africa might be compelled to relocate due to climate-induced alterations in agricultural practices. Sustainable agricultural practices, such as no-tilling farming and agroforestry, can mitigate climate change effects, improve soil quality, and enhance resilience. Government policies and international initiatives are also crucial. According to a report by the United Nations Environment Programme, providing financial assistance and implementing policies that support sustainable agriculture can effectively diminish poverty, improve food security, and safeguard the environment. Consequently, the various factors influencing sustainable agriculture are interconnected and should be addressed collectively to ensure the welfare of current and future generations.

Need for Sustainability in Agriculture

The Green Revolution initiated in 1960 aimed at enhancing crop production through increased fertiliser and pesticide use, introduction of high-yielding crop varieties, mechanisation, and improved irrigation. While it successfully bolstered food security, it fell short in addressing nutritional deficiencies, evident from India's Global Hunger Index (GHI) ranking of 107 out of 121 countries in 2022, indicating a severe hunger level. Recent data highlights India's highest child wasting rate among GHI-covered nations, although there have been improvements in child stunting and mortality rates from 2014 to 2022. Despite progress, the prevalence of undernourishment in India rose from 14.6% (2018-2022) to 16.3% (2011-2021), impacting approximately 224.3 million individuals, contributing to a global total of 828 million undernourished people (GHI, 2022).

In Rural regions, the presence of food largely hinges on crop yields and the financial situation of the inhabitants. Micro-nutrients are particularly crucial for the well-being of women and children. The nutritional condition of women during conception and

throughout pregnancy profoundly influences the growth and development of the fetus over the long term. Approximately 18 million infants suffer from neurological impairments annually as a result of insufficient iodine intake. Severe anaemia is a contributing factor to the mortality of 50,000 women and children annually (UNSCN, 2005; Micronutrient Initiative, 2014).

The significance of sustainable agriculture is on the rise globally. Sustainable agriculture transcends the conventional confines of crop cultivation and livestock management. It compasses a complex interplay of ecological, economic, and sociological factors, demonstrating its centrality in the global quest for nutrition security. Sustainable Agriculture entails farming practices that continuously meet increasing demand without imposing excessive economic, environmental, or social costs in line with rising incomes. It emphasises the need for agricultural systems to yield sufficient high-quality food while ensuring ecological safety (Donald, L.P and Donald, L.W: 1995). The various data shows that using different kinds of sustainable agricultural practices like organic farming, natural farming, rice- intensification system, crop rotation and intercropping, etc., improves the nutritional status of crops and ensures food security without damaging the environment. In the study, it is found that the use of Azolla (as green manure) bio fertiliser instead of chemical fertiliser enhances the yield and proper growth of crops. This means that the use of Azolla as a biofertiliser provided higher production along with higher nutritional value than the chemical fertiliser (Mishra and Dash, 2014). The use of nano fertiliser (NFS) can enhance crop production with reduced nutritional losses with significant advantages for the physiological fitness and performance of crops as well. Biofortification emerges as a promising, cost-effective, and sustainable approach to providing micronutrients to populations with restricted access to varied diets and other micronutrient interventions. Hence, they may prove a milestone in achieving SDG goals as we are handling the problem of nutrition security.

Sustainable Agriculture as a Way of Reducing Food Deserts and Enhancing Food Justice

Sustainable agriculture is a powerful tool in the fight against food deserts and a catalyst for enhancing food justice. Food deserts refer to regions where inhabitants face challenges in accessing fresh, nutritious and reasonably priced food, with marginalised communities bearing a disproportionate impact. Encouraging local food cultivation and distribution can facilitate enhanced access to fresh produce, enhancing food quality and public health on a broader scale. It also addresses food justice issues by focusing on equitable distribution and access to nutritious food. Local, community-based farming can empower marginalised communities, provide economic opportunities, and ensure their wages for farmworkers. A report by the U.S. National Research Council found that community-supported agriculture (CSA) initiatives and urban farming can improve access to fresh, healthy produce, particularly in underserved urban areas.

Moreover, sustainable farming practices prioritise environmental and social responsibility, ensuring that agricultural activities are conducted ethically and without

harm to surrounding ecosystems or marginalised communities. By promoting equitable access to healthy food, reducing the environmental impact of agriculture, and supporting fair wages for farmers, sustainable agriculture directly contributes to the broader goal of food justice, making it a key strategy to address the inequalities that perpetuate food deserts and improve access to healthy, affordable food for all.

Nutrition Security and its Sociological Implications

As per IFPRI, nutrition security ensures sufficient protein, vitamins, energy, and minerals for all household members (IFPRI, 2012). It extends beyond mere food availability to encompass access to safe, plentiful and nutritious food, vital for maintaining a healthy and active lifestyle. Nutrition security encompasses not only the quantity of food but also its quality, safety, and cultural relevance. Within sociology, examining nutrition marks the inaugural inclusion of a socio-cultural viewpoint. George Simmel interprets nutrition as a cultural element and a socially regulated behaviour that dictates what, how often, and what social context individuals should consume. According to Simmel, meal etiquette and aesthetics carry significant importance. Food culture thus serves as a means of socialisation and a marker of one's social standing (Simmel, 4,187-192,2010). An integral aspect of ensuring nutritional security involves the concept of food security, which pertains to the availability and accessibility of food. Nutritional deficiencies can result in malnutrition, undernutrition, and deficiencies in micronutrients, often termed as 'hidden hunger'. Hidden hunger arises when there is inadequate intake and absorption of crucial vitamins and minerals, hindering optimal health and development. In countries like India, there is a shift from traditional diets, which are primarily based on minimally processed foods, to diets consisting of highly processed, energy-dense, and nutrient-poor foods and beverages, contributing to the rise of obesity and diet-related chronic diseases This transition in nutrition patterns has led many developing nations to new experience the triple burden of malnutrition, which includes undernourishment, micronutrient deficiencies, and obesity (Pinstrup-Andersen, 2007). Each year, approximately 1.1 million child deaths are attributed to undernutrition resulting from micronutrient deficiencies (Black et al., 2013; Black et al., 2008).

According to FAO's observation in 2022, the global progress towards ending hunger, food insecurity, and malnutrition is regressing, with the gap to achieve SDG2 targets widening each year and only eight years remaining until 2030 (FAO, 2022). In his publication "Hunger as a Factor: The Influence of Hunger on Human Behavior, Social Organization, and Social Life" (1922), Sorokin delved into the societal ramifications of nutrition and the effects of widespread hunger on social stability. He highlighted the primary social function of nutrition as contributing to social reproduction and order while also linking food shortages to the emergence of deviant behaviour and social unrest, particularly in the form of crime and protests (Sorokin, 1992).

Nutrition is pivotal in realising the objectives of SDG2, which aims to eliminate hunger, guarantee food security, and advance sustainable agriculture. Additionally, it is

fundamental in achieving numerous other SDG targets, which concentrate on promoting nutritious and sustainable diets and securing food access for everyone (Giuseppe Grosso et al., 2020). Nutritional inadequacy is impacted by various socio-economic elements, encompassing food insecurity stemming from micronutrient deficits, illnesses, economic hardships, and hunger. Education, job prospects, and economic advancement (aligned with SDGs 4 and 8) have been associated with improved dietary standards. However, individuals from lower socio-educational backgrounds may consume lower-quality, energy-dense, and nutrient-poor foods due to limited accessibility or affordability of higher-quality alternatives, among other considerations (Giuseppe Grosso et al., 2020).

Swaminathan describes nutrition security as the provision of physical, economic and social access to a balanced diet, environmental hygiene, primary health care and primary education (Swaminathan, 2008). Socio-economic factors strongly influence nutrition security. Socio-economic determination plays a crucial role in shaping the ability of individuals and communities to exist and consume nutritious food. Income and economic status are significant determinants, as they impact the purchasing power of individuals. Lower-income households often struggle to afford nutritious food, leading to dietary deficiencies and poor health outcomes. Researchers assert that the issue of food insecurity is not primarily linked to the increased output and efficiency of farmers but rather to poverty. Amartya Sen, an Indian Nobel laureate in economics in 1998, argued that food insecurity stems from problems in food distribution (Gonzalez,2014). Approximately 80% of individuals experiencing food insecurity worldwide reside in rural areas. These individuals often cultivate small plots of land, rely on essential irrigation, or farm in dry regions with limited productivity. According to Godfray and Garnett (2014), one potential indicator that contributes to poverty reduction is the ability of small-scale farmers to enhance productivity sustainably, thereby fostering food security (Godfray et al., 2014). Education is another vital determinant. It affects individuals' knowledge about nutrition, food preparation, and dietary choices. Elevated levels of education frequently correlate with improved nutritional choices and a deeper appreciation of the significance of a well-rounded diet. Routine medical examinations and the availability of healthcare experts play a crucial role in detecting and managing nutritional deficiencies and health issues linked to dietary patterns.

Social inequalities, encompassing factors such as race, ethnicity, gender, and geographic location, can significantly impact food access and, by extension, nutrition security. These inequalities often manifest as food deserts–areas lacking affordable and nutritious food options. In many cases, marginalised communities, particularly those with lower incomes, may live in these food deserts, making it challenging to obtain fresh produce and other healthy foods. Gender inequalities further exacerbate the issue of nutrition security in many societies. Women typically hold pivotal roles in food preparation and distribution within households. Yet, gender discrimination and disparities can lead to unequal access to food and nutrition for women, impacting their families' well-being. Addressing social inequalities and improving food access is crucial for achieving nutrition security. Policies and interventions aimed at diminishing disparities, bolstering access to fresh and nutritious food in underserved communities

and promoting education on healthy eating can help narrow the gap, ensuring that everyone has the opportunity for nourishing healthy life, as highlighted by the FAO in 2011, providing women farmers with equal access to agricultural resources, education, and market could potentially reduce the number of hungry individuals by 100-150 million across 34 countries examined (FAO, 2011).

Societal Perceptions and Behavioral Change

The societal perspectives on sustainable agriculture and nutrition have undergone significant transformations, reflecting a heightened awareness of environmental issues and health considerations. This evolution in mindset has spurred behavioural changes among consumers and producers. There is a growing acknowledgement of the environmental consequences associated with conventional agricultural practices, which heavily rely on chemical inputs like fertilisers and pesticides. Concerns about food quality and its impact on human health have become more pronounced, with a widespread acceptance of the notion "you are what you eat", leading to a great emphasis on nutrient-dense foods. George Homans, an American sociologist, introduced the exchange paradigm, which interprets food practices through the lens of social relations at the micro level. Utilising the detective-nomological model, Homans outlined six fundamental patterns of human behaviour based on the concepts of "rewards" and "punishments" (Homans,1984). Within this framework, food is viewed as a social exchange characterised by rewards and benefits, shaping gastronomic preferences, trends, and rituals. Consequently, sustainable agricultural methods are now considered more responsible and environmentally friendly alternatives. This shift has prompted increased support for farming practices aimed at preserving soil health, minimising water consumption, reducing carbon emissions, and ultimately producing healthier and more nutritious food options.

Pierre Bourdieu's concept of habitus underscores the structured attitudes and collective and individual behaviours that define the perceptions, thoughts, and actions of individuals within social groups occupying similar societal positions. He views habitus as the generative force behind objectively categorised practices and the system through which these practices are classified, thereby shaping the space of lifestyles (Bourdieu, 6, p.537). The change in societal perspective has resulted in numerous shifts in behaviour. Farmers and producers increasingly embrace sustainable practices to fulfil this demand and minimise their ecological impact. Consumers are willing to invest more in sustainably sourced food, driving the expansion of organic and local food markets. Furthermore, educational programmes and initiatives aimed at raising awareness are being launched, encouraging more significant participation in local and sustainable food production endeavours. These changing perceptions lead to behavioural changes at both the consumer and producer levels, focusing on more sustainable and responsible practices in the food industry.

Policy Formulation for a Balanced Future

Over 40 years, the global population has doubled, surging from 3 billion in 1959 to 6 billion in 1999. Projections indicate a further 50% increase over the subsequent four decades, with estimates reaching 9 billion by 2037, 10 billion by 2057, and 10.4 billion by 2100 (UN, 2023). This population surge poses significant environmental concerns globally, intensifying the challenge of maintaining sustainable development to safeguard the needs of future generations. Hence, there is a pressing need to implement preventive measures to mitigate the uncontrolled environmental impact that poses serious threats, alongside formulating policies to foster healthy ageing and sustainable development. In response to these challenges, countries worldwide have embraced the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals. This global policy framework acts as a navigational guide toward eliminating poverty, the assurance of universal health and prosperity, and the preservation of the Earth's ecosystems. In light of these findings, policy formulation for a balanced future is imperative. Agricultural developments are undeniably linked to both food and nutrition security. Policymakers must prioritise sustainable farming practices that not only ensure food availability but also promote nutrition security, environmental sustainability, and social equity. SDG 2, aiming for Zero Hunger by 2030, strives to establish a world without hunger. Yet, the worldwide challenge of hunger and food insecurity has witnessed a concerning rise since 2015, intensified by a blend of factors, including the pandemic, conflicts, climate change, and widening disparities. Projections indicate that over 600 million individuals worldwide will grapple with hunger by 2030, underscoring the daunting task of reaching the Zero Hunger target (SDGs Report, 2023). Furthermore, nutrition is a vital element in achieving other SDG goals; improved diet quality has been linked to advancements in education, economic growth, and the promotion of decent work.

In rural areas, food availability hinges mainly on crop production and the population's economic status. Consequently, there is a pressing need to revamp agricultural practices to enhance food security and address nutritional deficiencies. Embracing sustainable agriculture presents a viable solution for boosting crop production and nutritional value, thereby addressing these challenges while simultaneously improving the socio-economic well-being of farmers and environmental conditions. In India, the government has implemented various measures, including initiatives like Poshan Abhiyan, Pradhan Mantri Matru Vandana Yojana, NFSA, and the Mid-Day Meal Scheme, to ensure access to nutritious food for all and mitigate hunger. Whereas solutions to hidden hunger such as diversifying diets, fortifying commercial foods, biofortification, and supplementation may effectively tackle the menace of hidden hunger and its socio-economic consequences but still becomes a matter of grave concern to study various other social issues such as public health problems like, severe visual impairment, weakened immune system, anaemia, impaired motor and cognitive development, blindness, etc. which not only affects the individual but has severe repercussions to the society as well. Hence, National and Global actions should promote sustainable agricultural practices to provide nutritional status to all individuals for better livelihoods and will try to achieve the target of various socio-economic problems.

Conclusion

In the face of global challenges such as hunger, malnutrition, and environmental degradation, the nexus between sustainable agriculture and nutrition security emerges as a critical paradigm. This paper has explored the multifaceted dimensions of sustainable agriculture and its socio-economic and environmental significance. Sustainable agriculture not only addresses the pressing issue of food security but also emphasises the importance of nutrition security, ensuring access to balanced diets rich in essential nutrients for physical and cognitive well-being.

The paper highlights the need for comprehensive policies and programmes at both the global and national prevails to achieve global nutrition targets. These policies should advocate for sustainable agricultural practices, driving progress in addressing various forms of malnutrition and promoting environmental sustainability. Furthermore, sustainable agriculture can catalyse reducing social disparities, promoting food justice, and empowering marginalised communities by encouraging local food production and equitable distribution. Moreover, it aligns with the Sustainable Development Goals and broader global agenda to foster a fairer and more sustainable future. The SDGs offer a holistic framework to steer these endeavours, emphasising the importance of eradicating hunger, advancing sustainable agriculture, and ensuring universal access to nutritious food.

The societal perspective on sustainable agriculture and nutrition has evolved over the years, leading to behavioural changes in producers and consumers. Farmers are increasingly adopting sustainable practices, consumers are willing to support sustainable food production, and educational initiatives are raising awareness and encouraging participation in sustainable food systems. These changing perceptions and behaviours underscore the importance of sustainable agriculture in addressing the world's pressing challenges.

By examining the intricate web of sustainability and nutrition, we aim to shed light on how our dietary decisions impact not only our well-being but also the sustainability of the planet. This study seeks to deepen comprehension of the obstacles and prospects found at the convergence of nutrition and sustainability, providing a groundwork for well-informed choices and policies that can lead toward a healthier and more sustainable future.

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