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Aims and Scope

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Subject areas include any thematic areas related to sustainable integrated rural development aligned with Sustainable Development Goals (SDGs). The thematic areas are including but not limited to the following:

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- Land and water resources management
- Agro processing and rural market
- Rural livelihoods and poverty reduction
- Education and skill development
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- Renewable energy for rural consumption
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Article

A Qualitative Evaluation of the Micro-level Barriers to Better Delivery and Utilisation of Nutrition Services in Rural India

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Abstract

Malnutrition remains one of the most rigid outcomes to be addressed by policies and interventions. Although the forms and predictors of malnutrition have been extensively studied, relatively less focus has been placed on the micro-realities of policy implementation that can explain the barriers to achieving better service utilisation outcomes. To fill this gap and gain insights into the socio-environmental barriers to the supplementary nutrition programme, a micro-level qualitative study was undertaken on the beneficiary experience from one of the largest nutrition services in the world, the Integrated Child Development Services (ICDS) in India. Combining qualitative phenomenological with a retrospective design, the study compared the service experience of current ICDS to its erstwhile regime called the 'UNICEF-Dular' using data from a 2018 study in Bihar. Thirty beneficiaries, including 12 mothers with children in both regimes, 10 front-line workers (FLW) and erstwhile second-line workers, and two Bihar-UNICEF officials, were included in the FGDs and interviews. The analysis revealed that strategic changes in the programme regarding downscaling personnel by removing second-line workers, selective coverage in supplementary nutrition, hazardous work conditions, the low capability of FLW, and social incoherence are barriers to service delivery in nutrition.

Keywords

Supplementary nutrition, nutrition programme, ICDS, maternal nutrition, nutrition service delivery, social protection

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Introduction

India has suffered from decades of high and worsening malnutrition, such as anaemia, stunting, and wasting (IIPS, 2020; Roy, 2020). Malnutrition outcomes have either remained rigid or regressed despite having some of the largest nutritional interventions, such as Integrated Child Development Services (ICDS). There is mixed evidence regarding the impact of large-scale nutritional policies on children's health. Some studies have found that interventions have low or inequitable effects (Bhasin et al., 2001; Dixit et al., 2018; Dutta & Ghosh, 2017). Some recent studies have pointed to the nuances of evaluating nutrition interventions in terms of coverage, as programmes rarely converge at the level of beneficiaries, and gaps exist in delivering the intended benefit, such as nutrition supplements or immunisation, even with high coverage (Menon et al., 2019; Nguyen et al., 2021). The micro-realities of policy implementation environments have received less focus than impact studies. Still, limited literature points to restrictive gender environment, low resources and skills, and extreme workload due to low staffing as barriers to better nutrition services in micro-settings (Sinha, 2006; Young et al., 2021).

This study attempted to gain insights into the determinants of service delivery and utilisation experiences by undertaking a micro-level qualitative retrospective evaluation comparing delivery, that is, front-line worker (FLW), and utilisation, that is, beneficiary experiences between the ICDS in India and its erstwhile strategic regime, ICDS-UNICEF- '*Dular*' *(Dular)* to compare utilisation experience and delivery experience in the same framework.

The ICDS is one of the largest nutrition programmes (Sachdev & Dasgupta, 2001). The Dular was chosen because of its continuity in service delivery, allowing for the opportunity to conduct a longitudinal comparison between beneficiaries and service delivery personnel within this huge service system. The ICDS started in 1975–1976 and was reinforced in 2001 and 2013 (Balarajan & Reich, 2016). The UNICEF-Dular strategy was launched in 2000 in four districts in Bihar. Muzzafarpur, Vaishali, Nalanda and Gaya (Adhikari et al., 2008). The intervention complemented the government in providing community services through a pool of *Local Resource Persons* (LRP) or community workers (Dubowitz et al., 2007). During 2008–2012, the Government of India took over the implementation of ICDS in Bihar/Jharkhand. It discontinued several strategic arms of the Dular, such as volunteer-honorarium and village-level training for LRPs. The programme trajectory is illustrated in Figure 1 (see Appendix Table 1 for details on the services).

This study compared the processes, functioning, and nutrition service experience before and after the government overtook the UNICEF-Dular strategy in the study area from beneficiary (utilisation) and FLW (delivery) perspectives.

Methodology

Study Design

The study followed the Consolidated Criteria for Reporting Qualitative Studies (COREQ) (Tong et al., 2007) but with some flexibility (see Appendix Table 2 for

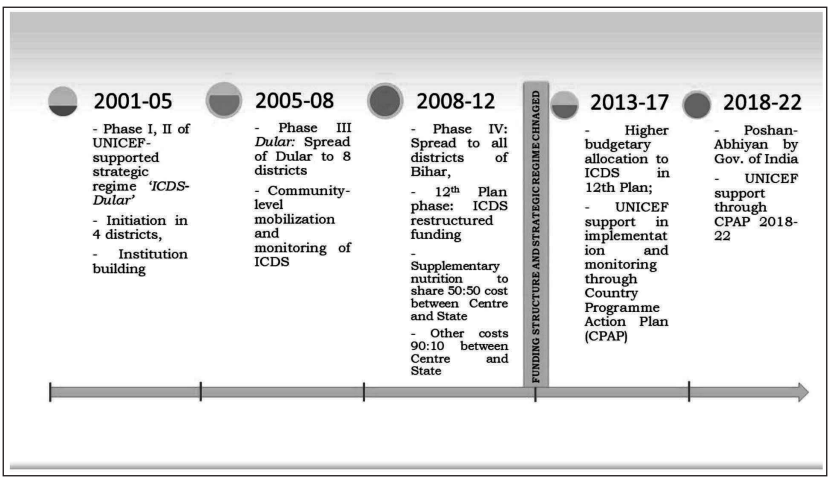

Figure 1. ICDS/Dular Implementation Trajectory in Bihar.

details). The study design combined qualitative phenomenological with a retrospective approach. Focus group discussions and in-depth semi-structured interviews were conducted to collect participants' experiences and knowledge retained from the two programme regimes. *The Dular strategy (Erstwhile) and ICDS (Current) are by the government.* This study was conducted in October 2018 using a research grant from the National Institute of Rural Development and Panchayati Raj, Ministry of Rural Development, Government of India. The Internal Research Advisory Committee approved the study design before the primary survey. Before the focus group discussions, the purpose of the study was explained to the participants, and informed consent was obtained for inclusion in the final FGD. The identity information of the participants was removed from the shared data.

Study Area, Sample and Data Collection

The study area was selected where the ICDS has been continuously running since 2001 through a brief survey of the literature and consultation with UNICEF-Bihar. A purposive sampling of beneficiary women was used in the centres, which had a continuous programme of UNICEF-supported Dular (erstwhile) followed by the government-supported ICDS (current). In consultation with UNICEF, two villages in Vaishali district were selected for the study. Two ICDS centres were randomly selected from each village. Participants were selected with the help of ICDS teachers (Sevika) and helpers (Sahayika).

Quantitative retrospective analysis of a programme requires a counterfactual. This study did not take a quantitative design as there were methodological challenges, such as the unavailability of '*non-willing non-participants*' due to the universal design, contamination, and spillover effects of the ICDS programme (Programme Evaluation Organisation, 2011). Instead, a qualitative

phenomenological approach was undertaken by including the FLWs and ICDS beneficiaries (mothers) who received the benefit from both Dular and ICDS regimes. Participants were asked to recall the experience of the erstwhile Dular regime ICDS along with the experience of current ICDS. The participants were:

a) Women with more than one child who availed themselves of both the erstwhile 'Dular' and the current ICDS for any of their children. Since the Dular beneficiary register was unavailable at the centres, any woman availing herself of the ICDS now but with at least one child between 0 and 3 years of age between 1999 and 2007–2008 was included in the study.

Thirty women who matched the criteria of having one child with a Dular eligible age between 1999 and 2008 (0–3) were interviewed. Out of the 30, 12 women who received the erstwhile Dular and current ICDS were engaged in focus group discussions. These 12 women had 42 children in the Dular (17 older children) and Current ICDS (25 younger children).

And,

b) Six FLWs and four erstwhile LRPs of UNICEF-Dular were identified and included in the FGDs across all four ICDS centres. These participants were identified with the help of UNICEF-Bihar in Patna.

In addition to the participants at the community-level, the study team also interviewed two key officials of UNICEF in the Patna ICDS office who had overlooked the Dular strategy to gain macro insights into the programme. The team held meetings with Sarpanch in the two surveyed villages, although no formal interviews were conducted.

Analysis

To recollect programme experiences from the past and present, the field coordinators structured the discussion so that participants could recall the maximum aspects of the programme service experience. Experiences were categorised into thematic areas. To identify themes, knowledge, attitude, practice (KAP) framework, and perceived outcome were used to steer the discussion.

The discussions and responses from the interviews and FGD diaries were reduced to phrases and coded to create a Boolean matrix for categories (Figure 2) (see Appendix Table 3 for data).

Few responses did not fit within the KAP framework, and a few pre-decided themes, such as 'outcomes', had no responses. Themes were modified by adding post-factor categories to the analysis. The final themes for beneficiaries (utilisation) were Accessibility, Quality, Knowledge, Practices/Behaviour, and perceived outcome, and for FLWs (delivery), they were Accessibility, Quality, Capacity building, and Work Environment.

The KAP framework was combined with a sub-framework of strengths, weaknesses, threats, and opportunities (SWOT). KAP has been used as a monitoring technique (Marías & Glasauer, 2014). The SWOT framework is a

Domain	Code	Dular-Exposed		Current ICDS	
		Yes (N= 22)	Response Matrix	Yes (N=71)	Response Matrix
Accessibility	Attendance	91.3%		43.1%	
	Frquency visit	87.0%		1.4%	
	ASHA support	26.1%		87.5%	
Quality	Quality of food	39.1%		88.9%	
	Quantity of ration	47.8%		94.4%	
	Variety in food	0.0%		0.0%	
Knowledge	Breastfeeding related	100.0%		100.0%	
	Santitation related	60.9%		91.7%	
	Nutrition, adulteration related	78.3%		38.9%	
Behavior	Training	56.5%		0.0%	
	Support system	73.9%		0.0%	
Outcome	Underweight children	17.4%		0.0%	
	Stunted children	0.0%		0.0%	
	Wasted children	0.0%		0.0%	

Figure 2. Response of Participants: Binary Code From Collapsing the Qualitative Response.

Note: This table should be read with Appendix Table 3 for an in-depth understanding.

#4th and 6th columns in the figure are sparklines for each code of responses (yes = line and no = blank). An intact or continuous line means that a greater number of beneficiaries responded.

##The 'can't /don't remember' responses are also blank. Themes in which sparklines were absent did not have any reactions from the 30 mothers.

rapid appraisal technique for understanding community-level enablers and barriers (Rocchigiani & Herbel, 2013). Within each theme, we prompted the participants to discuss their perceived strengths (service experience related) and weaknesses in the ICDS recollecting both positive and negative of the supply-side (accessibility, quality of the programme) and demand-side (nutrition-knowledge/behaviour retainment) aspects of the programme. The focus group discussions supplemented the learnings from one-to-one talks with the beneficiary women and the outreach workers (*Anganwadi*[1] *Sevika*). With the former Dular Outreach workers, we discuss the problems and prospects in implementing the Dular compared to the current ICDS.

Results

The average age of the participants in this study was 30.9 years—the majority were from *Extremely Backward Class (EBC*[2]*)* and agricultural labour households with little to no land. Only four women reported having gainful employment, such as tailoring and a small snack shop. About three in five women were illiterate and had a limited understanding of *Hindi* (the local language was *Bhojpuri*[3]). The study participants are shown in Figure 3.

No chronic or seasonal morbidity pattern has been reported. Nearly half (48 per cent) of the 93 children who received ICDS supplemental food were female. Twenty-two children availed of the Dular; the rest were young children currently availing of the ICDS (Appendix Table 4). Two of the four ICDS centres had poor infrastructure: no independent space, kitchen area, or toilets. Three centres had low sanitation and hygiene, with children and women sitting on torn floor mats in

Figure 3. Attributes of the Participating Mothers.

dust. Vaishali district (the study location) generally had poor maternal and child health outcomes (Appendix Figure 1). The qualitative comparison of experiences with 12 mothers who benefitted from Dular and current ICDS, Anganwadis, revealed mixed experiences in each theme alongside the experiences of the FLWs (Table 1). The discussion outcomes are summarised below.

Synopsis of One-to-one Discussion with FLWs

'*There are more children than there are food and more work than time*'.

The participating service providers shared that the number of beneficiaries always exceeded the actual budgeted amount. Service centres or Anganwadis served around 70–80 households in their neighbourhoods. Although '*universal*' in design, the supplementary food and ration services were capped to a fixed amount covering 40 children between the ages three and six, including 28 highly malnourished children between the ages of eight months and three years, 10 lactating mothers, and 10 pregnant women. The 40-child cap was pre-decided by the state government and did not change according to the actual population.

The Sevika (literally translates to '*a woman who serves*') prioritises the poorest of the poor children depending on the local government's EBC certification. Most malnourished children from eligible households were included in the roster as supplementary food. Sevika maintained a register of beneficiaries with details of age (scrutinised through birth certificates for some and verbal verification for many due to non-institutional births), caste, and so on. We asked Sevika to identify

additional children if the roster had vacant seats for supplementary food. Their amused reaction was, '*Are there ever "less" children than food?*'. Usually, in the place of the listed 40, all children of enlisted households show up, and the food is divided to ensure every child has something to eat. Suppose any child leaves the roster due to ageing, migration, or death. In that case, the same process is repeated, prioritising an extremely backward community and then the scheduled caste, scheduled tribe, minorities, backward community, and finally, the general category.

For ration and diet, a fixed amount was received in the joint account at the bank with the village secretary as another account holder. The money was then used to buy a ration containing food items according to a fixed week-based daily menu for 25 days. Changes in the supplementary food roster were based on two conditions. First, either the beneficiary child crosses the age of six and, therefore, is transferred to primary school, and second, if the child is absent for 17 days in a row. The list was occasionally updated and verified by a programme field officer. Child growth was monitored through child development cards developed by Sevika and Sahayika.

The FLWs believed that women's attendance has increased under the new regime but agreed that the burden of work is now disproportionately high, making monitoring pregnant/lactating mothers increasingly difficult (Table 1). Although the Dular regime LRPs were not explicitly discontinued, they were paid a nominal amount that was stopped in the UNICEF-Dular programme. The LRPs slowly disbanded the door-to-door monitoring, shifting the monitoring pressure on the FLWs. FLWs recalled that the Dular, such as the GMC booklets, was a more effective growth-monitoring tool for influencing or motivating mothers. The research team observed that two of the four centres were dilapidated, with one centre running in a non-permanent bamboo shack and the other running in a shared space with the Local Governance (*Panchayat*[4]) office.

FLWs reported that they must spend out of pocket to attend mandatory training and briefings at the blocks. A post-Dular regime strategic change noted as a weakness by the teachers and ex-LRPs was the regular doorstep training under Dular and a minimal stipend for attending these trainings. In the current ICDS, mandatory training at the Block offices, requires them to commute with out-of-the-pocket expenditure. The expenditure apart, participating FLWs stated that the compulsory travel made them dependent on male members of the household.

Stress at work was reported. The service providers were disgruntled about the excess work in the ICDS. Some beneficiaries confront them frequently, and there is no staff support system for FLW. Over the years, the workload has kept increasing—for any new government programme that requires community outreach; Sevika was the key personnel. Sevika's remuneration did not increase over time.

Synopsis of the FGDs With Mothers

Almost all participating women recalled that the accessibility or intensity of the programme's reach in individual beneficiaries' lives had weakened since the Dular pool of LRPs (or LRP Didis in the local language) was discontinued. The mothers recalled the Dular experience of chalk marking households with malnourished children for close monitoring of mother and child care, which was

Tabe 1. Comparison of Experience Between ICDS (Current) and Dular (Erstwhile).[a]

Participant	Experience Recalled for	Accessibility	Quality	Capacity Building/Knowledge Retained	Practices/ Behaviour	Work Environment	Outcome Recalled
Mothers (beneficiaries) (n = 12) categorised into five themes	ICDS Child[b] (n = 25)	(−) If mothers do not ensure attendance, the child loses out on a meal	(+) Taste/quality improved—both for hot and cold ration (+) There is more variety now (−) There is no regularity in the IFA	(+) Exclusive breastfeeding for up to six months (+) Complementary feeding after six months	(−) No demonstration is given on any behavioural issue	xx	(+) No SAM child in any centre (−) Strong feelings of exclusion in some women
	Dular Child (n = 17)	(+) LRPs personally visited to monitor (+) Chalk marking house with malnourished children for close monitoring	(+) IFA consumption was regular, and LRPs monitored the mothersGMC was provided for monitoring the child (−) Low variety in the content of meals	(−) None recalled	(+) Demonstration on • Identify iodine salt • regular hand-wash		(+) GMC helps track a child's growth (−) There were three SAM children

(Table 1 continued)

(Table 1 continued)

Participant	Experience Recalled for	Accessibility	Quality	Capacity Building/Knowledge Retained	Practices/ Behaviour	Work Environment	Outcome Recalled
Local resource persons (erstwhile) (n = 6) and front-line workers (n = 4) (service delivery personnel) categorised into four themes	ICDS Regime Services	(+) Higher participation of women in ICDS (−) No monitoring of beneficiaries due to low human resource (−) Capping on beneficiaries leads to exclusion	(+) Quality and variety of ration/ medicines improved (−) GMC was discontinued (−) Poor Infrastructure	(+) Mandatory training (−) Training shifted to Block level, raising dependency on husbands for travel (−) Travel costs paid out of pocket	xx	(−) High workload (−) Sanctioned vacancies not filled (−) Some beneficiaries confront and complain frequently	xx
	Dular Regime Services	(+) Paid second-line workers (LRPs) reduced the work burden (+) Close and personal monitoring of beneficiaries (−) Lesser women visited ICDS centres compared to now	(+) GMC booklets were provided (−) Insufficient ration for children's feed	(+) Regular training with a stipend to FLWs(+) Training conducted in villages (−) Finding constant engagement from second-line workers is difficult, even with payment		(−) No recollection	

Note: [a]Responses categorised in themes are further categorised into Strength (+) and Weakness (−).

[b]The children with ICDS and Dular were siblings. Focus group discussions with 12 women who availed of both Dular (for the older child) and ICDS (for the younger children) are included in this table.

discontinued. Beneficiaries accepted that food quality, quantity, and taste improved over time. Contrary to the FLW's experience, beneficiaries did not care much about the discontinued GMC booklets and were more concerned about the food served. Many women were confrontational that their children were losing out on the supplementary food—however, this was partly because of their misunderstanding about the capping and prioritisation system in ICDS.

Women hardly retained knowledge gained during the Dular regime. Women recalled that iron tablets are regularly given in both the Dular and in current ICDS but could not recall the exact numbers to be taken (120 Tablets as per the programme) even after having three or more pregnancies. Like the iron tablets, none of the women could recall any nutrition message from the Dular times. The study team prompted with key child care messages, such as *initiating breastfeeding immediately after birth and breastfeeding exclusively for 6 months,* but women connected these with the current ICDS. In the case of practice, three women were exclusively breastfed for seven or eight months. One of the major services recalled from the Dular regime by all 12 women was regular live demonstrations by LRPs on miscellaneous health and nutrition issues in the village, such as identifying food adulterers and fake iodine salt. There was a perception that health services improved over time. There were no thin children in the centre.

Discussion

This study reviewed the ICDS performance from beneficiary and service FLWs' experiences using a qualitative retrospective design to gain insights into the micro-level barriers to achieving better nutrition outcomes. In the case of the ICDS, scholars have reiterated its importance from a rights perspective (Drèze, 2006) found a high and increasing coverage (Chakrabarti et al., 2019) but low uptake (Rajpal et al., 2020), exclusion of the marginalised (Chakrabarti et al., 2019), harsh working conditions for the service providers (Sinha, 2006). All these findings hint at barriers to the impact of ICDS services on nutrition. A few micro-level barriers to service effectiveness and service experience may be identified based on a synopsis of the discussions.

Perils of Mixed Coverage

While some services, such as height and weight monitoring of children, iron tablets to pregnant women, and authorisation of birth registration certificates, are extended to all, supplementary nutrition is only served to a section of the community due to limited resources and capping on numbers. This mixed design created conflict and confusion within the community. Beneficiary women often accused that their children were wrongfully denied admission in the ICDS register, expressing anger against the Sevika, primarily out of misunderstanding that they enforce the 40-child capping. Daily abuse from these mothers was normal for FLWs at these centres.

Occasionally, the FLWs distributed supplementary food to more children than the roster to avoid excluding attending children, meaning some children received

less than the supplement's targeted nutrition (500 Kcal/12–15 gm protein). These experiences reiterate the concerns raised by scholars of low utilisation, low awareness in low- and middle-income countries, and even a decline in coverage in upper-middle-income countries (Heidkamp et al., 2020; Khapre et al., 2019). The discussions also revealed that the knowledge gained during Dular's community mobilisation strategy was not retained over time, except for a few women remembering iodine identification in salt.

The Influence of the Service Environment on Delivery and Utilisation

Some evidence of work environmental factors in determining health or nutrition service utilisation include geography, social demography, community support (Dassah et al., 2018; Hamal et al., 2020; Vellakkal et al., 2017), community-level factors (Khapre et al., 2019; Sinha, 2006). Our discussion reveals that sustained ICDS is affected by several social/community-level factors.

First, there was a drastic change in programme strategy. After discontinuing the *Dular* strategy in 2008, the ICDS witnessed several changes, such as discontinuing LRPs, village-level training, and some education components. These changes could not retain the momentum created for the progress of knowledge and attitudinal shift in women, as evidenced by the lack of recall about Dular regime learning. Secondary evidence shows a higher engagement with FLWs, especially among poorer households, resulting in better maternal health outcomes (Rammohan et al., 2021). Recent evidence has also observed scarce human resources as a major barrier to effective data-driven maternal health service delivery (Young et al., 2021).

Second, the disempowered service delivery personnel were a major constraint. FLWs were to function with high responsibility but even higher liability, yet low respect. The ICDS Sevika's were facing all the chaos of the programme implementation, including daily protests and disgruntlement of the beneficiaries if their children did not receive the food, or intimidation from Block level ICDS Officers if any account was missed or mismatched. Most of FLW's efforts were to keep the books clean rather than effectively reach beneficiaries. Some micro-level studies in Bihar showing the adverse effects of low trust and perverse behaviour expectations in public health service delivery also support our field observations (Khemani et al., 2020).

Third, there was low social cohesion. Evidence shows that public institutions fail to be assertive without social cohesion (Easterly et al., 2006; Sinha et al., 2016). This study also revealed the difficulties resulting from social conflicts. Women from upper-caste or relatively better-off households were excluded from the system because of the prioritisation of beneficiaries. Sevika was under constant fire from women from the upper-caste who were not prioritised and women from EBC households who wanted their younger children to be registered for supplementary food. During the preparatory meetings when all the women were present, there was clear disgruntlement around the Sevika's attempt to include more households rather than more children, due to which the third or fourth child of one mother was getting excluded in favour of the first child of another mother. The upper-caste women were threatening to boycott Anganwadi altogether.

Fourth was the low status of women in the community, which was reflected in the lack of awareness about rights and entitlements and no understanding of what the programme was offering and for whom. Interaction with the community also revealed open son preference, visible child marriage, teenage pregnancies, and absence of gainful employment for the women. The study team came across several women who were introduced by the older women (some of them SLWs from erstwhile Dular) with phrases like '*She doesn't/couldn't have a son yet*'—implying that more pregnancies are to be expected until a son is delivered.

It was observed that male leadership was shy to talk about Anganwadi, as it involved pregnant women. During the FGD with FLWs, a male senior village member would sit in the courtyard (ICDS centres are usually open buildings with courtyards outside) and typically interfere when the discussion was steered towards numbers, finances, and accounts. We could observe the dependence of FLWs on men when it came to financial accounts and other strategic issues. These observations are supported by existing studies that have reiterated the problems of low awareness about social protection and entitlements (Jose et al., 2019) and the effectiveness of empowered and autonomous self-help groups in nutrition service delivery (Feruglio & Nisbett, 2018).

This study has several limitations, though. First, it was a qualitative study; therefore, it does not claim the magnitude of the effect or the conclusions' replicability. Second, the study was small-scale. Thus, details of environmental barriers were not included; third, there was 'noise' in the discussions and qualitative open interviews, making digitisation and coding prone to the objective bias of the coders. Further research is required to understand the exact effects and solutions of the barriers listed in this study. Despite these limitations, this is an in-depth and unique study in which the beneficiary perspective was compared with the service delivery personnel's perspective for the two programme regimes. The results were crosschecked and validated over phone calls to ensure objectivity and precision to the best possible extent. The results presented significant learning for the successful implementation of nutrition schemes and opened possibilities for forming hypotheses for the empirical testing of conclusions in similar communities.

Conclusion

This micro-level qualitative study made in-depth inquiries about beneficiary experiences from one of the largest nutrition services in the world, ICDS in India. Focus group discussions and in-depth qualitative interviews provided several insights into the enablers and barriers to nutrition service delivery programmes in India.

The study observed that mixed coverage for programmes meant for the same community, mid-implementation changes to strategies such as dropping second-line workers, overburdened and poorly resourced delivery personnel, and restrictive gender environments created major barriers to service delivery. Over time, knowledge and capacity built into community programmes weakened, as women did not recall the messages shared during early training. In addition, daily

tensions in service centres due to non-universal coverage and exclusion resulted in a poor work environment and low motivation among FLWs. On the other hand, the participation of the Local Governance bodies in programme monitoring is an enabler of service delivery.

In a front-line outreach-driven implementation, FLWs should be empowered and capacitated for better beneficiary experience, and post-training support must be provided for the independent functioning of ICDS FLWs. Also, a programme targeting women cannot be gender blind; for example, shifting training to the blocks and not providing travel assistance or assigning monitoring tasks without adequate remuneration tends to lower motivation. Based on the study, effective programme delivery may be ensured by sufficient resources – both for the beneficiaries in terms of coverage in the supplementary nutrition programme and for the service delivery personnel in capacity.

Appendix

Table 1. Services Provided by DULAR-regime and the ICDS.

Action Level	Services/Activities AWW	2001–2008	2008–2018
Institution	Village contact drive to map the village and mark the households	✓	✗
	Conduct focus group discussions to educate on health and nutrition	✓	✗
	Entry of weights and consultation	✓	✗
	Women volunteers with leadership quality given Local Resource Person (LRP) recognition	✓	✗
	LRPs organise Local Resource Groups	✓	✗
	Local training and capacity building	✓	✗
	Infrastructure	✗	✓
Adolescent girls	Registration of girls (specially for girls who are not enrolled in school) at Anganwadi centres	✓	✓
	Weekly intake of iron pills	✓	✓
	Monitoring intake of green vegetables and fruits in diet	✓	✓
	Intake of iodised salt	✓	✗
	Importance of education, marriage after 18 years, physical cleanliness and health-related advice	✓	✓

(Table 1 continued)

(Table 1 continued)

Action Level	Services/Activities AWW	2001–2008	2008–2018
Pregnant women	Registration of pregnant women in Anganwadi centres	✓	✓
	Measurement of weight of pregnant women in an interval of three months	✓	✓
	Intake of 100 iron pills	✓	✓
	Encourage institutional delivery (with ANM)	✓	✓
	To have sober meals and iodised salt during pregnancy	✓	✓
	Advice of two hours rest at the day-time	✓	✓
	Breastfeeding education	✓	✓
Breastfeeding mothers	Measurement of weight of newborn	✓	✓
	Registration of breastfeeding mothers at Anganwadi centres	✓	✓
	Exclusive breastfeeding till six months age of children no water	✓	✓
	Measurement of weights of children at the Anganwadi centres	✓	✓
	Sober meals and iodised salt intake	✓	✓
	Vaccination for children (with ANM)	✓	✓
Seven months to three years old	Registration of all children below three years	✓	✓
	Measurement of weight of children every month	✓	✓
	Full immunisation of children	✓	✓
	Dose of Vitamin A in every six months	✓	✓
	Milk/banana/egg/seasonal fruits/micro-nutrient fortified food followed by a hot cooked meal (HCM)	✗	✓
	Pre-school non-formal education	✗	✓
	Immunisation	✗	✓
	Health check-up and	✗	✓
	Referral services	✗	✓

Table 2. Design and Reporting of the Study by the COREQ Checklist (Tong et al., 2007).

SL. No.	Domains/ Sub-domains	32 Criteria	Criterial Followed by the Study
1	Research team and reflexivity		
1.1	Personal characteristics	Interviewer/ facilitator Credentials Occupation Gender Experience and training	The field study was conducted by the corresponding author who is a PhD and Assistant Professor of Gender Studies. The logistics for discussions and interviews were arranged with the help of a local male associate. The lead researcher (also corresponding author of this study) had research and capacity-building experience in the area of food, nutrition security and public health policy. Telephonic interviews were conducted by the co-author who is also well-versed in the local language, that is, *Bhojpuri*
1.2	Relationship with participants	Relationship established Participant knowledge of the interviewer Interviewer characteristics	The associate was familiar with the area, but no prior relationship was established with the participants. The corresponding author personally conducted the interviews and explained the study to the participants in a preparatory meeting before taking their consent to take part in the study. All the participants were women in the village, reaching them before or making early contact was not possible as most women did not own private phones in 2018. Prior calls could also lead to canvassing of positive reviews by the ICDS workers
2	Study design		
2.1	Theoretical framework	Methodological Orientation and Theory	The study combined a qualitative phenomenological approach with a retrospective design comparing beneficiary experience of the ICDS program. In-depth semi-structured interviews were done to collect participant's experiences of, and knowledge retained from the two program regimes of ICDS. The responses were digitized, coded and also compared in a thematic manner

(Table 2 continued)

(Table 2 continued)

SL. No.	Domains/ Sub-domains	32 Criteria	Criterial Followed by the Study
2.2	Participant selection	Sampling	Three sets of stakeholders were interviewed: (a) Beneficiaries, (b) service-providers or front-line workers and (c) UNICEF ICDS officials. Due to the specific nature of eligibility (women availing both program regimes), participants were selected based on convenience. Identification of the relevant ICDS Centre was done with the help of the Women and Child Department, Bihar and the UNICEF Bihar office. Once the team visited the ICDS Centres, the beneficiaries were identified with the help of the front-line workers.
		Method of approach	A combination of approaches was used. Focus group discussions, face-to-face in-depth interviews and for selected front-line workers, telephonic interview was conducted.
		Sample size	Thirty beneficiaries and 10 service providers. Two UNICEF officials were also interviewed.
		Non-participation	All eligible beneficiaries were invited to take part. However, only 30 women finally participated in the study.
2.3	Setting	Setting of data collection	Majority of the interviews were in the Anganwadi Centre. A few women were contacted at the Local Government office (Panchayat)
		Presence of non-participants	Anganwadi staff and teachers were present at the ICDS Centres where the majority interviews were held. In the FLW meetings, male members, that is, teachers, panchayat workers were around—not in the meeting but trying to listen in closely. We noted that book-keeping, that is, accounts is a sensitive issue and FLWs take help from the male members of the family or authority figures in the Panchayat
		Description of sample	A vivid sample description is provided with an infographic presentation for clarity of readers

(Table 2 continued)

(Table 2 continued)

SL. No.	Domains/ Sub-domains	32 Criteria	Criterial Followed by the Study
2.4	Data collection	Interview guide	The focus group discussions were guided by the author to cover thematic areas of access, quality, knowledge, behaviour and practices and perceived outcome
		Repeat interviews Audio/visual recording Field notes Duration Data saturation Transcripts returned	Semi-structured questionnaires and diaries were used to collect data from the field. Each group discussion (four groups of beneficiaries and two groups of font line and second-line workers) lasted for almost five hours, that is, a full working day. Keeping the beneficiary women engaged continuously in a group discussion was a tenuous task with most women taking breaks for domestic work, child care and other duties. The discussion will also often digress from the theme—leading to a loss of time. None of the women were contacted after the field survey. A few interviews with ICDS front-line workers were conducted only over the phone
3	Analysis and findings		
3.1	Data analysis	Number of data coders Description of the coding tree Derivation of themes Software Participant checking	Data was coded in an Excel sheet manually by a research assistant. Specific guidance was provided, and coding was regularly monitored to ensure thematic analysis. Any noise in the data that did not fit the themes was dropped from the coded tables, however, some responses external to the themes provided significant inputs in interpreting the results. A few facts regarding the functioning of the program were cross-verified with the front-line workers who were interviewed telephonically
3.2	Reporting	Quotations presented	This study did not include quotations data. The diaries and semi-structured questionnaires were digitized to create the database for analysis.
		Data and findings consistent Clarity of major themes Clarity of minor themes	The results from the data are presented through infographics narrated by major themes (five service-experience domains for mothers and four work-experience domains for front-line workers) and subthemes (strengths and weakness). The discussion of learnings from the interviews and FGDs follows the structured result section so that consistency can be checked by the reader

Table 3. Reductions of Qualitative Response to Boolean Matrix for Thematic Arrangement.

	Noise'-cleaned Phrases in Semi-structured Questionnaire, FGD Notes and Diary (Some Translated From Bhojpuri/Hindi)			Collapsed response (Replace observation as 1 if response = 'Collapsed response', else 0)	Post facto Assigned Thematic Domain for Analysis	
Program Regime	Strength	Weakness	Blank			Remark
Dular	We attended every day| Children ate here| we got food			Attendance| Access	Accessibility	
	We visited everyday| LRP Didi used to pay regular visits | they put chalk outside some houses			Regular| Visit| Monitor| Mark	Accessibility	
	She took me to the Hospital| visited for an injection| ASHA didi helped in labour			ASHA support		
	It was ok| food was fine	Whatever they gave we ate| what can we say-it was edible		Quality	Quality of Services	
	We got some food| enough for me| it was good enough			Quantity	Quality of Services	
		We got daal-chawal| nothing special was there		Variety	Quality of Services	
	No other food till six months| spinach mix| daal-chawal after six months		Can not remember message	Knowledge breast-feeding	Knowledge Retained	
	Yes they trained on hand washing	No there was no training	Can not remember anything	Knowledge sanitation	Knowledge Retained	

(Table 3 continued)

(Table 3 continued)

Program Regime	Noise'-cleaned Phrases in Semi-structured Questionnaire, FGD Notes and Diary (Some Translated From Bhojpuri/Hindi)			Collapsed response (Replace observation as 1 if response = 'Collapsed response', else 0)	Post facto Assigned Thematic Domain for Analysis	Remark
	Strength	Weakness	Blank			
	Yes ate tablets everyday| Didi (LRP) used to ask| They gave 100 tablets| we had demonstrations on testing iodine-level in salt| didi asked to have spinach during pregnancy	Had 120 tablets| no don't remember tablets		Iodine salt| IFA| knowledge MISC	Quality of Services	Since these responses are linked to the content of program benefits| they were put under the Quality theme
	Yes there were meetings| there were demonstrations| didi used to show things	No, they told us nothing		Training	Knowledge Retained	
	Didi used to observe| everyday she will ask			Supervision	Accessibility	
	We could see it in the book (GMC)	We do not know about underweight	Not sure about the result	Impact underweight	Outcome	Women were asked about personal experience of improvement in nutrition, not about the program outcome— however, none of the participants responded anything relevant for this theme.
		There are no such children|	Not sure about this	Impact stunted	Outcome	
		My child was very thin| took five months to recover (could not validate)| yes child was thin| now he's fine| he was born thin| now he's all grown	Not sure about this	Impact wasted		

(Table 3 continued)

(Table 3 continued)

Program Regime	Noise'-cleaned Phrases in Semi-structured Questionnaire, FGD Notes and Diary (Some Translated From Bhojpuri/Hindi)			Collapsed response (Replace observation as 1 if response = 'Collapsed response', else 0)	Post facto Assigned Thematic Domain for Analysis	Remark
	Strength	Weakness	Blank			
ICDS	Yes we attend in this Centre| our child comes to eat| my son/daughter eats|	We can hardly come here| Didi does not register my child| no we have not eaten last week		Attendance| access	Accessibility	
		No one ever visits us| not to my house| no they do not visit		Regular| visit| monitor	Accessibility	
	ASHA didi is there| Didi came to help me| ASHA didi helped	I was not here| I went to a private		Asha support	Accessibility	
	Food is better than before| yes it is tasty| my child likes it			Quality	Quality of services	
	yes it is good enough	We get food as if that's not enough| it is good| my child is not getting registered| didi discriminated against my child| I came the other day she did not give food		Quantity	Quality of services	
	Yes food is much tastier now| It is better than before			Variety	Quality of services	
	No other food till six months| have to give daal-chawal after six months| special care for thin child			Knowledge breast-feeding	Knowledge retained	

(Table 3 continued)

(Table 3 continued)

Program Regime	Noise'-cleaned Phrases in Semi-structured Questionnaire, FGD Notes and Diary (Some Translated From Bhojpuri/Hindi)			Collapsed response (Replace observation as 1 if response = 'Collapsed response', else 0)	Post facto Assigned Thematic Domain for Analysis	Remark
	Strength	Weakness	Blank			
		Didi should help us get loan (construction of toilet)| no there is no such training here		Knowledge sanitation	Knowledge retained	
	Got Toffee (IFA tablets) at the Centre| I got tablets| had 120 tablets| we got Laddoo [special sweet]| halwa [sweet with nutrient supplement]			Service| IFA| supplement	Quality of services	
		Never heard of anything| no not anymore| never attended		Training	Knowledge retained	
		No one asks| no supervision		Supervision	Accessibility	
			Can not tell	Impact underweight	Outcome	
			Can not tell	Impact stunted	Outcome	
		No thin child in our village now	Not sure about this| her only son is disabled	Impact wasted	Outcome	

Table 4. Distribution of Children of the 30 Mothers by Program Exposure.

Participant No.	Number of Children in Dular	Number Children ICDS	Total	Whether Included in FGD
1	2	3	5	FGD
2	1	2	3	FGD
3	1	3	4	FGD
4	0	4	4	
5	0	3	3	
6	0	4	4	
7	1	2	3	FGD
8	0	3	3	
9	5	0	5	
10	2	1	3	FGD
11	1	3	4	FGD
12	0	3	3	
13	0	3	3	
14	0	2	2	
15	0	2	2	
16	0	3	3	
17	0	4	4	
18	0	2	2	
19	2	1	3	FGD
20	0	1	1	
21	0	3	3	
22	0	2	2	
23	0	2	2	
24	1	2	3	FGD
25	0	2	2	
26	0	3	3	
27	1	3	4	FGD
28	1	2	3	FGD
29	2	1	3	FGD
30	2	2	4	FGD
Total Children	22	71	93	12
Summary of Program Exposure of Children				
ICDS (No DULAR exposed siblings)			46	
ICDS but has a DULAR-exposed sibling			25	
DULAR (No ICDS availing siblings)			5	
DULAR but has an ICDS availing sibling			17	

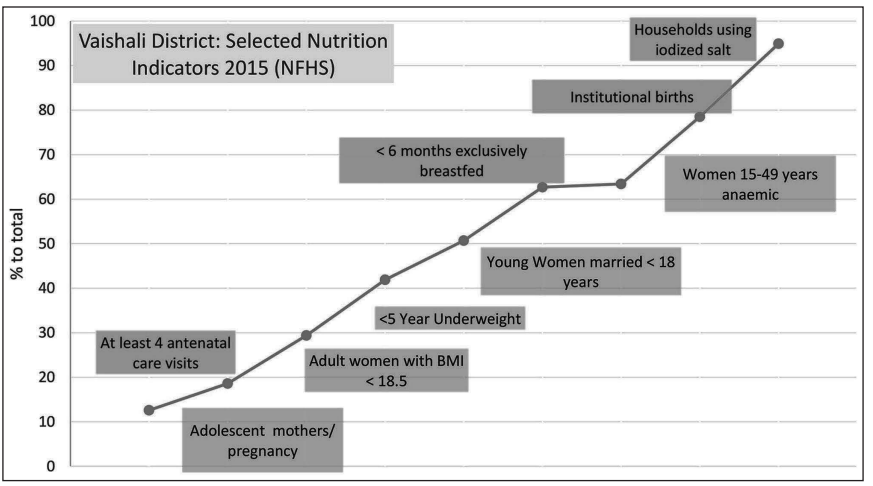

Figure 1. Vaishali District Nutrition Statistics (2015 NFHS).

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Notes

1. Anganwadi is a type of rural childcare centre in India started by the Indian government in 1975 as part of the Integrated Child Development Services program to combat child hunger and malnutrition. Anganwadi means 'courtyard shelter' in Indian languages.
2. EBCs (Extremely Backward Castes) are made up of 113 castes from among the most marginalised OBCs in Bihar. They constitute about 30 per cent of the state's electorate. The dominant EBCs include Bind, Mallah, Kewat (fisherfolk by profession), Nishad (boatmen), Chandravanshi, Lohar, Kumhar, Badadhi, Sunar, Tatwa, Teli, Kahar, Kewat and Nonia.
3. A language spoken mainly in Bihar, parts of Jharkhand and eastern Uttar Pradesh, India. It has similarities with Hindi, but the pronunciations are largely different.
4. A village council, instituted for governing a village (oldest system of local government in India) which got Constitutional sanction in 1992.

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Article

Spatiotemporal Land Use Changes in Remote Rural Regions of India Between 2000 and 2020

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Abstract

This study tracks the spatiotemporal changes in high-population growth and high-density rural regions of India, also called 'ururall'. The ururall areas are remote, high-density rural areas far from zones of urban influence. Deriving the land use and land cover changes from the *Global Land Cover and Land Use Change* dataset and analysing them in the most populated and dense districts, the study confirms the hypothesis that land uses are continuously changing and have accelerated in high population growth and density in rural districts in India. The findings demonstrate significant changes in land use patterns in the last two decades, that is, 2000–2020, particularly in the last decade. Almost all physical changes, such as an increase in built-up areas, a reduction in agricultural lands, and depletion in vegetative cover and water bodies, were significant. This means that high population density, combined with population pressure in remote rural regions, is a leading contributing factor to considerable land use transformations, essentially turning them into areas with urban characteristics, that is, making them *ururall*.

Keywords

High-density rural, ururall, land use patterns, spatiotemporal changes, India

Introduction

High population density is a key indicator of urbanity (Castells, 1977; Harvey, 1985; Qadeer, 2000, 2004; Rex & Moore, 1967; Wirth, 1938), which has been on the rise globally over the last two decades due to population growth (World Bank, 2023). High density and population pressure could transform a region's spatial

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organisation, land market, and housing and community needs of a rural area, among others, introducing major urban characteristics.

According to the United Nations (UN), guidelines on rural–urban definition boundary lie within 400 persons per square kilometre, where areas above this threshold are considered urban. However, Qadeer (2000) points out that certain rural regions in India, neighbouring South Asian countries, and many parts of developing countries have emerged with higher population densities that exceed this recommended guideline. Despite the high population pressure, many of these regions retain economic and social rural characteristics. Agrawal et al. (2021) coined the term 'ururral' to describe these remote areas far from zones of urban influence but experiencing higher population pressures and density. These ururral areas significantly impact land use, spatial organisation, land market, housing, communities and other infrastructure requirements, endowing them with urban characteristics. The population increase in these areas may have led to increased land pressure, contributing to significant changes in land use and land cover, mainly at the expense of agricultural and forestry areas.

India loosely follows the UN guidelines on rural–urban designations (Qadeer, 2000; UN, 2005). However, rural population densities in India have surpassed this threshold in various regions, including along the Ganges River, on the route from Delhi to Kolkata in Kerala and along the coast of Odisha. The Census of India defines the rural area based on the UN density criterion and two other requirements: A population of less than 5,000 and at least one-quarter of the adult male population employed in agriculture (Government of India, 2013). Despite this definition, most districts in populous states have greater than 1,000 persons per square kilometre.

Over 60% of India's population lives in rural areas, with an increase of nearly 142 million people in the last two decades alone (World Bank, 2023). This rise in rural population, particularly in states with a higher rural population, can lead to changes in land use patterns attributed to fulfilling the increased resource demands such as infrastructural development and housing. Changes in land use in these regions have far-reaching implications for various aspects of society, including the economy, environment and social structure. Qadeer (2000, 2004) and Vidyarthi et al. (2017) also indicated that areas of rural India with high population densities show signs of changing land use, deteriorating economic situations, and poor or absent physical and social infrastructure. Therefore, it is crucial to understand the land use changes in these areas to strike a balance between economic development, the needs of a growing population and sustainable land-use practices.

In a previous study by the authors of this paper (Agrawal et al., 2021), they hypothesised that India's high-density rural areas—also known as ururral— are experiencing significant changes in their land use characteristics. This earlier study analysed the land use changes between 2001 and 2018 in two high-density rural areas of Bihar, one of India's most populous and dense states. We conducted this study, including 58 districts across India that have >80% rural population covering over 17 million hectares of land, to further confirm the hypothesis developed by Agrawal et al. (2021) and to better understand the spatial variation of land use changes. Further, our study draws attention to the need for medium

and long-term policies that are more attentive to the changing dynamics in rural areas in India. Our study is arguably the only study conducted at the national level to examine the nexus of population density and land use patterns in rural India over the last two decades.

Literature Review

The literature review covers an extensive scholarly review of areas, mainly in the Global South, that are neither urban nor rural, factors contributing to land use conversions and techniques used to measure them.

Mixing Urban–Rural Distinction

High-density rural regions are the least explored phenomenon, particularly in rural India, barring a few studies by the study's first author. In contrast, in the Global North, the urbanisation of the countryside has been more thoroughly investigated within the context of suburbanisation and urban sprawl. A few scholars have examined the mixing of urban and rural areas in regional contexts, particularly in Asia, generating insights into changing land and density patterns in such locations. They have described this phenomenon through various terminology: Dispersed metropolis (Ginsburg et al., 1991), desakota (McGee, 1991), in-situ urbanisation (Zhu, 2004; Zhu et al., 2013), rurban (Afshar, 1994), ruralopolis (Qadeer, 2000, 2004) or urural (Agrawal et al., 2021; Vidyarthi et al., 2017).

McGee (1991) has explored the phenomenon of non-agricultural activities infiltrating rural areas through his concept of 'desakota' (derived from the Bahasa Indonesian language, in which *desa* means village and *kota* means city). He deploys this term to describe corridors of mixed agricultural and non-agricultural activities connecting large Southeast Asian cities. Rural villages are situated within these linear corridors that connect the urban centres. Agricultural and urban land uses have transformed these villages, which have grown substantially in size due to this mixed-use.

Ginsburg et al. (1991) favour a 'dispersed metropolis' to describe the extended metropolis between the rural and urban corridors, which are socio-economic zones organised by neither urban nor rural strategies in particular; instead, they preserve the essential ingredients of each form. He says, 'This complex and compound regional system consists of central cities, fringe areas, exurbs, satellite towns and extensive intervening areas of dense population and intensive traditional agricultural land uses' (1991, p. xiii). Most people live in villages, and almost all of the land is cultivated, with the landscape and topography remaining unchanged for the most part. However, most people's incomes in these extended metropolitan zones come from non-agricultural sources: Village-based work, small-town industries, city work entailing daily commutes from the village and remittances from family members who have relocated to central cities. Ginsburg attributes these income streams to the ongoing improvements in the transportation system.

The concept of 'in situ urbanisation', coined by Zhu (2004), addresses the dramatic growth in rural villages as a direct result of government intervention. He

examined urbanisation in the rural areas of the Quanzhou municipality in China and across Fujian Province, the region in which Quanzhou is located, exploring beyond just the province's coastal areas, as the government claims (Zhu et al., 2013). Government schemes aimed at developing township and village enterprises in rural areas were intended to stop the flow of rural-to-urban migration but have led to increased rural industries in China. These changes, in turn, have undermined the distinction between rural and urban areas (Zhu, 2004). Importantly, rural regions of both China and India have undergone in situ urbanisation. However, the Indian experience is mostly a natural one, with little or no government involvement—unlike the Chinese instances, fuelled by rural industrialisation through government intervention.

Qadeer (2000) has identified the urban potential of high population density in rural areas, calling such regions 'ruralopolises'. These hybrid settlement systems are spatially urban but economically, institutionally, socially agrarian and rural. A ruralopolis is an area with high population density, an agricultural economy and small landholdings broadly defined by extended corridors or bands of homesteads and villages sprawled amidst farms and woods.

Elsewhere, Qadeer (2004) explains a ruralopolis as a

> form of urbanization that emerges with large institutional deficits or lags between needs and provisions for facilities, services, and resources, as well as administrative organizations on the one hand and spatial-environmental structures and community institutions on the other. (p. 9).

These rural communities are situated away from large centres, having grown exclusively through 'urbanisation by implosion' (Qadeer, 2004). Notably, while ruralopolises experience intensive population growth from within by increased births, they lack parallel increases in infrastructure, institutional capacity, or public services.

While rural segments of urban areas have long been called 'rurban' (Afshar, 1994), Qadeer (2000) was more interested in the transformation that occurs in such regions rather than considering them simply a settlement type or zone. For him, pre-existing urban patterns and lifestyles alter rural forms at the periphery of large metropolitan areas and cities, generating new rurban forms. Examples include rooftop or backyard chicken farms; the keeping of large animals like cows, goats, sheep or pigs in cities; and rural industries making gunny bags, shopping bags, handicrafts, carpets and many other items for urban dwellers. Conversely, computer and internet cafés in the countryside would also qualify.

The Vidyarthi et al. (2017) chapter on high-density rural areas in India mentioned above extends Qadeer's (2004) concept. This work, however, proposes the term 'urural' for remote, high-density rural areas far from zones of urban influence—unlike McGee's (1991) desakota, Ginsburg' et al. (1991)'s extended metropolis and even Afshar's (1994) rurban. The density of these urural areas, as well as their economy (a criterion not considered in Qadeer's ruralopolis), have evolved past the current definition of rural due to in situ transformation that occurred *without* government intervention or support (different from Zhu's (2004) examples from

China). Specifically, what makes them urural is that urban elements have been introduced in remote rural areas changing their physical, social and economic character. The urural classification draws attention to the blurring of rural–urban distinctions in areas not proximal to cities or within metropolitan areas.

Rising unemployment, poverty and the shift away from traditional agricultural work towards the non-agricultural sector significantly contribute to increased out-migration rates from the area. These concerns intertwine with growing pressures on land and public resources in these areas, producing evermore conflicts linked to drainage routes, land ownership and access to water (Vidyarthi et al., 2017). Further, the increase in land values prompts many rural residents to sell their holdings, which are converted to non-agricultural uses.

Urural regions are also complex because they are difficult to classify within the current rural and urban binary system. A clear divide between rural and urban does not exist anymore, given the emergence of new urban forms and evolving patterns of physical development. The 2011 Census of India[1] considers *urural* areas as rural—and not census towns (CTs)—settlements administered as rural areas. However, these have crossed the thresholds of urban characteristics concerning the workforce's size, density and nature. However, we hypothesise that urural zones may be more rural in their physical characteristics. Further, compared to CTs, these areas have fewer or no institutions such as banks and schools or infrastructures such as sewerage, drainage and water supply systems. In this paper, we intend to examine if the urural areas in India are indeed undergoing land conversion from agricultural to non-agricultural uses.

Factors Contributing to Land Conversion

Multiple factors contribute to land use conversion. For instance, Fazal (2000) looked at urban expansion surrounding a mid-size city in northern India with a similar method. The study evaluated the trade-offs linked to the rapid conversion of agricultural areas to non-agricultural uses that accommodate the growing urban population, observing that this unfolds at the expense of surrounding fertile agricultural land and a loss of food production. Similarly, Fox et al. (2017) focused on Kerala, a state in India with a high population density, employing mixed methods (including remote sensing) to show that land use change is gradually decreasing agricultural land. This shift depends on several intertwined factors, including declining profitability of farm practices, rural urbanisation, unreliable weather patterns, housing demands, remittances from the Gulf countries and government policies such as MNREGA.[2]

Measuring Land Use Conversion

Several research tools can uncover changes in land use over time, but remote sensing and geospatial technology systems provide high accuracy at a lower cost than other methods (Rawat & Kumar, 2015). Multiple satellite sensors provide

several image types with different spatial, spectral and temporal resolutions that aid in detecting specific land cover types to meet diverse research needs. Techniques to classify land use vary as well: For example, supervised classification (Huang et al., 2015; Mallupattu & Reddy, 2013); unsupervised classification (Mishra et al., 2014); spectral vegetation indices; and normalised difference built-up index (Rawat et al., 2013) and machine learning tools (Potapov et al., 2022). However, most of these methods depend heavily on the spatial and temporal resolution of satellite images, and the known information of prior ground-based land use maps (Al-doski et al., 2013).

Due to the lack of reliable spatial land use data for the study area, we used the Global Land Cover and Land Use Change (GLCLU) dataset and tools to understand detailed information about changes in major land use classes. The *Methods* section, Data Analysis, goes into detail about this approach. We also applied this technique on the Landsat[3] satellite imageries, available for our study area during the study time frame.

Methodology

Study Area

To determine the most appropriate area for the study (hereafter referred to as the *test area*), we first gathered data from the Government of India's report of 2020 and the Census of India 2001 to calculate the percentage of the rural population and population density in each district of the states. We selected the test area based on two criteria: A rural population of 80% or more and a population density of at least 1,000 or more persons per square kilometre (km). After analysing the data, we identified 37 district clusters covering a total land area of 9,931,864 hectares (ha) in three states—Uttar Pradesh, Bihar and West Bengal (Figure 1 and 2). This test area enables us to understand urural growth over the last two decades.

Additionally, we identified 21 reference/control districts (hereafter referred to as the *reference area*) around the test area. The reference areas also have a rural population of at least 80%. Still, their population density is less than 1,000 persons per square km—a means to isolate the effects of population and density. The average density in the test area in 2001 was 1,018 km^2, while the reference area in 2001 had an average density of 627 km^2, considerably lower than our threshold of 1,000 km^2.

All districts we identified lie in three populous states in India: Uttar Pradesh, Bihar and West Bengal. These states have significant rural populations and extensive land areas (Government of India, 2021). According to the Government of India (2020), Uttar Pradesh, Bihar and West Bengal had a population of 199,812,341, 104,099,452 and 91,276,115 in 2011, respectively. As of 2020, the estimated populations in these states are 227,943,000, 121,302,000 and 97,516,000, respectively (Government of India, 2020). Table 1 shows a summary of the test and reference areas.

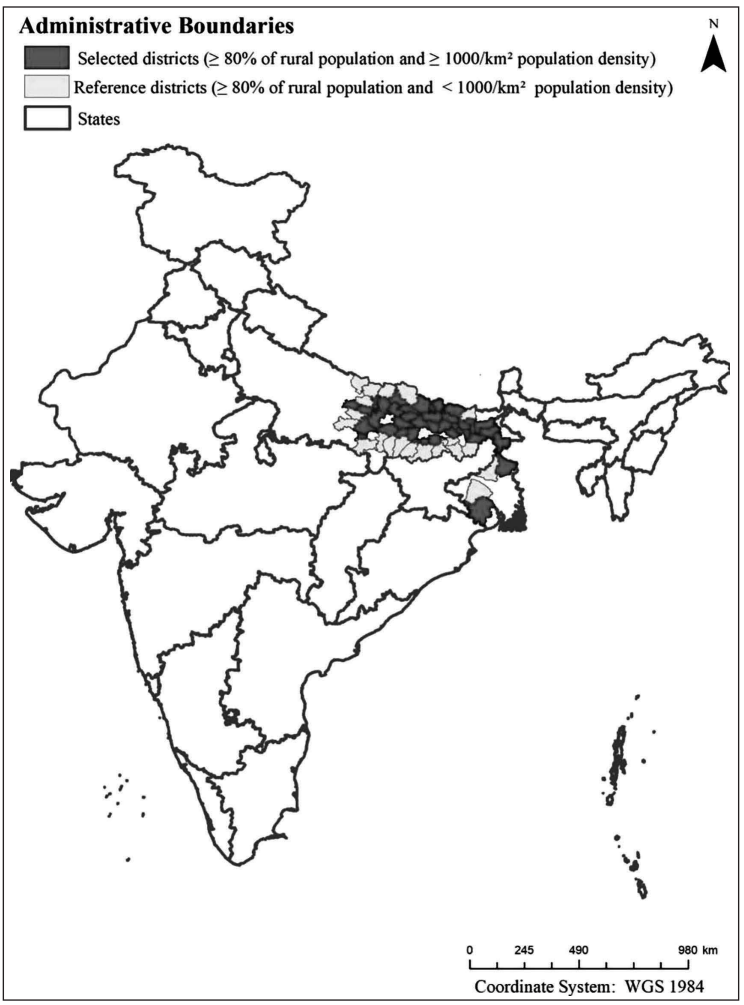

Figure 1. Location of Study Area in India.

Source: DIVA-GIS and ArcGIS® software by Esri.

Methods

The method section includes three steps, as depicted in Figure 3:

1. Deriving focus areas from administrative boundaries.
2. Deriving the land use land cover (LULC) maps of 2000 and 2020 from the GLCLU 2000–2020 dataset.
3. Creating the LULC map of 2010 and assessing classification accuracy.

Collecting Administrative Boundaries and Deriving Focus Areas

We obtained administrative boundaries for India up to the district level by collecting Geographic data from the DIVA-GIS (https://www.diva-gis.org/Data). Then, spatial

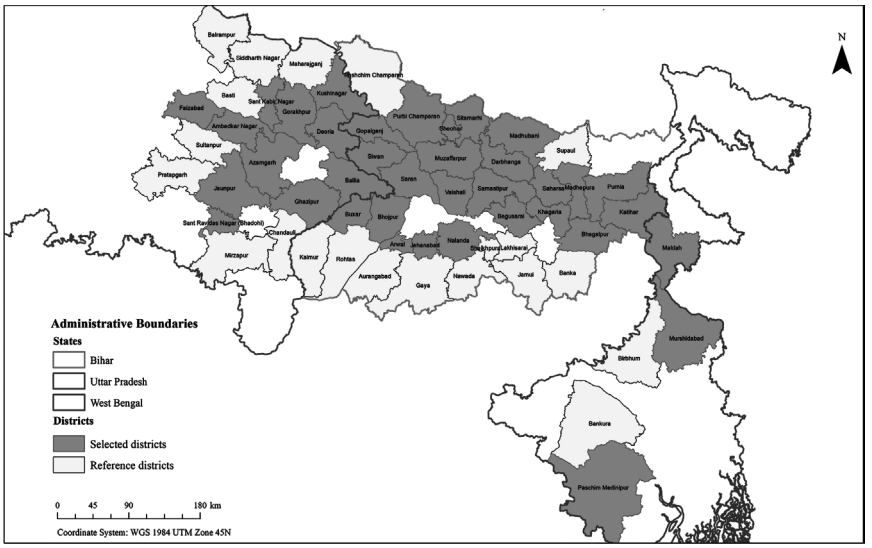

Figure 2. Administrative Boundaries of Test and Reference Districts.

Source: DIVA-GIS and ArcGIS® software by Esri.

Table 1. Attributes of the Test and Reference Areas.

Attribute		Focus Area	
		Test/Studied Districts	Reference/Control Districts
Area (ha)		9,931,864	7,113,690
Number of districts in selected states	Bihar	23	11
	Uttar Pradesh	11	8
	West Bengal	3	2
Rural population		≥80%	≥80%
Population density (per km²)		≥1,000	<1,000

analyses were conducted to categorise the test and reference districts based on the criteria outlined in the study area. The districts in each category were combined to create single layers for test and reference regions. These files were used to extract temporal LULC maps.

Deriving LULC Maps Using the Global Land Cover and Land Use Change Dataset

Downloading LULC maps of 2000 and 2020

We obtained LULC maps for the years 2000 and 2020 from the GLCLU dataset developed by the Global Land Analysis and Discovery Laboratory (GLAD) at the University of Maryland (Potapov et al., 2022). These maps were created using Landsat archive data with a spatial resolution of 1 arc-second per pixel or approximately 30 meters at the equator. The GLCLU data, which consists of 10 × 10-degree granules, is publicly available at https://storage.googleapis.com/earthenginepartners-hansen/GLCLU2000-2020/download.html. This published

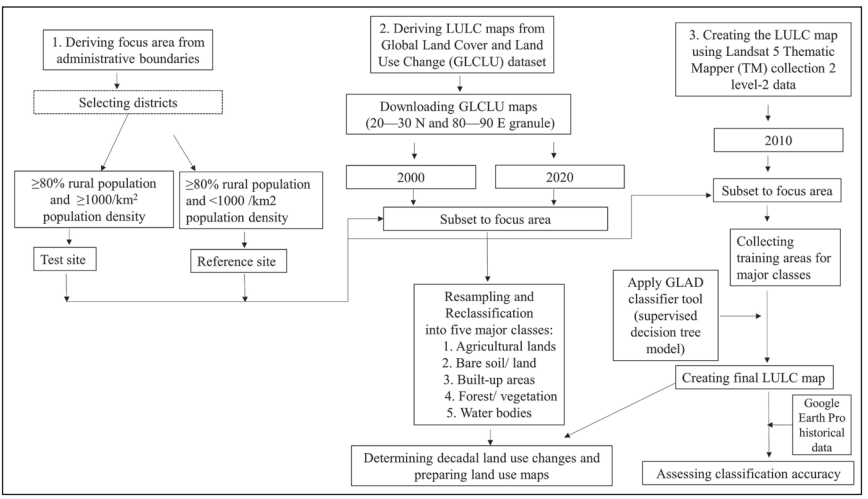

Figure 3. Schematic Diagram of the Method.

GLCLU dataset has been widely used in global land monitoring systems (Tubiello et al., 2023; Yuh et al., 2023; Zhu et al., 2022) and has been created using Landsat Analysis Ready Data (ARD) and machine-learning tools that were locally and regionally calibrated for higher classification accuracy (Potapov et al., 2022).

Furthermore, the dataset has been validated using independently collected reference data, ancillary data from the UN Food and Agricultural Organization, and other global land cover products from the NASA Global Ecosystems Dynamics Investigation (GEDI) service (Potapov et al., 2022; Yuh et al., 2023). Given its high accuracy (above 85%) and availability, we have used this dataset for our analysis.

These GLCLU maps' thematic classes were created using manually collected training data and supervised classification models with machine learning tools, including decision tree models (Potapov et al., 2022). These maps consist of seven primary classes, including forest regions, wetlands, croplands, surface water, built-up areas, snow/ice and ocean, and they were further categorised into 110 subclasses with designated colour codes. Forest areas were defined as regions with trees at least 5 m tall at the Landsat pixel scale. Croplands were land used to produce annual, perennial and herbaceous crops. Pixels that cover more than 50% of the pixels by water were defined as the Water surfaces. Built-up areas were identified as Landsat pixels that include man-made structures or surfaces, including settlements, roads and industrial areas, regardless of whether they are the dominant land cover class of the pixel. Therefore, built-up areas outline the extent of human settlements without distinguishing internal structures, such as impervious surfaces, soil, trees and grasses within the settlements or industrial areas. The complete methodology used to derive and validate GLCLU maps can be found in Potapov et al. (2022).

To conduct our analysis, we downloaded GLCLU data for 2000 and 2020 covering 20–30N and 80–90 E regions. The data was resampled to 30-m spatial resolution and re-projected into Transverse Mercator (UTM) Zone 45 N with the

Table 2. Major Land Use Land Cover Classes.

Land Use Class	Definition Criteria
Agriculture	The land is typically devoted to agricultural practices like farmland and cropland.
Built-up area	Man-made structures and surfaces: Buildings and paved surfaces like roads and airstrips, industrial areas
Bare soil	Dry river beds, land use for brick manufacturing, desert and salt pans (<3% vegetation)
Vegetation/forests	Areas dominated by trees, shrubs, grazing areas, wetlands and grasslands
Water bodies	Rivers, ponds, reservoirs, lakes, canals and irrigation channels

World Geodetic System 1984 (WGS84) datum to match the GIS data and LULC map of 2010.

Reclassifying GLCLU maps

Our previous study (Agrawal et al., 2021) analysed five major LULC classes in three selected districts to achieve the study objectives. In the current study, we maintained consistency with our prior work by analysing the same land use classes, which include agricultural, bare lands, built-up, forest/vegetated areas and water bodies, as defined in Table 2.

There are 110 subclasses in the GLCLU maps. We reclassified these maps to create LULC maps with five major classes, as in Table 2. We have not encountered snow/ice-covered areas or oceans within our study area, two of the major classes in the GLCLU maps. After reclassification, we extracted separate LULC maps for the test and reference regions using GIS data and calculated the area of each class in each region. We then developed a transition matrix to quantify the conversion and changes of each class over the past two decades.

Deriving the 2010 LULC Map and Assessing Classification Accuracy

One of our objectives was to determine the decade with the most land use changes in the focus areas, and to do so, we needed a LULC map for 2010. However, the GLAD GLCLU dataset did not include the 2010 data. Therefore, we created a LULC map using a similar procedure to that used by GLAD.

In order to create a LULC map, we downloaded the cloud-free Landsat 5 Thematic Mapper (TM) Collection-2 Level-2 atmospherically corrected surface reflectance data (30-m spatial resolution) from the USGS EROS data centre (https://earthexplorer.usgs.gov/). These data adhere to the highest geometric and radiometric standards and provide estimates of surface spectral reflectance as it could be measured at the earth's surface without the impact of atmospheric scattering and absorption. To map the area of interest, we downloaded 17 scenes/tiles acquired from January to April 2010, with the path-row[4] coverage ranging from 139—045 to 143—042. We selected the January–April period for the analysis, as it is one of the major crop-growing seasons of the focus area, which aids in enhancing the accuracy of the classification. After downloading the data,

we combined/mosaicked all the scenes into a single image except band 6, typically used for thermal mapping. Then, the mosaicked single image was subset into the focused area, including test and reference areas, using GIS data.

For the image classification, we followed the same procedure used by GLAD to create the GLCLU maps described in the ARD user manual (Potapov et al., 2022). We downloaded the latest version of the GLAD ARD management and application software tools (https://glad.umd.edu/ard/software-download) and open-source software, including PERL, QGIS and the R package, necessary to use the ARD tools. We collected training sites manually, randomly from the focus region, for each land use class listed in Table 2. The GLAD classifier tool (supervised decision tree model) only operates with two land cover classes at a time: A target class that comprises training class pixels and a background class that indicates the likelihood of each pixel being assigned to the target class (https://glad.umd.edu/ard/user-manual). We, therefore, collected two polygon shapefiles for each class and applied supervised decision tree classification for each class using the classification parameter file in the ARD tools. We used the CMD (command line interpreter) to operate GLAD tools and to run the classifier as per the user manual. To create the final LULC map, we combined all the classes into a single layer. Additionally, we developed Normalised Difference Vegetation Index and Normalised Difference Water index maps to verify land uses. After completing the classification, we used the recode function to rectify misclassifications in certain areas. Finally, we calculated the classification accuracy and kappa coefficient using the stratified random sampling method to evaluate how well the classification process worked. We used Google Earth's historical data through the Google Earth Pro desktop version software to obtain reference points to check the validity and develop a classification accuracy assessment. The overall classification accuracy of the map was 90%, and the kappa value was 0.85, indicating a high degree of accuracy in the final LULC map.

Finally, we calculated the areas that have changed over the past 20 years and prepared maps showing land use changes within the study areas. We also analysed the land use changes between 2000 and 2010 and 2010 and 2020 to better understand the trend of changes for reclassifying images and creating a transition matrix. ArcGIS was used to combine classes and develop final maps and accuracy assessments. The QGIS software was used for the training data collection and classification of the 2010 map using ARD tools.

Results and Discussion

Land use land cover maps have shown significant land use land cover changes in the selected districts compared to reference areas (Figure 4 vs 5).

Further analysis of these maps shows some interesting findings related to land use changes in the urural areas in India. We noticed a depletion in vegetation and forest land and a substantial increase in built-up areas most likely used for residential and other land use (Table 3). Also noticeable were tested districts. Vegetation losses were present in both types of districts and of almost similar amounts. The low-density districts have witnessed a slight increase in agricultural land. It is possible that the increase took place at the expense of vegetation and forest lands. Water bodies did not show much difference over the years in both districts.

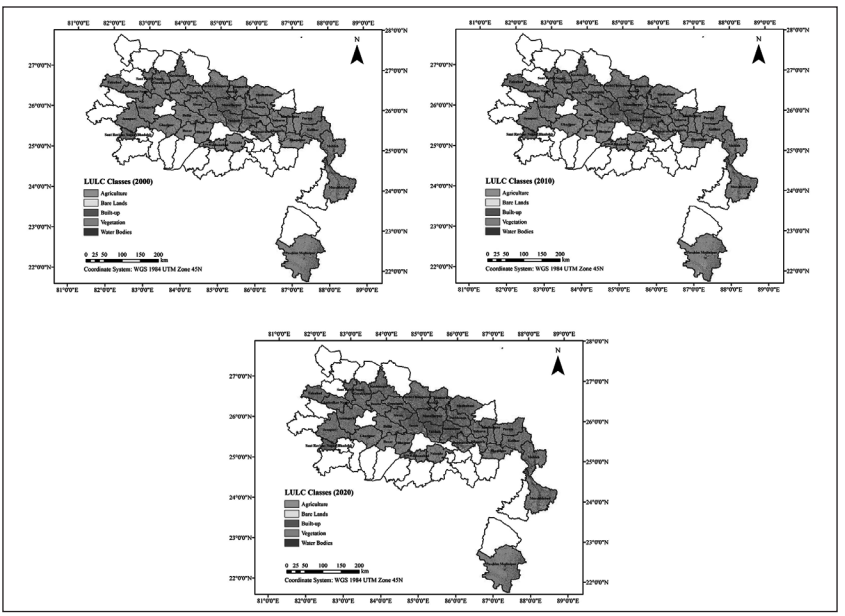

Figure 4. LULC Classes in the Test/ Study Districts in 2000, 2010 and 2020.

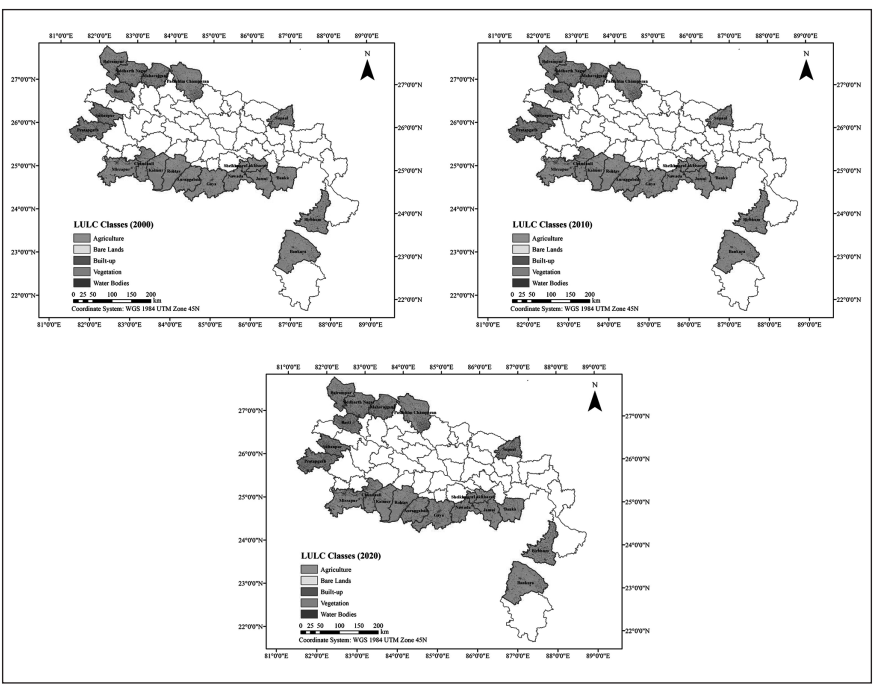

Figure 5. LULC Classes in the Reference Districts in 2000, 2010 and 2020.

Table 3. Land Use Land Cover Changes in Test and Reference Areas.

Test Area: Districts with >80% Rural Population and >1000/km² Population Density							
Land Use	2000 Area (in ha.)	2010 area (in ha)	2020 Area (in ha.)	Difference Within Class 2000–2010 (in ha.)	Difference Within Class 2010–2020 (in ha)	Difference Within Class 2000–2020 (ha)	% Change Across Land Uses
Agriculture	6,904,382	6,659,402	6,677,494	–244,980	18,092	–226,888	–2.28
Bare lands	115,419	113,099	105,529	–2,320	–7,570	–9,890	–0.10
Built-up area	1,160,449	1,494,160	2,022,148	333,711	527,988	861,699	8.68
Vegetation/forest	1,533,110	1,475,460	949,648	–57,650	–525,812	–583,462	–5.87
Water bodies	218,504	189,743	177,044	–28,761	–12,699	–41,460	–0.42
Total	9,931,864	9,931,864	9,931,864				
Reference area: Districts with >80% rural population and <1000/km² population density							
Land Use	2000 area (in ha.)	2010 area (in ha)	2020 area (in ha.)	Difference within class 2000–2010 (in ha.)	Difference within class 2010–2020 (in ha)	Difference within class 2000–2020 (%)	% change across land uses
Agriculture	4,066,427	4,249,510	4,176,904	183,083	–72,606	110,477	1.55
Bare lands	58,744	51065.2	51,370	–7678.8	304.8	–7,374	–0.10
Built-up area	567,432	690,559	911,482	123,127	220,923	344,049	4.84
Vegetation/forest	2,336,207	2037579.1	1,887,074	–298627.9	–150505.1	–449,133	–6.31
Water bodies	84,880	84976.7	86,861	96.7	1884.3	1,981	0.03
Total	7,113,690	7,113,690	7,113,690				

Note: Highlightness indicate land cover changes; red colour to indicate a reduction in particular land cover while the green colour indicates the gained area of some land covers.

Reduced Agricultural Land

Agricultural land has been decreasing since 2001 in urural areas in India (Agrawal et al., 2021). We notice a similar trend in this study as well. However, the net shrinkage in the agricultural land is not as pronounced as was noticed in our previous study. However, the loss over 20 years is about 2.28%, much of which was between 2000 and 2010. Furthermore, we also notice that the 2010–2020 period showed a slight increase in agricultural land, which masked some of the losses that occurred in the previous decade. This may be due to the fast upsurge in a new development in the past decade, largely meant for residential and transportation uses, which consumed a large portion of the agricultural land (see similar findings by Zhilong et al., 2017). Other factors responsible for the slight increase in cropland in the last decade are removing vegetation, uprooting trees and destroying forest land to pave the way for farming (also confirmed by Reddy et al., 2016 in a smaller study). Changing rainfall patterns due to climate change might also have been a factor (Meer & Mishra, 2020), a phenomenon often witnessed in similar conditions in different geographical contexts in India.

Much of the agricultural lands were converted into built-up areas because of the population pressure and the need for people to house themselves. The population increased by almost 30% in the test area, while the average density increased from 1,018 to 1,341 persons per square kilometre. Between 2000 and 2020, we noticed that 8.76% of agricultural land turned into built-up areas in the test area, while 27.32% of vegetation and forest were cut down and 33.2% of water bodies were drained out to convert the land for agricultural use (Table 4). The overall percentage increase in conversion from agricultural land to built-up is almost 10%. The districts that exhibited the highest increase in built-up areas (mainly converting agricultural areas to built-up) were located just north of Patna district in Bihar, particularly in five districts—Vaishali, Saran, Siwan, Samastipur and Muzaffarpur.

The test area showed a specific trend of land conversion: Agricultural areas were initially turned into built-up areas (6.17%), followed by the conversion of forest areas (5.26%) to gain more cropland. Opposite trends were observed for the reference area: Initially, forest areas were converted into agricultural areas, followed by a conversion of some agricultural areas into built-up areas. This trend in the reference area can be partly because the area has had more vegetation/forest cover than the test area.

In urural areas, between 2000 and 2020, 27.32% of vegetation and forest lands were uprooted to use the land to grow crops. In total, 36.48% of bare lands were used for agricultural purposes and 33.2% of water bodies were converted into croplands.

Agrawal et al. (2021) previously showed that agricultural land also turns into bare land. The study attributed it to an increase in brick kiln industries that manufacture bricks to meet the demands for building construction in nearby towns or cities or within rural areas. In this study, we did notice instances of bare land in the proximity of urban areas such as Patna and other cities and towns in

Table 4. Transition Matrix of LULC Area (ha) in Test and Reference Areas.

Test Area: Districts with >80% Rural Population and >1000/km² Population Density							
		2020					
2000	LULC class	Agriculture	Bare lands	Built-up area	Vegetation/forest	Water bodies	Total 2000
	Agriculture	6,100,600 (88.36%)	23,804 (0.34%)	604,539 (8.76%)	140,804 (2.04%)	34,635 (0.50%)	**6,904,382**
	Bare lands	42,105 (36.48%)	24,351 (21.10%)	5,190 (4.50%)	15,592 (13.51%)	28,182 (24.42%)	**115,419**
	Built-up area	43,378 (3.74%)	885 (0.08%)	1,093,720 (94.25%)	21,504 (1.85%)	962 (0.08%)	**1,160,449**
	Vegetation/forest	418,860 (27.32%)	22,718 (1.48%)	311,320 (20.31%)	753,164 (49.13%)	27,047 (1.76%)	**1,533,110**
	Water bodies	72,551 (33.20%)	33,771 (15.46%)	7,380 (3.38%)	18,584 (8.51%)	86,219 (39.46%)	**218,504**
	Total 2020	**6,677,494**	**105,529**	**2,022,148**	**949,648**	**177,044**	**9,931,864**
Reference area: Districts with >80% rural population and <1000/km² population density							
		2020					
2000	LULC class	Agriculture	Bare lands	Built-up area	Vegetation/forest	Water bodies	Total 2000
	Agriculture	3,714,580 (91.35%)	5,637 (0.14%)	217,955 (5.36%)	121,640 (2.99%)	6,616 (0.16%)	**4,066,427**
	Bare lands	14,653 (24.94%)	12,236 (20.83%)	1,681 (2.86%)	15,059 (25.63%)	15,116 (25.73%)	**58,744**
	Built-up area	30,488 (5.37%)	568 (0.10%)	522,131 (92.02%)	13,404 (2.36%)	842 (0.15%)	**567,432**
	Vegetation/forest	400,447 (17.14%)	22,370 (0.96%)	168,019 (7.19%)	1,725,250 (73.85%)	20,121 (0.86%)	**2,336,207**
	Water bodies	16,737 (19.72%)	10,560 (12.44%)	1,696 (2.0%)	11,722 (13.81%)	44,166 (52.03%)	**84,880**
	Total 2020	**4,176,904**	**51,370**	**911,482**	**1,887,074**	**86,861**	**7,113,690**

Note: Bold colour indicate the total land cover area for each land cover.

the vicinity. However, they were not significant, given the extent of the geographic area we were examining in this research.

Sinha et al. (2017) present similar findings confirming the loss of agricultural lands in Bihar and rising shrinkage in the agriculture-led area as a critical concern for sustaining food security for the ever-increasing population. Mondal and Mandal (2018) also confirm the loss of agricultural lands in West Bengal state and attribute the loss to bank erosion processes caused by the dynamicity of the river Ganga (also see Hazarika et al., 2015 study with similar findings in the upper Brahmaputra plain of India).

The transformation of agricultural lands into other land uses can have important long-term implications for sustainable livelihood, forced internal migration (Mondal & Mandal, 2018), and food security of rural communities. These issues are further exacerbated by existing economic and social barriers (Gaur & Squires, 2020; Vidyarthi et al., 2017). Some critical implications of rural agricultural land depletion that arise from these changes are reduced cultivable land, exacerbated land values, increased non-farm activities, changing cropping patterns and farming practices, and imposed food insecurity challenges.

Increased Built-up Areas

Of 58 districts, 37 with the highest population density are experiencing a rapid rise in built-up areas. Between 2000 and 2020, the built-up areas have increased by 604,539 ha, that is, 8.7% of the total agricultural area. In the same period, however, the reference area, consisting of 22 districts, experienced a 5.36% increase in built-up area, considerably less than that of the test area. The differences here illustrate how unique the concern is in urural areas.

Over the two decades, 20.31% of vegetation and forest lands were paved. These changes are likely a response to the needs of the growing population and their associated demands, leading to the consumption of other land uses (especially agricultural land, forested areas and depleting wetlands), as these demands are wide-ranging: Home construction and related physical infrastructures (e.g., roads, bridges and railroads); amenities and healthcare systems (e.g., schools and hospitals); service sectors; and businesses. As a result, built-up areas have been increasing rapidly. The reference area also shows decreased vegetation, forests, waterbodies, bare lands and conversion into agricultural areas. Regarding size, a similar amount of vegetation and forests were cut down in both test and reference areas.

Salghuna et al. (2018), in their study in the Krishna district of Andhra Pradesh, attributed the increase in built-up land use there to necessary accommodations for population growth, mainly due to the construction of the new capital city of Telangana-Amravati. They also pointed to excessive mining and logging of the forests as additional contributing factors. The effects of such changes are profound, including changes in the biodiversity of the region as well as adverse effects on ecosystem services (Rimal et al., 2019; Talukdar et al., 2020). Other scholars also highlight that increasing built-up areas contributes to the destruction of forest areas, as Rahaman et al. (2020) demonstrated in their study of land use and land cover changes in the Barddhaman district in West Bengal, India. Rapid increases

in built-up areas, often at the cost of forest and vegetation areas, result in increased ecological disturbances, micro-climatic conditions and long-term threats to the ecosystem (Prasad & Ramesh, 2019; Salghuna et al., 2018). Although the growth dynamics of our study areas' predominantly rural character may differ, these areas all reflect the intense trade-offs between economic growth and ecological conservation.

Depleting Vegetation and Forest Areas

In the Indian Subcontinent, deforestation is generally linked to population growth as it requires more land for people (Zhilong et al., 2017). Environmental factors, climate change and forest (mis)management also play a role in deforestation (Reddy et al., 2016; Roy, 2014). Population growth and the subsequent agricultural expansion are the two top driving forces behind deforestation (Baidya et al., 2020; Geist & Lambin, 2002). As Table 4 shows, vegetation or forested areas have decreased by 6% in the test area between 2000 and 2020. Interestingly, low-density districts also showed a similar reduction in the same period. In the test area, 20.31% of vegetation and forest land turned into built-up areas, and 27.32% were cleared for farmlands. In low-density districts, a larger proportion, 17.14%, went towards agricultural land, while 7.19% was taken over to expand newer development. Deforestation increased tenfold between 2010 and 2020 compared to the previous decade.

The population increase is likely one of the dominant factors for decreasing forest land use, as percentages of built-up areas have increased to accommodate more people (Zhilong et al., 2017). Of note, the population growth rate between 2000 and 2020[5] in the test area was about 30% (Government of India, 2020), with the Madhepura, Khagaria and Purbi Champaran districts topping the list with over 50% increase in population, while several other districts in Bihar are not too far away. However, detailed ground truthing information may be required to confirm the large-scale deforestation we have detected with the Landsat imagery.

Findings from similar studies in other districts in India by Roy (2014) and Reddy et al. (2016) suggest that forest land depletion is likely due not only to population growth but also to the lack of national-, state- or local-level policy tools for monitoring and conserving forest lands. Salghuna et al.'s (2018) Andhra Pradesh study shows that government policies regarding forest conservation are inconsistent. A few critics contend that recently passed amendments to the 1980 Forest Conservation Act will likely increase the destruction of forest lands (Gupta, 2023).

In sum, built-up areas are marked as one of the major expansions in the rural areas in both test and reference areas. Agricultural land areas and vegetation cover have decreased significantly to accommodate housing and the affiliated needs of the growing population. The type of land use under pressure for urban development may vary, as does the conversion sequence. For instance, in the test area, agricultural areas were initially turned into built-up areas, followed by the conversion of forests (5.26%) to gain more cropland. Opposite trends were observed in the reference area: Initially, forest areas were converted into

agricultural areas, followed by a conversion of some agricultural areas into built-up areas. Such dynamicity in land use and land cover changes may be a combination of rapidly changing densities, migration flows and policy changes (see previous studies by Agrawal et al., 2021; Vidyarthi et al., 2017).

These are alarming trends in the high-growth and high-density rural districts as they portend the possibility of a looming crisis in food supplies, insufficient availability of potable water and decreasing forest cover. The scarcity of such necessities of life is already leading to abject poverty, high unemployment and social conflicts; it is also forcing people to migrate out of the area (Vidyarthi et al., 2017). These changes should be of major concern to the state and national policymakers and government officials. The situation warrants a stricter implementation of agricultural land conversion laws, coupled with strategic management of natural resources, that will place a check on expanding built-up areas and brick-manufacturing activities, as well as establish better employment and incentives for farmers (such as PM-Kisan scheme[6], expanded MNREGA, and/or other forms of subsidies) to remain in farming activities, and thus reduce rural to urban migration.

Conclusion

Our study objective was to track spatiotemporal changes in urural areas across India. We used the *Global Land Cover and Land Use Change* dataset to confirm the hypothesis that land uses are continuously changing due to high population growth and density in rural districts in India. The study findings demonstrate significant changes in land use patterns observed over the last two decades, particularly in the last decade in the test area, which consists of predominantly rural districts with high density and population. Almost all changes, such as an increase in built-up areas, a reduction in agricultural lands and depletion in vegetative cover and water bodies, were significant in the test area when compared with the reference area. This means that high population density, combined with population pressure in remote rural regions, is leading to significant land use transformations, essentially turning them into areas with urban characteristics.

Such urural areas are the new frontier in rural and regional planning in India. Barring some progress in educational facilities and improvements in road connectivity, other forms of physical and social infrastructure and services are not commensurate with the urban characteristics of these villages—especially their population, density and land use changes (Vidyarthi et al., 2017). The spatial and socio-economic characteristics of these areas are close to those described in Ginsburg et al.'s (1991) extended metropolis or even McGee's (1991) desakota concept, especially concerning these features: The rural nature of these landscapes, which also reveal shifting land uses; the non-agricultural economy; the improving connectivity; and the dense, but also migratory, population. However, as noted earlier, urural areas are remote and far from any metropolitan zone of influence.

Two possible explanations, also hypothesised in Agrawal et al. (2021), would account for similarities in the spatial and socio-economic characters of urural

areas and those of extended metropolises or desakota regions. Either the metropolitan influence transcends far beyond what we have traditionally understood, or these characteristics appear despite the absence of a nearby metropolitan area. Such appearances may also arise because of rapidly diversifying and interconnected rural–urban economies and an ever-improving transportation system beyond a metropolitan area, allowing people to traverse much longer distances in short amounts of time.

The findings of this study further suggest that urural areas need several urban amenities (such as water, drainage, sanitation and healthcare) because they face unprecedented population density and economic pressures that are often going under noticed from a policy perspective. Increased disputes and public encroachments might result from population density pressures on land and a lack of public resources. The formal governance system in India needs to urgently recognise the reality of these zones of intense rural-urban interaction and direct investment in these underserved areas.

This study could help the Government of India's rural programs such as the National Rurban Mission, which has two specific goals: To stimulate local economic development and to enhance basic urban services in rurban clusters. Interestingly, land use changes are not a factor that was invoked to identify rurban clusters. Therefore, the study methods used here could be applied to the hundred or so identified clusters, along with other factors, to prioritise those in dire straits and, thus, most in need of urgent attention. In addition, the study can help stimulate discussion on categorising urban, rural, rurban and the presented 'urural' regions and formulate appropriate land use policies based on the local issues in each category.

Employing remote sensing data to ascertain land use changes is useful. However, a more extensive and significantly more in-depth study is needed to better understand the dynamics affecting the change of land use and other characteristics in remote rural areas such as Bangladesh, China and Pakistan. Further investigation is also necessary to identify other major factors affecting the loss of fertile agricultural land in such countries. Higher-resolution satellite imagery coupled with more detailed ground-truthing through field checks and qualitative interviews with the locals could further ascertain the details of changes and the factors affecting them.

Notes

1. The census of 2011 is the most recent census available for India.
2. MGNREGA refers to the Mahatma Gandhi National Rural Employment Guarantee Act of 2005. The act aims at enhancing the economic security of people in rural areas by guaranteeing 100 days of wage employment in a financial year to rural households whose adult members volunteer to do unskilled manual work.
3. The Landsat program is the longest-running enterprise for acquisition of satellite imagery of Earth. The most recent, Landsat 9, was launched on 27 September 2021. The instruments on the Landsat satellites have acquired millions of images.
4. The path-row is a part of the Worldwide Reference System, which enables a user to inquire about satellite imagery over any portion of the world by specifying a nominal scene center, designated by Path and Row numbers.

5. 2001 population data were obtained from Supplement of Paper 1 of Census 2001, Registrar General of India, Government of India (Government of India, 2023) and 2020 population projections were obtained using Population Projections for India 2011–2036 files that were provided by the Registrar General of India form the basis for planning and implementing various health interventions available at https://main.mohfw.gov.in/sites/default/files/PopulationProjectionReport2011-2036-upload_compressed_0.pdf.

Declaration of Conflicting Interests

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Article

Groundwater Practices and Vulnerability at a Pocket of the Northwest Region of Bangladesh: A Study Based on Social and Hydrogeological Factors

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Abstract

The combined effects of climate change and anthropogenic factors are causing the depletion of the groundwater level in the Northwest region of Bangladesh, leading to the rise of socio-economic stress among the rural marginalised communities. This research aims to assess the current water practices by identifying the changes in water supply sources and associated socio-economic stress to rural marginalised communities. Both social and hydrogeological factors have been taken into consideration for vulnerability assessment. The social factors are (a) percentage of indigenous households, (b) percentage of poor households, (c) percentage using unhygienic water sources and (d) percentage of households having water scarcity. On the other hand, the hydrogeological factors are (a) depth of topsoil, (b) elevation, (c) stream density, (d) slope of the elevation, (e) land use and (f) soil. The geospatial-based weighted linear combination technique combines all the social and hydrogeological factors. The resultant areas are characterised by five categories: very low to very high vulnerability. According to social and hydrogeological factors, Sapahar, Tilna, Dibar, Sihara and Nirmail unions are in the most vulnerable zone.

Keywords

Depletion of groundwater, hydrogeological factors, social factors, marginalised communities, vulnerability, Northwest region of Bangladesh

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Introduction

Many streams that feed into the Ganges River convert from perennial to seasonal, thus limiting stream water flow in non-monsoon periods. This is due to the combined effect of climate change (delaying and shortening monsoons) and anthropogenic factors (mismanagement of water resources). As a result, the groundwater levels in the Ganges basin are falling sharply (Mukherjee et al., 2018). To determine the effects of anthropogenic factors on groundwater depletion, Siddik et al. (2022) assessed the impact of anthropogenic factors on groundwater recharge potentiality by determining the effects of land use changes on groundwater recharge. Datta et al. (2022) studied the urbanisation effcts on the water quality of semi urban area of Chattogram City. In addition to over-extraction, due to the hydrogeological and climatic factors, the groundwater recharge rate is very low with respect to groundwater abstraction. Priya et al. (2022) estimated the recharge potential rate to be 60 mm/year, which was determined using field observation and numerical modelling.

Several factors affect the recharge potential of groundwater in the Northwest Region of Bangladesh. These include topography, land use and precipitation. Studies have shown that areas with higher elevations and lower levels of land use tend to have higher recharge potential. Additionally, areas with higher precipitation tend to have higher recharge potential (Kabir et al., 2016). Ahmed et al. (2021) developed a spatio-temporal groundwater method for determining vulnerability, considering 18 factors, including six climatic factors. Adham et al. (2010) determined the recharge potential on the whole Barind Tract using the weighted linear combination (WLC) method. Nowreen et al. (2021) developed a potential map for groundwater abstraction using WLC and Water table fluctuation techniques.

Groundwater depletion is a major environmental issue in the Northwest Region of Bangladesh. This region is predominantly agricultural and farmers rely heavily on extracting groundwater. Farmers in this region also struggle to provide adequate water for crop production, which results in reduced yield, ultimately affecting the local farmers. There are some studies on the sustainability of the cropping pattern. Alauddin et al. (2020) recommended alternative wetting and drying irrigation methods to reduce wastage. Dey et al. (2017) recommended completing Boro rice cultivation by November. Institute of Water Modelling (IWM) (2006) suggested crop diversification with less water-consuming crops for the area.

The depletion of groundwater has led to several adverse impacts on the environment and people's livelihoods. This results in increasing water scarcity for drinking and domestic purposes. The Bangladesh government has recognised the severity of the groundwater depletion issue in the region and has taken several steps to address the problem. For example, the government has recommended rainwater harvesting, surface water irrigation and the introduction of more efficient irrigation systems that use less water. The government promoted more sustainable use of the groundwater, and different organisations like Barind Multipurpose Development Authority (BMDA), Department of Public Health Engineering (DPHE) and NGOs use various schemes to provide water to the locals. Despite the development conducted by other organisations, few studies

have been done to assess the current water practices and associated socio-economic stress due to water scarcity.

This study aims to address the current water practices and determine the vulnerable area, which incorporates not only physical factors (e.g., geology, hydrology, climate and distance to wells) but also social (e.g., representation of and near to marginalised community wells) and economic factors (e.g., procuring land, mobilisation of village communities). Village surveys have been conducted to produce social-economic inputs to the maps. High-resolution free satellite imagery has been used to identify key locations based on physical factors.

Study Area and Background

Sapahar & Patnitala Upazilla of Naogaon district is situated in the Northwest Region of Bangladesh. The total area is about 3,626 km^2 and the population is about 435,522 (Bangladesh Bureau of Statistics, 2022 census). Sapahar & Patnitala consists of around 17 unions, which has been provided in Figure 1. A digital elevation model (DEM) of 30 m resolution was collected from SRTM to define the topography of the

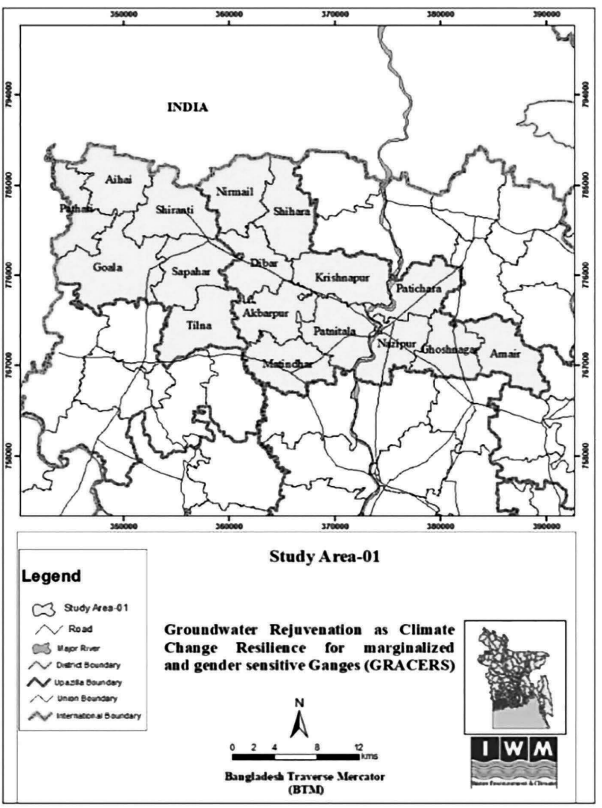

Figure 1. Study Area.
Data Source: IWM

study area. The elevation of the study area is plain in the eastern part, dissected and undulating in the western part. Elevation of the area varies from 9.00 m PWD to 47.0 m PWD in the study area.

The Atrai and the Punorbhaba are the major rivers that carry the most drainage water in the study area 01. Because of these and several small rivers, the study area appears well-drained. Also, there is a huge low-lying area (Joboi Beel) in the Aihai Union. The area is not subject to flooding during normal years of rainfall.

Climate

According to the temperature data from the Bangladesh Meteorological Department (Figure 2), the highest temperature occurs in April, about 35.7°C, and the lowest temperature is in January, about 24.5°C. The annual average rainfall is about 1,500 mm, collected by Bangladesh Water Development Board (BWDB). The highest rainfall occurs in July, and the highest temperature occurs from March to May. On the other hand, annual evaporation in the study area is about 897 mm from 1971 to 2018.

Hydro-stratigraphic Cross Section

Litholog data has been collected from relevant sources like DPHE and BWDB to identify the aquifer's horizontal and vertical layers. Five hydro-stratigraphic cross-sections traversing the study area's N–S and E–W directions have been generated (Figures 3 and 4). Considering lithological variations and groundwater flow capacity, the study area's hydro-stratigraphic units have been defined as Clay Top, Upper Aquifer, Clay Middle, Lower Aquifer and Clay Bottom.

The top clay layer ranges from 20 to 80 m in the study area. The upper and lower aquifers are often interconnected, as the clay layer in the middle is disconnected.

Groundwater Depletion

Groundwater level hydrograph from the BWDB groundwater station data from 2000 to 2016 shows a declining trend of groundwater for all the

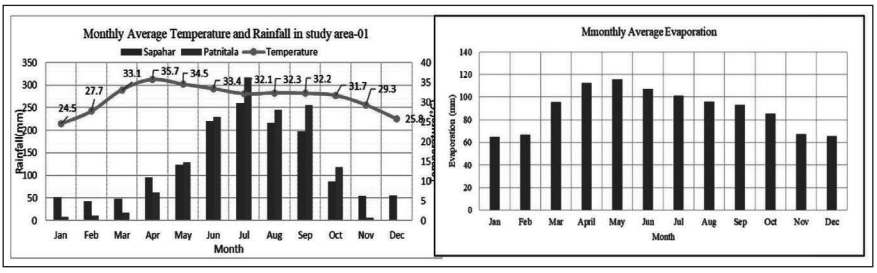

Figure 2. Climate of the Study Area.

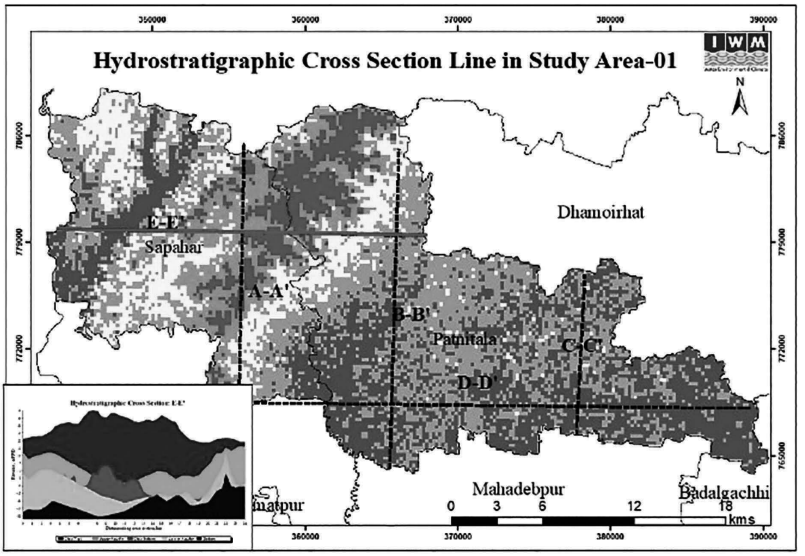

Figure 3. Hydro-stratigraphic Cross Section Line of the Study Area.

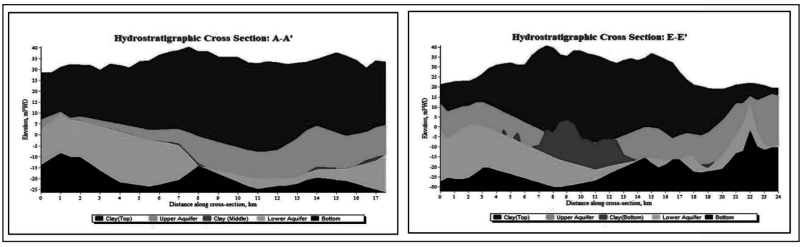

Figure 4. Hydro-stratigraphic Cross Section at Section A-A'(left) and E-E'(right).

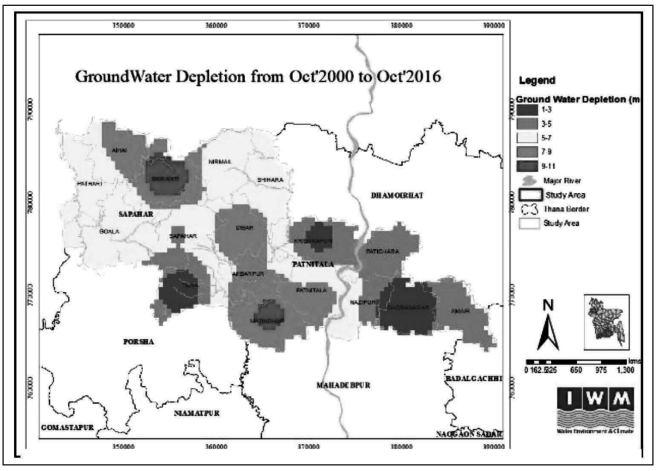

Figure 5. GWL Depletion.

groundwater stations in the study area, indicating the lack of recharge and increasing extraction from the groundwater. The GWL has been depleted up to 11 m in Shiranti and Matindhar within 16 years (0.69 m/year). In most areas, the depletion is about 5–7 m. The spatial distribution of groundwater depletion is provided in Figure 5.

The seasonal data shows that the lowest peak of the GWL occurs in April–May and the highest peak in September/October. As the abstraction increases in the dry season, the GWL begins to decrease, and it again increases in May due to the rainfall in the monsoon period.

Current Water Sources in the Sapahar and Patnitala

Sapahar and Patnitala of Naogaon district have been facing water scarcity for a long time due to their geological conditions. According to their geological aspects, different governmental organisations have taken different schemes to overcome water woes in Sapahar and Patnitala. However, many poor people, predominantly indigenous, isolated communities, are still deprived of these facilities. The social survey has been done to understand water-related misery and water use. Here, some of the water sources have been described.

Dug Well

BMDA has installed a dug well in areas where tubewell installation is not possible because of the unavailability of the aquifer. The dug well that BMDA has installed has two structures (Figure 6). They are solar panel structures and overhead tank structures. The water is stored in an overhead storage tank with a minimum of 2,000 L capacity. The overhead tank is situated 5,000–5,500 mm above the land surface. A truss structure stabilises the overhead tank platform. The power needed to carry the water into the overhead tank comes from solar energy. In the panel structure, there are 16 solar panels with a voltage of 650 V. The water is carried to the outlet from the overhead storage tank, which has a capacity of 2 L per second. This well is constructed for vegetation and communal use. The Schematic Diagram of the Dug Well is provided in Figure 7.

Sapahar, Tilna in Sapahar Upazilla and Nirmail, Sihara, Dibar in Patnitala Upazilla has the highest number of dug wells. Union-wise distribution is given in Table 1.

Deep Tubewell

In addition to the dug well, BMDA also installed several deep tubewells. Due to the depletion of GWL, the shallow water tubewells have become obsolete. Therefore, the number of deep tube wells is higher than other water sources. The union-wise distribution of DTW installed by BMDA is given in Table 2.

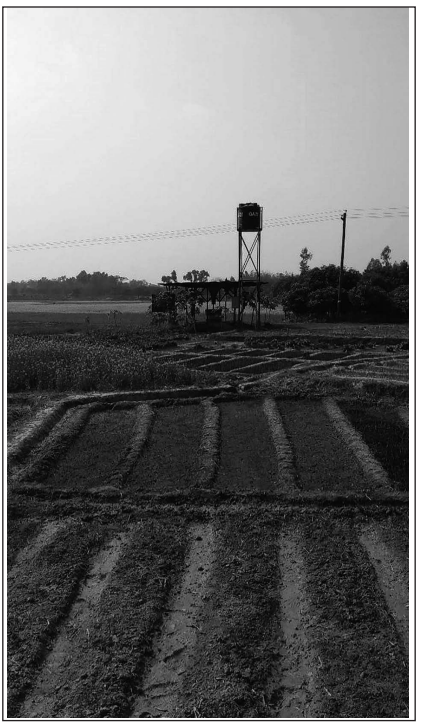

Figure 6. Dug Well Installed by BMDA.

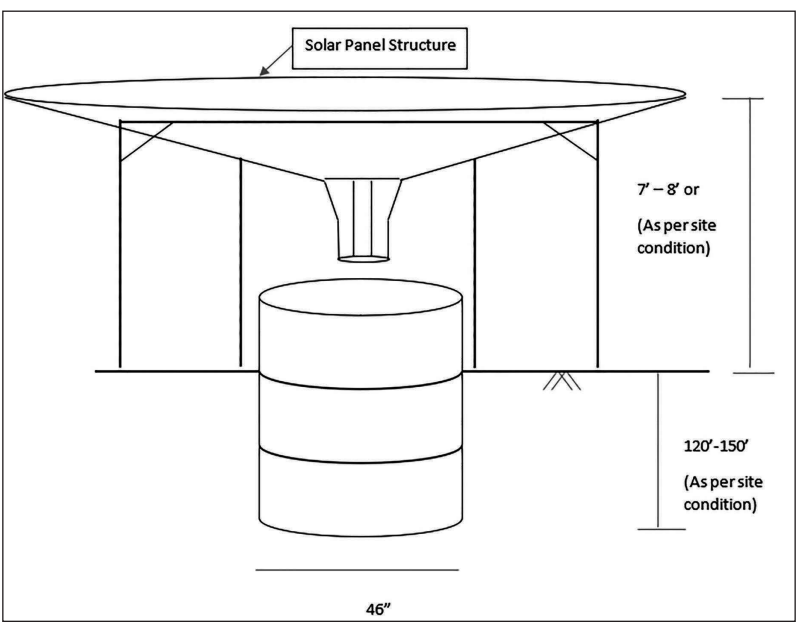

Figure 7. Schematic Diagram of Dug Well.

Table 1. Union-wise Distribution of Dug Well Installed by BMDA.

SL. No.	Upazilla	Union	Dug Well
1	Sapahar	Sapahar	49
2		Tilna	42
3		Goala	16
4		Siranti	0
5		Aihai	0
6		Patari	0
7	Patnitala	Nirmail	43
8		Dibar	24
9		Patichora	4
10		Patnitala	2
11		Akbarpur	0
12		Matiandor	0
13		Krishnopur	0
14		Amair	0
15		Ghoshnagar	0
16		Nazipur	0
17		Sihara	0

Table 2. Union-wise Distribution of DTW Installed by BMDA.

SL. No.	Upazilla	Union	No.
1	Sapahar	Sapahar	55
2		Tilna	50
3		Goala	42
4		Siranti	40
5		Aihai	20
6		Pathari	3
7	Patnitala	Akbarpur	75
8		Matiandor	72
9		Krishnopur	65
10		Patnitala	44
11		Amair	42
12		Ghoshnagar	40
13		Patichora	33
14		Dibar	20
15		Nazipur	17
16		Nirmail	16
17		Sihara	15

Figure 8. Submersible Pump Installed by DPHE.

Submersible Tubewell

DPHE has also installed submersible pumps for drinking purposes only. These Pumps have been installed under several projects, such as PRWSP (Preferential Rural Water Supply Project), CBWSP (Community-based Water Supply Project) and PEDP4 (Primary Education Development Project) (Figure 8). Table 3 gives the union-wise distribution of submersible pumps.

The depth of the submersible pump varies between 150 and 160 ft, depending on site conditions. The pump collects water and stores it in a 3,000 L overhead tank elevated 17 ft from the ground by an RCC column. An auto controller is installed at the pump to stop the pump automatically in case the tank is overloaded. Though it helps reduce water wastage, this process lessens the pump's longevity, repeatedly turning it on and off.

Khash Pond

Some khash ponds, along with tubewells and dug wells, are sometimes used for domestic water resources. Table 4 shows the distributions of khash ponds by union.

Table 3. Union-wise Distribution of Submersible Pump Installed by DPHE.

SL. No.	Upazilla	Union	Total No. of Submersible Pump
1	Sapahar	Sapahar	30
2		Goala	19
3		Tilna	24
4		Aihai	24
5		Patari	11
6		Siranti	21
7	Patnitala	Nazipur	4
8		Patichara	2
9		Amair	3
10		Ghoshnagar	8
11		Patnitala	5
12		Krishnopur	3
13		Akbarpur	7
14		Matindhar	7
15		Dibar	18
16		Sihara	17
17		Nirmail	16

Table 4. Union-wise Distribution of Khash Pond.

SL. No.	Upazilla	Union	No. of Khash Pond
1	Sapahar	Sapahar	214
2		Tilna	105
3		Shiranti	117
4		Goala	201
5		Aihai	315
6		Patari	64
1	Patnitala	Krishnapur	64
2		Patnitala	52
3		Akbarpur	84
4		Patnitala	61
5		Ghoshnagar	33
6		Amair	43
7		Nazipur	54
8		Patichara	38
9		Dibar	131
10		Sihara	168
11		Nirmail	134

Table 5. Union-wise Distribution of other Drinking Source Installed by DPHE.

SL. No.	Upazilla	Union	Shallow Tube-well	#6 Tara Tube-well	#2 Tara Tube-well	Deep Tara Tube-well	Conventional Deep-set Tubewell	Ring Well with Tara Pump
1	Sapahar	Sapahar	0	30	0	0	0	9
2		Goala	0	130	0	0	0	4
3		Tilna	5	50	0	0	0	8
4		Aihai	0	80	0	0	0	0
5		Patari	20	90	0	0	0	0
6		Siranti	0	95	0	0	0	5
1	Patnitala	Nazipur	216	95	0	0	2	0
2		Patichara	127	113	0	0	0	0
3		Amair	157	78	0	0	0	0
4		Ghosh-nagar	159	101	0	0	0	0
5		Patnitala	105	204	10	0	0	0
6		Krishno-pur	143	125	9	0	0	0
7		Akbarpur	87	182	14	0	0	0
8		Matind-har	87	159	10	0	0	0
9		Dibar	34	252	15	0	0	16
10		Sihara	35	184	12	0	1	22
11		Nirmail	6	183	17	0	1	23

Other drinking sources: DPHE installs several water sources. Due to the depletion of GWL, water cannot be extracted with shallow tubewells, as the groundwater level is decreasing. The depth of a shallow tubewell is 30–50 ft.

DPHE has installed the #2 Tara tubewell, which has been proven to be less convenient as it relies entirely on mechanical energy. Therefore, more energy is needed to draw groundwater. Then DPHE modified the #2 Tara tubewell into #6 Tara tubewell. The conventional deepest tubewell is no longer active. It is a dug well that has a head of a hand tubewell (Table 5).

Socio-economic Stress Due to Poor Groundwater Quality and Quantity

Despite the installation of several water resources by different government organisations and NGOs, the rural people in some regions are still affected. The depletion of GWL and water scarcity has caused severe implications for the local populations, especially among the rural communities, including indigenous, isolated

people. Water access is limited to a nearby school and wealthy neighbouring families due to the absence of privatised water sources. Water collection requires up to 2 hours, often involving children, ultimately impeding their education.

Furthermore, livestock are negatively impacted by the lack of water in the dry seasons, reducing rural communities' economic benefits. The nature of cultivation has altered as well, with mango gardening replacing paddy and vegetable cultivation and grasslands. Mango gardening not only requires less labour but also generates higher profits. The landowners get an annual lease of at least 25,000 Taka, two to three times more profitable than before. This shift in cultivation becomes beneficial for landowners even though marginalised, indigenous and poor people are economically affected. In the dry season, insufficient water causes dehydration in infants and young children susceptible to diseases.

Vulnerability Assessment

Several social parameters and hydrogeological factors have been considered to assess the study area's vulnerability. The social indicators collected from the social survey are described below.

Vulnerability According to the Social Indicators

The focus area of the study is vulnerable communities. The most vulnerable populations affected by the falling groundwater table are the marginalised (economically weak, tribal and isolated communities) and women (as they are entrusted to secure drinking water for households)—the approach to understanding this vulnerability involves collecting and analysing primary and secondary data. Primary data were collected by field survey; secondary data were obtained from BBS Census Data, 2011, and local union offices. The research methodology involves key informant interviews with local government officials, Union Chairmen, and Members to identify vulnerable villages. The severity of water scarcity is categorised into five levels ranging from very low to very high. Four focus group discussions were conducted in the selected vulnerable villages, and the GPS coordinates of the consultation locations were recorded for geospatial analysis.

The vulnerability assessment was based on four indicators, including the percentage of poor households (PH), the percentage of indigenous households (IH), the percentage of villages with scarcity impact, and the percentage of households using unhygienic water sources (UWH). The resulting data were subjected to geographic information system (GIS) processing. The methodology is provided in Figure 9.

Social Indicators

Percentage of IH

The percentage of IH was determined by using the total number of households of marginal people and divided by the total number of households of that union.

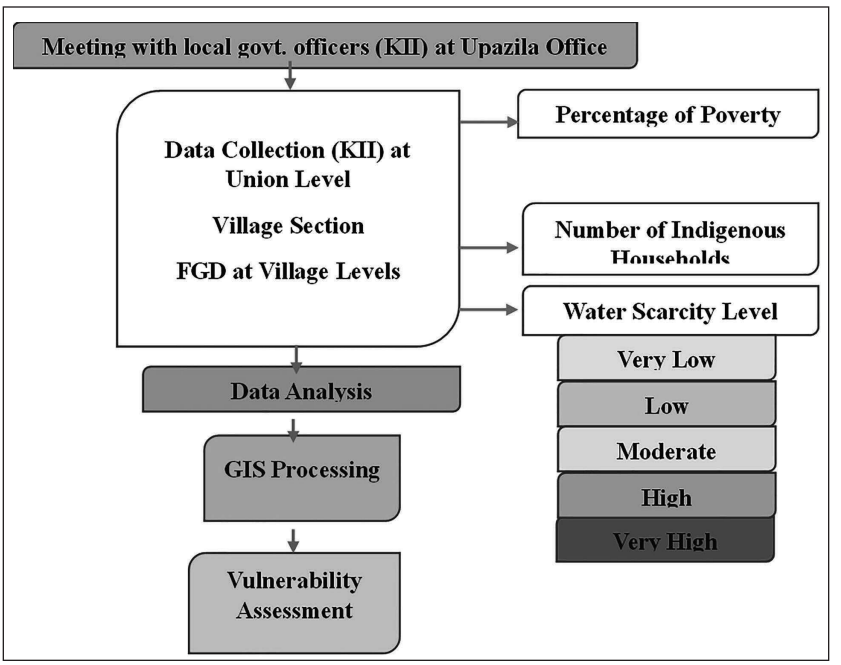

Figure 9. Methodology.

Nirmail and Shihara unions exhibited the highest percentage of IH, ranging from 12% to 17%. Meanwhile, Nazipur, Akbarpur and Krishnapur unions have 10%–12% IH. However, Pathari, Aihai, Shiranti, Tilna and Patichara unions have the lowest percentage of IH, ranging from 0% to 4%. In the remaining unions, the rate fluctuates from 6% to 10%.

Percentage of PH

The percentage of PH was determined by using the total number of households of marginal people and divided by the total number of households in that union. The union of Shiranti, Nirmail and Shihara has the highest percentage of PH, ranging from 47% to 48%. By contrast, Goala and Ghoshnagar unions have 34%–35% of PH, the lowest percentage among these unions. For the rest of the unions, the rate fluctuates from 38% to 47%.

Percentage of Households Using UWH

UWHs were those from which local people collect water except for tube wells and treated water. The percentage of UWH for each Sapahar and Patnitala Upazila union was collected from Bangladesh Population and Housing Census 2011 community report Zila: Naogaon, August 2014, (BBS). Sapahar and Shihara unions have the highest percentage of households using UWH, ranging from 55% to 65%. Meanwhile, Dibar, Tilna and Nirmail unions have 30%–50% of 1%–15% of households using UWH, the second highest percentage among these unions.

Percentage of Villages with High Water Scarcity Impact (WSH)

The percentage of households with high water scarcity was collected from the Union Parishad. Figure 10 shows the number of villages, the number of households and the percentage of villages with high WSH under each union. Sapahar, Dibar and Tilna unions have the highest percentage of villages with high WSH, ranging from 50% to 86%.

Identification of Vulnerable Area

All social indicators have been given equal weight to calculate the study area's vulnerability. Figure 11 shows the vulnerability analyses. Dibar, Sapahar and Shihara unions are in the very highly vulnerable category. Meanwhile, Tilna and Nirmail unions are in the highly vulnerable category.

Vulnerability Methodology According to the Hydrogeological Factors

This study area has been facing water scarcity because of the unavailability of groundwater resources and lack of recharge. For that purpose, recharge potentiality in the area has been determined. The groundwater recharge potentiality in Sapahar and Patnitala has been studied using the WLC method based on the Geographic Information System (GIS) and Remote Sensing technique. In Sapahar and Patnitala, less favourable infiltration capacity of topsoil does not allow infiltration to the study area. As a result, a major portion of rainfall has become overland flow. That is why minimal recharge occurs in the study area. To determine the groundwater potential zone of the current study area, each of the seven different thematic layers (clay layer, elevation, stream density, slope, land use and soil map) is integrated by applying the weighted overlay method of ArcGIS (Figure 12). All thematic maps have different kinds of impacts on groundwater recharge. These layers are classified into five groups depending on their effects on

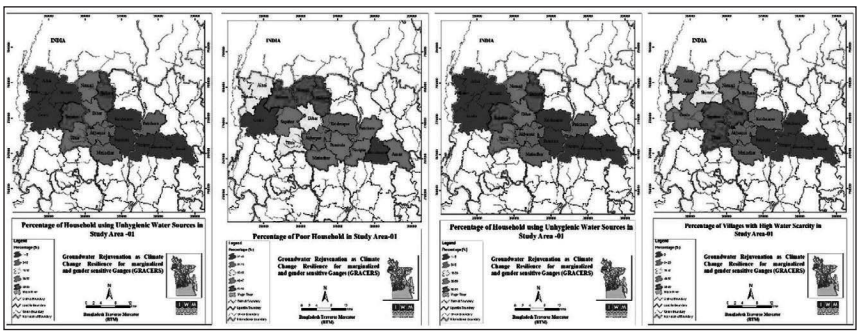

Figure 10. Maps Showing. (a) Indigenous Household, (b) Poor Households, (c) Households Using Unhygienic Water Sources and (d) Percentage of Households with High Water Scarcity.

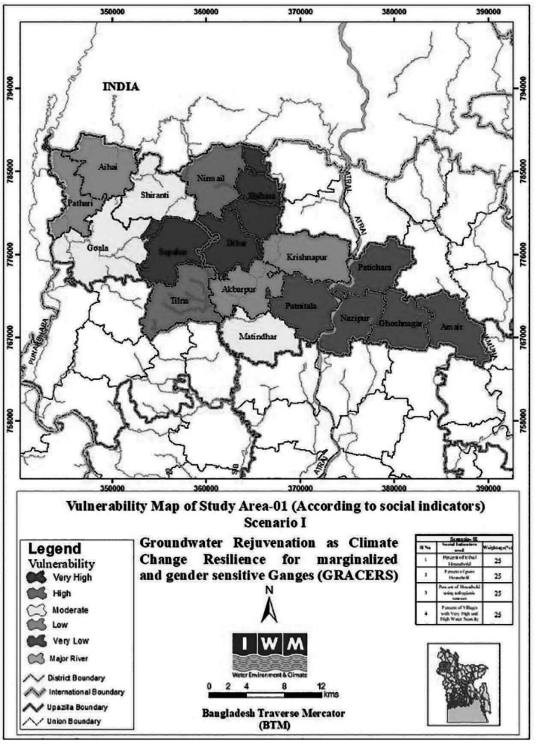

Figure 11. Vulnerability Maps According to the Social Factors.

groundwater recharge. Thus, the layers were classified into five groups based on their impacts on groundwater recharge.

The groundwater potentiality (GP) is calculated as follows:

$$GP = 0.25 \times AD + 0.20 \times Elv. + 0.15 \times DD + 0.15 \times S + 0.10 \times LU + 0.15 \times So$$

AD = Aquifer depth; *Elv* = elevation; *SD* = drainage density; *S* = slope; *LU* = land use; *So* = soil type.

Hydrogeological Factors

Aquifer Depth

Aquifer depth has been processed from the lithology data collected from different secondary sources. The Aquifer Depth is in the range of 3–48 m. The highest depth is found on the border of Sapahar and Patnitala Upazilla. On the other hand, the eastern part of the study area has depths ranging from 3 to 20 m, which is the lowest in the study area. The aquifer depth is a crucial factor in determining the GP of an area, with lower depths indicating a higher potential for groundwater availability. To account for this contribution to GP, a weighted factor of 25% was

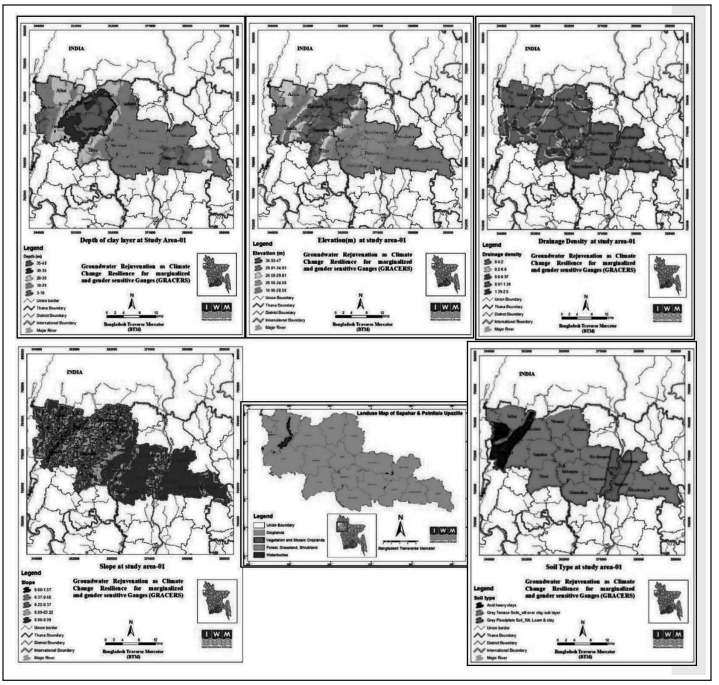

Figure 12. Maps Showing. (a) Depth of Clay Layer, (b) Elevation, (c) Drainage Density, (d) Slope, (e) Land Use and (f) Soil Type.

assigned in the analysis. The assigned weights of the factors were determined using the Konkul et al. (2014) method.

Elevation

Areas with higher elevations contribute less to groundwater recharge. Shiranti, Nirmail, Shihara and Goala have higher elevations ranging from 34 to 47 m PWD. On the other hand, the eastern side of the study area, such as Nazipur, Amair and Goshainagar, has elevations of 14–20 m. The weightage of the elevation is considered as 20%.

Drainage Density (Dd)

Stream density is the length of all channels within the basin divided by the area of the basin. The drainage map of the area is prepared from DEM. The Dd values range from 0.00 to 2.5 km/km^2. The weighted factor of Dd is considered 15%.

Slope

The higher slope value creates runoff, thus causing less infiltration of rainwater through surface soil to recharge the aquifer. The recharge phenomenon to groundwater occurs in flat and gentle slope areas, where a print of steep slope facilitates the rapid flow of runoff, resulting in comparatively less infiltration.

A major part of the study falls under flat to gentle slope. According to the contribution of GP, 15% is the weighted factor considered for slope.

Land Use

A land use map has been collected from the globe cover. Its resolution is 0.5°. A significant portion of the study area is cropland, and this parameter is weighted at 10%.

Soil Map

The Soil Resource Development Institute has collected a soil map. According to the map, three soil types are classified in the study area: acid-heavy clays, grey terrace soils and grey floodplain soils. Acid-heavy clays play an inferior role in the groundwater recharge potential, while grey terrace soils with silt over the clay sublayer play a moderate role. Grey Floodplain Soils _ Silt, Loam and clay are considered intermediate.

Identification of Groundwater Recharge Potential Zone

The resultant map in Figure 13 shows that 0.3% of the area is very poor, 22.6% is poor, 53.1% is moderate and 24% of the total area has good groundwater recharge potential. Sapahar, Tilna, Goala and Siranti Union in Sapahar Upazilla have poor recharge potential. Nirmail, Sihara and Dibar Union in Patnitala Upazilla have poor recharge potential. In Sapahar, Pathari and Aihai Union have good potential recharge, and in Patnitala, the remaining eight unions have moderate to good recharge.

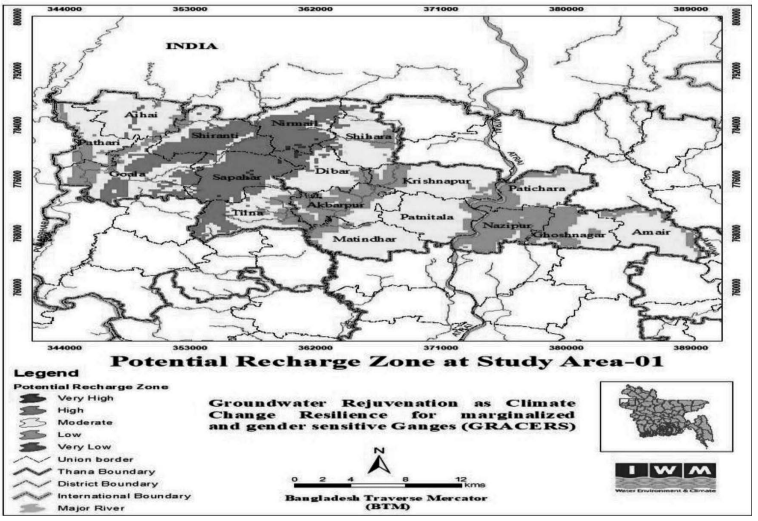

Figure 13. Potential Recharge Map.

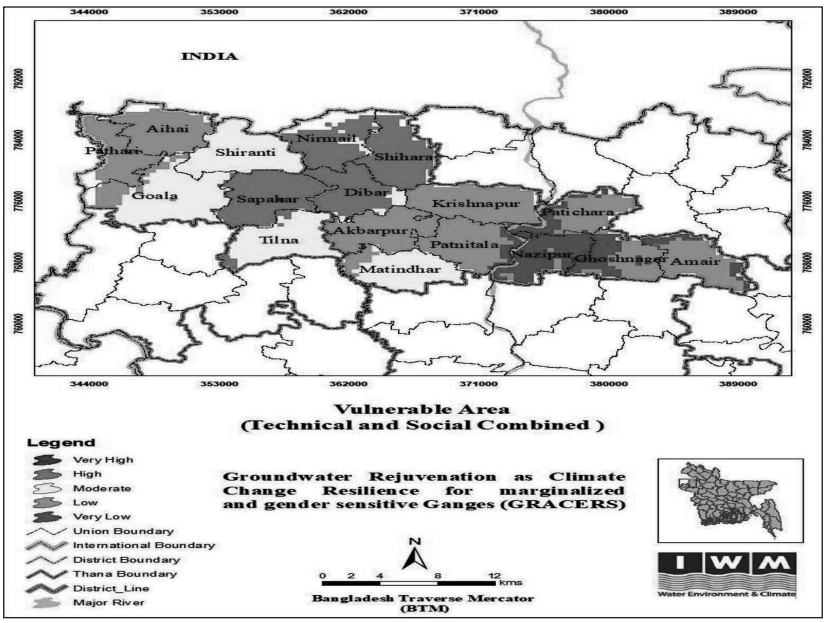

Figure 14. Vulnerable Area of Sapahar and Patnitala.

Combined Vulnerability

The vulnerable area is determined by incorporating all the social and technical parameters in this study area. The first scenario of the social vulnerability map, where all the parameters have been considered, has been combined with a recharge potential map with equal weightage.

The map in Figure 14 shows that Sapahar, Dibar, Nirmail and Shihara unions are in 'high vulnerable', and Shiranti, Goala and Matindhar unions are in the moderate vulnerable category.

Conclusion and Recommendations

Based on vulnerability analysis, it can be concluded that with equal weightage on the four indicators, the most vulnerable unions are Sapahar, Dibar and Shihara, and with equal weightage without the water scarcity indicator, the ranks change and the most vulnerable unions are: Shihara, Sapahar, Tilna. On the contrary, taking only indigenous and PH indicators, the most vulnerable unions are Shihara, Nirmail and Patnitala.

Over time, various types of assistance have come to the vulnerable areas of different Upazilas. Yet, most of the time, the indigenous, poor, isolated community was deprived of these facilities due to the influx of wealthy family-centred support. However, when they got facilities such as wells or submersible pumps,

the system became inactive due to mismanagement or poor maintenance. Therefore, the survey participants have highlighted a direct intervention of the government to alleviate their suffering. Existing public and private ponds are recommended to be re-excavated. Digging Khas ponds can work as recharge ponds and reservoirs for meeting household and domestic needs. These will reduce the pressure of groundwater, which will help regain the groundwater table in that area. On the other hand, installing a submersible pump is a viable solution without adequate land. Alternatively, dug wells can be used where submersible pumps are unsuitable without an aquifer. However, to ensure the proper maintenance of these systems, a committee consisting of local people should be established. Local government organisations and NGOs can provide training for these committees.

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The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Article

Food Security in Rural Bangladesh: A Comparative Study of Scientific and Grassroots Perceptions

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Tanvir Shatil[1] and M. Rezaul Islam[2]

Abstract

The literature provides a comprehensive understanding of the scientific definition of food security in terms of its conceptual meaning, measurement and analysis. However, this definition contrasts significantly with the non-scientific or local understanding of food security. This article illustrates this disparity by examining the scientific definition and perception of food security in rural Bangladesh. Data was collected through qualitative research using focus group discussions and in-depth case interviews with smallholder farmers. The results reveal a significant difference between the scientific and local definitions of food security, with the latter being defined as having a sufficient supply of rice to last the entire year. Their food security is largely influenced by their socio-economic realities, coping strategies, and social networks, and the disparity in understanding of food security differs across the categories. This study highlights the importance of understanding the local perspective of food security for development practitioners, experts and policymakers, which has serious implications from a policy perspective.

Keywords

Food security, socio-economic development, smallholders, scientific perception, grassroots perception, rural Bangladesh

Introduction

The concept of 'food security' emerged in the 1970s in international development, leading to a formal academic definition in 1974 (Von Braun, 1992). Over time, the definition has undergone several changes and expansions. First, the focus on food

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security has moved from a global and national level to the household and individual level. Second, the perspective has shifted from a food-centred approach to a livelihood-centred one. And third, the metric used has changed from objective indicators to subjective ones (Simon, 2012). The concept of 'household food security' has since been broadened in the literature. In 1996, the concept was integrated into discussions on gender equality, public health and nutrition, taking a holistic approach. In the early 21st century, the definition was expanded to include social aspects [such as cultural factors, community dynamics and access to social support systems], enhancing its comprehensive understanding.

As a nation that was among the poorest at its birth in 1971, Bangladesh has made significant strides in reducing poverty, including income and food poverty, and improving various social indicators in recent decades. The country has made remarkable advancements in rice production, tripling output from 11 million tonnes in 1971 to 33 million in 2012, and has seen notable growth in potato and vegetable production (Deb, 2016; Sayeed & Yunus, 2018). Despite this progress, a significant portion of households in Bangladesh are either landless or have only half an acre of land, making it difficult to meet the food needs of the average four to five-person household despite high output through advanced technology. With a lack of employment opportunities in both the formal and informal sectors, nearly 60% of rural households in Bangladesh are involved in farming (Hossain, 2013). While Bangladesh has achieved food self-sufficiency over time, smallholder farmers in rural areas still experience food insecurity, often resulting from their firsthand experiences of severe food scarcity.

Smallholder farmers and marginalised populations in Bangladesh have struggled with severe food scarcity since independence. However, their understanding and practical definition of food security significantly differ from the scientific definition. This disparity between the scientific definition and community perception becomes apparent when considering the coping strategies and practices employed to achieve food security. The local community's conceptualisation of food security also highlights this difference. They consider themselves relatively food secure as they have access to staple food (rice) almost year-round and can have meals two or three times a day for their households. This assessment is based on their past experiences of rice grain shortages or famine. The community is not concerned with other aspects of the academic definition, such as nutritional or food safety issues, in their meal practices.

This article aims to understand the differing definitions of food security between academic/theoretical perspectives and those held by the community. Through a qualitative analysis, it aims to explore the causes of food insecurity among marginalised farming households in rural Bangladesh. The study seeks to uncover how marginalised farmers, through their lived experiences and livelihood conditions, intentionally and unintentionally, practice and perceive food security differently from development theorists.

Literature Review

Food Security

The idea of food security has undergone a significant evolution and transformation throughout history. Initially, the concept referred to the availability and supply of food. However, this changed over time due to factors such as global food crises that resulted in the death of thousands, the recognition of food as a basic human need, and the growth of international organisations. Today, various official definitions of food security exist in the literature, including one from the State of Food Insecurity in 2001, which encompasses the social aspect of access to sufficient, safe and nutritious food for a healthy and active life. This concept reached maturity with the insights of economist Amartya Sen, who emphasised the importance of individuals' and households' entitlements to food (Clay, 2002; Sen, 1982).

The evolution of the concept of food security has undergone significant changes over the years. It initially referred to food supply and availability. Still, following global food crises and the recognition of food as a basic human need, the definition has expanded to include access to sufficient, safe and nutritious food at the individual, household, national, regional and global levels (Shaw, 2007). This formal definition was established in 1996 and emphasised the importance of physical and economic access to food. Over time, the meaning of food security has evolved to reflect changes in official policy thinking and current conceptualisations. Implementing food security policies requires considering the complex social structures and relevant concerns for successful outcomes. The concept has been developed and refined over the last three decades to reflect shifting policy perspectives (Clay, 2002; Heidhues et al., 2004).

The definition of food security includes all individuals and households. The idea of 'all people at all times' having access to sufficient, safe and nutritious food has replaced the previous concept of steady expansion of food consumption. The definition now focuses on public health, nutrition, physical health and food choice. The definition has become a more holistic and applied understanding of food security. It is now widely agreed that food security means access to a minimum daily diet, which is calculated based on age and sex and includes 2,242 calories and 70 grams of protein, along with vitamins and minerals along with vitamins and minerals, used per person per day.

Theefinitionn of food security was further expanded in 2001 to include the aspect of social accessibility. This considers a society's cultural and political context, which can sometimes create barriers to accessing sufficient, safe and nutritious food. Social and cultural stigmas, such as the status of women, children, indigenous peoples and caste systems, can prevent individuals from accessing the food they need. Even if someone has economic and physical access to food, they may not have social or cultural accessibility in their society, hindering their overall food security.

State of Food Security in Bangladesh

Despite Bangladesh reaching lower-middle income status in 2015 and significant advancements in reducing poverty and food insecurity, a large number of people in rural areas still live below the poverty line. Despite the implementation of various anti-poverty programmes, it has been acknowledged that they often fail to reach the ultra-poor, according to studies by Matin and Hume (2003) and Hashemi (1997), as well as research by Hume and Mosley (1996). Bangladesh has made remarkable progress in rice production, increasing from 11 million tonnes in 1971 to 33 million tonnes in 2012 due to the development of high-yielding crop varieties, irrigation infrastructure and private investment in tube wells. There has also been significant progress in the production of vegetables and potatoes in recent decades. However, the country is facing challenges with the volatility in prices leading to fluctuations in production from year to year.

In contrast, prices of crops, such as pulses, oilseeds, sugarcane, etc., have either remained the same or decreased, leading to an increase in the availability of pulses, edible oil, sugar, milk and wheat. Fish is a crucial dietary item for the Bangladeshi population due to its nutritional value, and the growth of pond aquaculture has rapidly boosted fish production by 7% per year (Hossain, 2013). The 12th round of the Food Security Nutrition Surveillance Project (October-November 2013) revealed a decrease in the number of people concerned about food, from 53% in 2012 to 32% in 2013. The tendency to consume less preferred foods, rely solely on rice, and eat smaller meals declined from 19%, 14% and 21% from 2012 to 2013, respectively. Only 7% of the people skipped a meal, 27% of households ran out of food, and only 14% experienced hunger. Approximately 60% of rural households in Bangladesh are involved in farming, and while they have access to food (rice, wheat and vegetables) from their production as well as local markets, many people, even farmers, are still unable to achieve food security due to their landlessness and low levels of land ownership. The government of Bangladesh implements several initiatives to guarantee food security for all households, including stabilising market prices, providing targeted food distribution to poor households and emergency relief after natural disasters. However, the goal of ensuring food security for all remains distant. Many individuals continue to suffer from malnutrition, lack of safe food and the threat of hunger.

Methodology

This study used a qualitative approach to gain in-depth and contextual information about food security. The sample was taken from three levels of data collection, including baseline, midline and end-line fieldwork. During the baseline, the study selected 24 households from 18 socio-economic backgrounds, 12 villages and 12 agroecological zones in Bangladesh. The data collected from various topics, such as farm and non-farm occupations, agriculture, tenancy systems and credit reach, was crucial in understanding the lives and livelihoods of the research participants. One year later, a midline assessment was conducted with 12 households selected

from four villages and four agroecological zones. During the end-line, the study selected 16 tenant households from eight villages, two from each village, of four agroecological zones.

Convenient purposive sampling was used to select two tenant households from each selected village. The study used two sets of guidelines for conducting focus group discussions and in-depth case interviews to collect qualitative data. Researchers' memos and field notes were used as sources of observational data. The goal was to capture and describe the central themes that cut across many participants and geographical variations to identify patterns. The collected qualitative data was manually coded, cross-checked under various themes and sub-themes, and triangulated for analysis. The ethical guidelines and procedures of the funding and organising authorities were adhered to in the study. The relevant local authority also granted permission, and participants were informed of the study's objectives and benefits. Verbal consent was obtained from the participants during data collection.

Results and Discussion

Grassroots Perception

This research aimed to understand the perception of food security among rural communities in Bangladesh, where despite an improvement in the country's food production, some people still face food insecurity, malnutrition, lack of safe food and even hunger. The findings revealed a difference between the local people's understanding of food security and the scientific definition, as poor local people used traditional and local coping strategies to overcome food insecurity, which were embedded in their community practices. This research observed that the local people's perception of food (in)security was shaped by their past experiences in the current context, which differed from the commonly referred definitions of food (in)security (Keller et al., 2007). By examining the experiences of different stakeholders, the research concluded that local people's understanding of food security is closely tied to self-sufficiency in rice and other staple foods (Hossain, 2013). In Bangladesh, rural smallholders typically associate food security with having a sufficient rice supply to meet their needs for an entire year without much consideration for nutritional value, food safety, or social demand for food.

The Bangladeshi poor people had a chronic historical experience of inadequate food and famine. The past horrible experiences of war and famine are knitted in the people's minds. From those experiences, some reflections have been amassed among the poor/smallholders of Bangladesh. In continuation, people's perceptions about food security have been constructed according to the reflections, which are far different from the scientific definition and understanding. Islam (2012) showed that the lack of awareness about nutrition is the root cause of this. He found it difficult to get the right answer to the question: 'What do you (rural people) mean by food, and why do you take food?' because it is such a habitual fact from the very beginning of life that they never think about it. He frequently heard: 'We

(rural people) take food to live because we cannot live without food', 'We take food when we feel hungry' and 'We take food to fill up our stomach'. These people have little concern about a balanced diet, which is essential for a healthy and active life. They take delicious food for them and are satisfied if they can fill their stomach with a bowl of rice by any means. Local perception is associated with the socio-economic context as well. Most smallholders noticed almost the same narrative in this regard. A woman smallholder from the southern part of Bangladesh expressed:

> There is no inadequacy of food as it was in the past. The situation has changed. Nowadays, people do not suffer from chronic starvation or die from lack of food. In the past, people faced severe food shortages during the month of Kartick (October to November), but this is no longer the case. There is no famine, and people do not die of starvation. Today, people have money in their pockets and can get food. At least they can manage to have a daily meal every day.

Prevalence of Food Insecurity

The intensity of food insecurity has been defined as the number of months the households encountered food shortage (Muhammad, 2006). According to a survey, the households were asked how many months of the last Bengali year (1418–1419) they were bumped into food shortage problems and which months. The respondents replied that the month of Chaitra (March–April) was highly food-insecure (Aziz & Atkins, 2014). This month falls in the Boro (dry) season and small farmers have to invest a significant amount of money in their rice cultivation, which results in a high production cost of rice (Uddin, 2008). The month is also called 'mora Kartik', which means 'months of death and disaster', and occurs twice a year—September-November (after the aman crop is planted) and March-April (after the Boro crop is planted) (Muhammad, 2006). During these times, extreme poverty, particularly among farm labourers, leads to unemployment and increased food insecurity and hunger (Uddin, 2008). Natural disasters, such as floods, river erosions, and coastal winds/tornadoes/cyclones, often intensify hunger and food insecurity, particularly among char land and coastal island people (Islam, 2018; Islam et al., 2020; Mazid & Johnson, 2010). Forced displacement and migration to nearby cities also increase vulnerability due to the lack of education, low skills and low coping strategies of the affected individuals in urban areas. The situation often worsens for those who cannot migrate, leading to malnutrition, starvation and food shortage (Mohammad, 2006). Small farmers usually have to sell their stored food grain to meet cultivation expenses during this time, resulting in a shortage of food for the household members. According to the Bengali crop calendar, Agrahyan is the harvesting season of aman, and Kartik is the month just before the harvest season when farmers typically face food grain shortages due to the long gap in rice cultivation. Smallholders also work as farm day labourers and face food grain and wage shortages before harvest due to the lack of work in paddy fields (Muhammad, 2006).

Coping Strategy: An Assortment Based on Context

The concept of food storage and food security has been prevalent since ancient times, as evidenced in the case of ancient Egypt, where the Egyptians had already developed the idea of storing crops for uneven days. According to Smith (1928), the Egyptians were well aware of their realm's natural cycles and environmental behaviour and could understand the Nile River's nature and its potential for natural disasters. This knowledge allowed them to increase their agricultural production and build granaries to store their crops for future use. Thus, food security has been a concern for civilisations throughout history, and it is fascinating to see how the ancient Egyptians were able to address this challenge.

Smallholders in rural Bangladesh adopt both self-coping and assisted coping strategies to cope with food insecurity. The self-coping strategy includes reducing the number and size of daily meals, relying on wild food, selling labour at a low rate, selling fixed and movable assets, taking out new loans at high-interest rates and growing short-duration crops. On the other hand, the assisted coping strategies include relying on relief food, social networks and begging (Uddin, 2012). The research showed that most smallholders relied on cheap and low-priced food during food scarcity and reduced their meal size or number of meals. Some also borrowed food or received help from friends or relatives and purchased everyday necessities related to their daily meals on credit from the local shop. The coping strategies adopted by each household are based on their specific livelihood patterns and suit their individual needs and circumstances.

In the context of the present rural Bangladesh, smallholders use their social, economic and cultural competence in their coping strategies for food insecurity. This research found that the marginal farmers adopted six self-coping strategies and three assisted coping strategies to cope with vulnerability and food insecurity. The self-coping strategies were lessening the number and size of everyday meals, feasting on wild food, selling labour at a very low rate, selling fixed and movable household assets, contracting new loans at a high-interest rate, and cultivating short-duration crops. On the other hand, assisted coping strategies include relief food, social networks and begging (Uddin, 2012). The current research showed that most smallholders relied on cheap and low-priced food during food scarcity. Many smallholders also reduced their meal size or number of meals on uneven days. Some of them borrowed food or received help from friends or relatives. They brought food, grain, salt, oil, etc., from the local shop in a due payment. It is one kind of loan. Especially everyday necessities related to their daily meal had to be brought from the village shop for a due payment. Simultaneously, this research found such case stories of those who coped with food scarcity by adopting suitable coping strategies. All the practices or coping strategies were based on the local context. Every household has their dynamics according to their livelihood patterns. They adopt strategies that are suitable for their livelihoods.

Daily Food Behaviour

In the days of the food shortage, grassroots smallholders usually reduce their meal size, number of meals, or quality as part of the coping strategy. This research

apprehended local stallholders' struggle and compassion regarding food shortage. Rekha (pseudonym), a woman, explained her experience regarding the food insecurity they had passed miserable days. She informed that a few years ago when her husband left her along with her children due to extreme poverty, she took a loan from a well-wisher and started vending clothes in her neighbourhood villages. She spent miserable days with her family, even taking one or half meals without curry in a day. She managed the vulnerable situation then and gradually became stable in her survival. They could not meet their regular meal, but now the days have been changed. She said:

> Days have changed, people do not strive now, and the miserable period has been reduced. People do not suffer from hunger as they did in previous days.

There are food grains in her granary. She also added that regarding the issue of food insecurity, the level of insufficiency of food has been changed. Rekha said that she felt insufficient when facing a shortage of money, especially during the period of land cultivation in the Boro season (March-April). She had to meet the cultivation expenses by selling the rice grain stored for the yearly needs. Because of meeting the cultivation expenses, her household faced food insufficiency every year. She also said that she and her family coped with the food insecurity through their coping strategies—they took their limited meals considering the situation and reduced their standard of meals, such as a low consumption of meat, fish and eggs. Here, it is notable that she and her family are not worried about the nutritional value of their meal. She alleged that now,

> We eat regularly. We cultivate rice and potatoes. Food is not a problem for us.

She seemed pleased that she could fulfil all her food demands with what she had. She learned this perception from her miserable experience: having enough food means having no tension about her food.

Mominul Islam (pseudonym), another smallholder from northern Bangladesh, had almost the same perception regarding food security as Rekha. He also had the rental business of agro-technology and did not face food insecurity as he gets all food grains year-round from his land. Nevertheless, in the dull season, especially when crops are growing in the field, he cannot earn anything from his rental business agro-technology and faces financial inefficiency, which affects even his regular meals. During this time, he followed some coping strategies, such as reducing the cost of his daily meal. He said:

> Look, I used to buy one kilogram of fish, but I cannot buy this as I do not have enough money to buy it. Now, I will buy a half kilogram of fish. I have another option; even if I cannot buy this amount of fish, I will buy 50-gram dry fish, which is much cheaper than half a kilogram of fresh fish. Ultimately, I must succeed delicately, which is not a big deal.

Almost the same echoes have been heard from other smallholders during FGDs.

Savings Aiming the Days of Food Shortage

Aleya (pseudonym), a housewife from the southern side of the country, informed that every day, she saved some rice from the amount of which she was supposed to cook every meal, bearing in mind the days of food shortage. She sold the saved rice after a week or month and bought some meat/fish, which are recognised as good ingredients by her. Another saving practice to overcome the incidence of food shortage had been found in the case of Kader Molla (pseudonym) from the northern side of the country, where he intentionally withheld some payments of his agro-machinery rent in the hands of reliable farmers so that he could utilise his debt amount during the days of shortage. In this case, Kader said:

> Sometimes, I do not collect my machine rental immediately from some farmers for harvest or cultivation. I collect this money during my scarcity.

The above findings showed that value is engendered through interrelationships where the smallholders are economically poorer with less social capital (low interrelationship) than those with larger access to social networks. Here, social capital enlarges the concept of human capital as an outcome of rising economic productivity and well-being (Farhad & Munsi, 2006). In rural Bangladesh, smallholders use their social capital to meet the food shortages of their households. Research found from FGDs and in-depth case interviews that the local smallholders took help from their friends and relatives regarding the food shortage. Generally, they used to take non-interest loans for a short time from their well-off friends and relatives in times of food deficiency. They also took food grain (rice) and other necessary foodstuffs from the neighbourhood shop in a due payment; they used to pay the due payment when they got money in hand. It is usually after the season of harvest. In this case, Nazmul (pseudonym), a mason from the southern part of the country, said:

> I feel so discomfort if I see that I cannot buy sufficient food daily. I used to eat ample food all the time. I eat chicken often a month, and though I cannot pay instantly, they (shopkeepers) give me the due payment. I had a poultry smallholding and engaged with the poultry business; for this reason, I have a good relationship with the local poultry businessmen. Moreover, I get work orders in winter when people make new houses or refurbish their old ones. I get a shortage of money in the rainy season, but I can buy my daily food and stuff from the local shopkeepers in this off-season as they know I will return/pay my dues in time.

FGD findings showed that the smallholders faced food deficiency when they were bound to sell their stored food grain at certain times of the year to meet the cost of cultivation. In that circumstance, micro-credit loans helped the smallholders to overcome this crisis, where social capital was an important factor. Most of the smallholders are members of the VOs (village organisation called SAMITI), where the VO members select the borrowers through social interaction. By borrowing from VOs, the smallholders can also protect their food granaries for yearlong food needs. They invest in agricultural cultivation from borrowed money and pay the loan instalment from their weekly or monthly income. Thus, they can also get a secure path during times of food deficiency using their social capital.

Economic Behaviour-oriented Coping Strategy

In rural Bangladesh, smallholder farmers typically deal with food shortages in various ways, adapting their strategies based on their local context and household needs. Some coping strategies are primarily economically driven, such as taking out loans to cover costs associated with cultivation and household necessities. Smallholders may use borrowed funds to purchase food or sell their livestock when faced with food shortages. The research found that households with multiple sources of income through occupational diversification were better equipped to cope with food shortages, as they had a greater capacity to earn money in difficult times. Occupational diversification, therefore, serves as a safety net during food scarcity. A smallholder from the southern part of the country said:

> Though I am engaged with farming to some extent, I do not grow paddy. I do not have paddy land, so I must buy rice year-round from the market. I am a mason. I can earn enough in winter when people make new houses or renovate them, but I have to face insufficient money in the dull season. If I do not get any work in the dull season, I can engage myself as a waiter in a restaurant. Thus, I can earn money to meet the food shortage in my household.

In the face of food scarcity, some rural residents in Bangladesh may migrate to survive. They often find work in urban areas as rickshaw pullers, day labourers, vendors, potters and other similar occupations. On the other hand, some smallholders try to prepare for food scarcity by saving money or food for such days. They also try to increase household productivity, with all able-bodied members contributing to the effort. Women, in particular, have been observed taking loans from VOs and investing in productive endeavours such as cow rearing, poultry farming and small businesses. This serves as a coping mechanism during food scarcity and helps provide financial stability.

Conclusions

The findings of this article suggest that food security in rural Bangladesh is perceived and addressed differently by smallholders compared to the scientific definition. Smallholders are primarily concerned with ensuring enough food to meet their basic needs, regardless of nutritional value or safety. Their socio-economic realities, coping strategies and social networks largely influence their food security. They often reduce their dietary expenses and compromise their food quality in food shortages. Despite efforts by the government and non-governmental organisations to increase their awareness of food security, the level of understanding remains limited.

Rural smallholders' preferred coping strategies during food shortages include purchasing low-priced food, borrowing food from relatives and friends, taking loans from local shops and reducing the size of their meals. These strategies are based on traditional practices, past experiences and the local context and do not compromise the quality of their food. This study highlights the importance of

considering the local context and the perspectives of smallholders when addressing food security in rural Bangladesh.

The findings of this research have significant implications for food security policy in Bangladesh. It highlights that food security is not just about increasing food production or ensuring food availability but also about people's perceptions, awareness and participation. The lack of knowledge about food and nutrition and traditional practices and superstitions are major obstacles to ensuring food security in Bangladesh. The National Food Policy adopted in 2006 aims to address these issues by promoting safe and nutritious food, increasing access to food and improving nutrition for all, particularly women and children. However, the policy has a significant shortcoming in that it fails to address the issue of food security awareness.

The research findings can contribute to the achievement of two targets of SDG 2 (Zero Hunger): ending hunger and ensuring access to food for all people, particularly the poor and vulnerable, and doubling the agricultural productivity and income of small-scale food producers, especially women and indigenous peoples. To achieve these goals, it is important to include awareness-raising activities for economically disadvantaged people to ensure proper responsibility and accountability of local organisations and administration.

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Article

Societal, Economic and Behavioural Predictors of Stunting Among Children Aged 24 to 59 Months: Evidence from the National Survey of Bangladesh

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Abstract

With long-term detrimental consequences of irreversible physical and intellectual impairment, stunting remains one of the most prevalent public health problems. This study aimed to identify the factors contributing to stunting among children aged 24 to 59 months in Bangladesh. An analysis of nutrition survey data from the Nutrition, Health and Demographic Survey of Bangladesh analysed the data from a sample of 4,182 children. A predictive model was constructed to identify the association of stunting with family socioeconomics and children's characteristics. The study found that the development of stunting among 24- to 59-month-old children has been attributed to several factors such as household food security, child feeding practices, parental education and domestic violence. Mothers with secondary education had lower odds of having stunted children. Houses with better flooring quality reduced the probability of stunting by 50%. Children growing up in a moderately food-insecure family had higher odds of becoming stunted. Better child-feeding practices also had lower odds of stunting by 33%. The presence of domestic violence in the

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household increased the odds of having a stunted child. However, household sanitary conditions, safe water sources and maternal nutritional knowledge and practice were not significantly associated with stunting.

Keywords

Stunting, prevalence, risk factor, Bangladesh, children aged 24 to 59 months

Introduction

Stunting, or linear growth retardation, in children is defined as a height-for-age below -2 standard deviations of the median height-for-age as per the Child Growth Standards of the World Health Organisation (WHO, 2006). It is estimated that stunting is the cause of about a quarter million child deaths annually (Myatt et al., 2018). For the children who survive, stunting in infancy and early childhood causes lasting damage, including increased morbidity, poor cognition and educational performance in childhood, short stature in adulthood, increased risk of perinatal and neonatal death for women, lower productivity, reduced earnings in adults and—when accompanied by excessive weight gain later in childhood—increased risk of chronic diseases (Bhutta et al., 2013, Black et al., 2013; De Onis & Branca, 2016; Dewey, 2016).

Globally, approximately one-quarter of children under five years of age (i.e., 149 million) have stunted growth because of chronic nutrition deprivation (Dewey, 2016). Levels of child stunting in South Asia (34.4%) are comparable to those in Eastern and Southern Africa (33.6%) and four times higher than those in East Asia and the Pacific (8.4%) or Latin America (9%). The high prevalence of stunting and the region's large child population (26% of the world's children under five years of age) mean that South Asia, with about 35% of the global burden of stunting, is the epicentre of the global stunting crisis (UNICEF, WHO/World Bank Group, 2018). Bangladesh, in particular, despite its praiseworthy achievements in improving public health over the past couple of decades, is home to more than 5 million children with stunted growth (NIPORT et al., 2018). According to the WHO threshold, Bangladesh is in an emergency with regard to stunting, as the prevalence of stunted children is more than double the threshold of 15% (World Food Programme, 2012).

The government of Bangladesh has made high-level commitments to nutrition with the endorsement of the World Health Assembly's (WHA) target and participation in the international Scaling Up Nutrition (SUN) movement (WHO, 2014). However, the average annual rate of reduction (AARR) of stunting in Bangladesh is 2.7%, much less than the required AARR to reach the global WHA target of a 40% reduction in the number of stunted children by 2025 (NIPORT & ICF International, 2016). A significant acceleration in the annual reduction rate to 3.3% needs to occur to achieve the WHA target by 2025 (De Onis et al., 2013).

This acceleration requires delineating appropriate interventions, considering all the factors contributing to stunting.

The WHO conceptual framework on Childhood Stunting: Context, Causes and Consequences (Stewart et al., 2013), which builds on the UNICEF framework (UNICEF, 1990), comprehensively describes the determinants of stunting. According to this framework, stunting results from a complex interplay of household, family, community and societal factors, in addition to the immediate determinants of infection and inadequate breastfeeding and complementary feeding practices. To date, few studies have identified the determinants of stunting in Bangladeshi children (Ahmed et al., 2012; Bhowmik & Das, 2019; Chowdhury et al., 2016; Jesmin et al., 2011; Mostafa, 2011; Rahman & Chowdhury, 2007; Sarma et al., 2017; Sultana et al., 2019). However, none specifically focused on the risk factors of stunting among children aged 24 to 59 months, neither were they guided by a comprehensive framework of risk factors or used national data as a future reference for stakeholders and policymakers to develop prevention strategies and inform nutrition intervention programmes.

Methodology and Data

Conceptual Framework

Although the UNICEF framework has long been used to assess malnutrition determinants in children (UNICEF,1990), we adapted and applied the WHO conceptual framework to the context, causes and consequences of childhood stunting (Stewart et al., 2013), as the former focuses on malnutrition in general. With a specific focus on stunting, the WHO framework has been internationally endorsed as the causative model for stunting. It is beneficial to assess and explain the determinants of stunting in resource-poor settings (e.g., Bangladesh). This framework, as shown in Figure 1 (excluding the 'consequences' domain of the framework as our study focuses only on determinants of stunting), represents factors of stunting across two levels: (a) 'causes,' representing child- and household-level variables; and (b) 'context,' representing community/national-level variables. Positive changes in the community- or national-level variables are hypothesised to be translated into improved nutritional status in children through these upstream variables' direct/indirect influence on children's sociodemographic, environmental, maternal and individual factors. However, manipulating the 'context' is often almost impossible, whereas individual- and household-level variables explaining significant variation in child stunting are more amenable to policy interventions. Therefore, this study focuses on individual- and household-level variables of stunting. However, we included 'region' as an explanatory variable to identify any geographical area to be prioritised for future interventions.

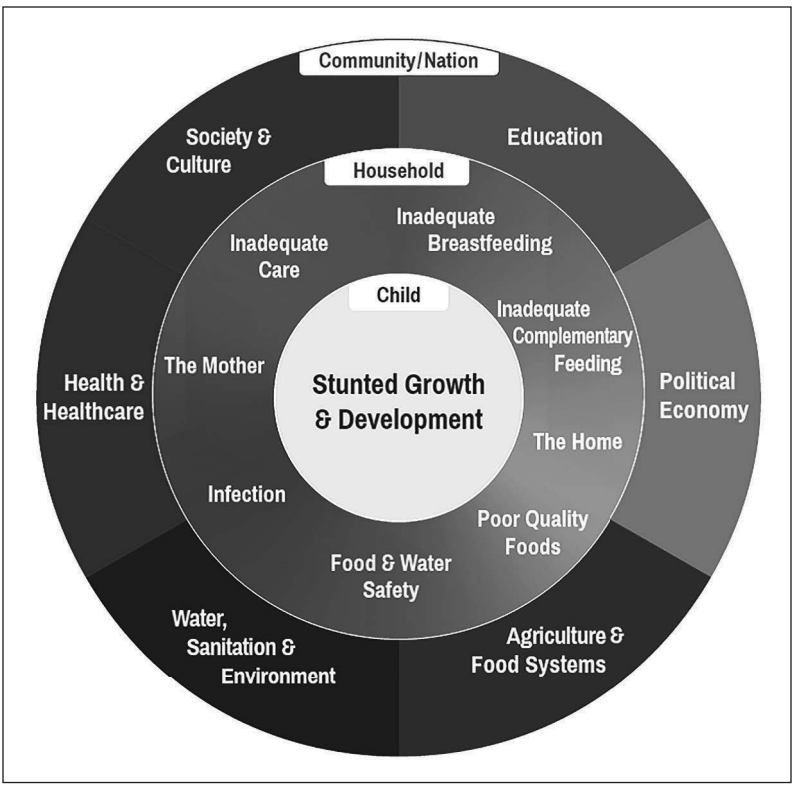

Figure 1. WHO Conceptual Framework of Stunted Growth and Development.

Source: Adapted from Stewart et al. (2013).

Dataset

This study used the dataset from the Bangladesh Nutrition, Health and Demographic Survey (NHDSBD) 2013, a nationally representative survey that provides high-quality information on the nutrition and health of women and children (Akhtaruzzaman et al., 2013). These survey data are available to the Institute of Nutrition and Food Science (INFS) at the University of Dhaka, Bangladesh, and the United States Department of Agriculture (USDA). Access to and approval for further analysing this survey dataset were obtained by the principal investigator of the survey. For the NHDSBD study, ethical permission was obtained from the Ethical Board of the Faculty of Biological Science, University of Dhaka, and informed consent was sought and obtained for all participants upon enrolment. In addition, permission was granted by the University of Dhaka, and all procedures conformed to Texas Tech University Institutional Review Board regulations. This survey was conducted with a sample of 7,530 households chosen nationally. A multi-stage cluster sampling was used, where the first stage involved selecting the sample points or clusters from a structured master sampling frame, and the second stage involved the systematic sampling of

the households scheduled in each cluster. With the structured household questionnaire, 6,274 households were interviewed, consisting of a mother and at least one child aged less than five years. Details about the survey design and data collection method are available in the NHDSBD report (Akhtaruzzaman et al., 2013). For this study, the data were screened for children aged 24 to 59 months; therefore, the study used a sample size of 4,182 children.

Description of Variables

The conceptual framework served as a basis for identifying relevant variables within each determinant. Our goal was to establish a relationship among these variables and the occurrence of stunting. We carefully investigated all potential variables and chose suitable variables or proxies for inclusion in the regression model to suit the study's objectives. Child age and gender are the nonmodifiable factors here, and these variables were categorised and used in the model. Variables such as household monthly income, occupation and education attainment of fathers and mothers were reassessed. Educational level was put into four categories, and occupation was sorted into five categories (Pryer & Rogers, 2006). Information on household size was collected as a factor of the home environment. The region of residence was based on all seven divisions of Bangladesh. The model collected and used information on household water sources for drinking and cooking and household toilet facilities. The infection section of this framework includes factors related to both clinical and sub-clinical infection; specifically, we used the household floor type as the proxy indicator of the occurrence of infection (Akinyemi & Morakinyo, 2018), as household floors made with poor constituents can be contaminated with large numbers of bacteria and are commonly assumed to be important reservoirs of infection (Vilcins et al., 2018). As part of access to health care, information on children's vitamin A capsule intake and completion of the full course of immunisation was also collected and used in the model.

For household food security conditions, a country-specific food security status was created based on how often the respondent either felt a certain way or adopted a specific behaviour; it was categorised into three groups, with higher scores representing more severe insecurity conditions (Coates et al., 2006). A child-feeding index was created based on questions on previous breastfeeding behaviour, previous complementary feeding practices, diet diversity, meal quality, food frequency and feeding frequency (Ruel & Menon, 2002). Based on the sum of these scores, a child was designated as low, moderate or high in terms of feeding practices (Ruel & Menon, 2002). Additionally, mothers were asked a series of questions each on cooking and cleanliness knowledge and practice. Then, the scores were categorised into three classes: low, moderate and high. A similar index was also created to assess maternal nutrition knowledge and practices based on questions on knowledge and practices relevant to food culture and feeding practices. Also, mothers were asked about specific acts and experiences of violence, spousal violence and reasons for spousal violence. The causes of abusive behaviour they had faced were viewed as either general abuse or punishment

(Lake, 2010). The occurrence of maternal domestic violence was used in the model. Information on women's participation in decisions on different household roles was collected to assess the mothers' decision-making autonomy. We used daily purchase decisions by the mothers as a proxy indicator of decision-making autonomy. A detailed description of the variables is provided in Supplementary Table 1.

Table 1. Socioeconomic and Demographic Characteristics of the Households.

Variables	*N* (%)
Age group	
24–35	1,294 (31.0)
36–47	1,390 (33.2)
48–59	1,498 (35.8)
Household size	5 (median)
≤4	1,846 (44.0)
≥5	2,336 (56.0)
Monthly income (US$) (mean ± SD)	156 (±101)
≤62	424 (10.2)
63–125	2,077 (50.0)
126–187	742 (17.9)
188–250	324 (7.7)
250+	585 (14.1)
Monthly expenditure (US$) (mean ± SD)	153 (±109)
≤62	1,161 (27.8)
63–125	2,169 (51.9)
126–187	491 (11.7)
188–250	167 (4.0)
250+	193 (4.6)
Food expenditure (US$) (mean ± SD)	72 (±108)
Father's occupation	
Salaried worker	555 (14.7)
Skilled worker	809 (21.4)
Unskilled worker	1,250 (33.13)
Self-employed	1,096 (29.04)
Not employed	63 (1.7)
Mother's occupation	
Salaried worker	80 (2.0)
Skilled worker	19 (0.5)
Unskilled worker	46 (1.1)

(Table 1 continued)

(Table 1 continued)

Variables	*N* (%)
Self-employed	18 (0.4)
Not employed	3,882 (96.0)
Father's education	
Unschooled	1,533 (38.5)
Primary (grade I–V)	988 (24.8)
Secondary (grade VI–X)	839 (21.1)
Grade 10 & above	725 (18.2)
Mother's education	
Unschooled	1,219 (30.7)
Primary (grade I–V)	1,088 (27.3)
Secondary (grade VI–X)	1,292 (32.5)
Grade 10 & above	482 (12.1)
Source of drinking water	
Safe	4,012 (96.0)
Unsafe	170 (4.0)
Lavatory facilities	
Sanitary	2,529 (61.6)
Unsanitary	1,579 (38.4)
Materials of the house floor	
Better quality	927 (22.3)
Poor quality	3,234 (77.7)
Food security status	
Food secure	3,130 (74.4)
Mild or moderate food insecure	469 (11.1)
Severe food insecure	610 (14.5)
Food insecure	1,079 (25.6)
Child feeding practice quality	
Low (0–4)	47 (1.2)
Moderate (5–8)	945 (22.8)
High (9–12)	3,158 (76.0)
Maternal nutritional knowledge	
Low	112 (2.6)
Moderate	1,055 (25.4)
High	2,997 (72.0)
Maternal nutritional practice	
Low	231 (5.5)
Moderate	1,244 (29.8)
High	2,702 (64.7)

(Table 1 continued)

(Table 1 continued)

Variables	*N* (%)
Maternal cooking/cleanliness knowledge	
Low	33 (0.8)
Medium	952 (22.9)
High	3,172 (76.3)
Maternal cooking/cleanliness practice	
Low	76 (1.8)
Moderate	2,335 (56.3)
High	1,741 (41.9)

Data Analysis

Anthropometric data for children were converted to *z*-scores based on WHO references using the software package ENA 3.5.4. Further data analysis was conducted using R-3.5.0. Demographic and socioeconomic characteristics were expressed as the mean ± standard deviation (SD) for normally distributed quantitative variables or as the median for asymmetric quantitative variables. The frequency with a proportion estimate was applied for categorical variables. For predictor analysis, a logistic regression model was used to identify the factors associated with stunting in children, which determined each of the variable's odds ratio (OR), 95% confidence interval (CI) and statistical significance (*p* value) of the association with stunting. Logistic regression was used as the binary outcome variable (stunted or not stunted) format. The analyses followed the regression diagnostics to justify the assumptions and validity of this logistic regression model. The Hosmer-Lemeshow (HL) goodness of fit was performed to test the validity of the multivariate logistic regression model, resulting in an insignificant *p* value specifying a good fit. Multicollinearity was checked to remove the redundant factors because the variance inflation factor (VIF) was less than 2. The assumption of linearity was tested next to assess whether a linear association exists between the log odds of the outcome and the predictors, which showed a linear relationship. An insignificant hatsq in the link test indicated that (a) the link function was correctly specified; and (b) there was no specification error in this logistic regression model. The primary outcome measurement was stunting with numerous predictor variables, and multiple comparisons were needed to be performed. Therefore, the significance level was determined after performing Bonferroni adjustment to control the family-wise error rate (FWER). The significance level (*p* value threshold) for this study was .05/21 = .0023.

Findings

Table 1 presents the socioeconomic and demographic characteristics of the households of the sampled children. The median household size was five family members. The mean income of the study households was US$156 per month, with

a standard deviation (SD) of US$101. Half of the households had a monthly income ranging from US$63 to 125. Regarding monthly expenditure, US$153 was the average expenditure of a household. The monthly expense for food per household was US$72. Around 44% of the household sizes were less than the median. One in three fathers was an unskilled worker, working as a construction worker, rickshaw/van driver or day labourer. However, 30% were involved in business or living abroad. On the other hand, 96% of the mothers were unemployed. Almost 40% of the fathers never went to school, and only 21% and 18% of them went to secondary school and had completed a Secondary School Certificate (SSC) or grade 10 equivalent, respectively. A large percentage (31%) of mothers never went to school, and only 18.2% completed grade 10 or higher. Almost every household (96%) had access to safe water sources, but only 62% had sanitary lavatory facilities. Most (77%) households used earth or clay as the main floor materials, which are considered poor materials. In three out of four households children were food secure and experienced high-quality child-feeding practices. A significant proportion of mothers had good ('high' category) nutrition and cooking/cleaning knowledge, but this was not reflected in practice.

A total of 1,831 (47%) children were found to be stunted, with the highest proportion (55.8%) of stunted children being in the youngest age group. Figure 2 depicts the prevalence of stunting in children segregated by gender and age group. Overall, there was no apparent discrepancy in stunting prevalence between male and female children; however, more female children were stunted beyond 35 months, whereas male children were more likely to be stunted in the youngest age category of 24–35 months.

Table 2 shows the results (odds ratio (OR) with associated 95% CI and *p* value) obtained from logistic regression analysis. Female children were almost identical to their male counterparts regarding their likelihood of being stunted (OR = 1.022,

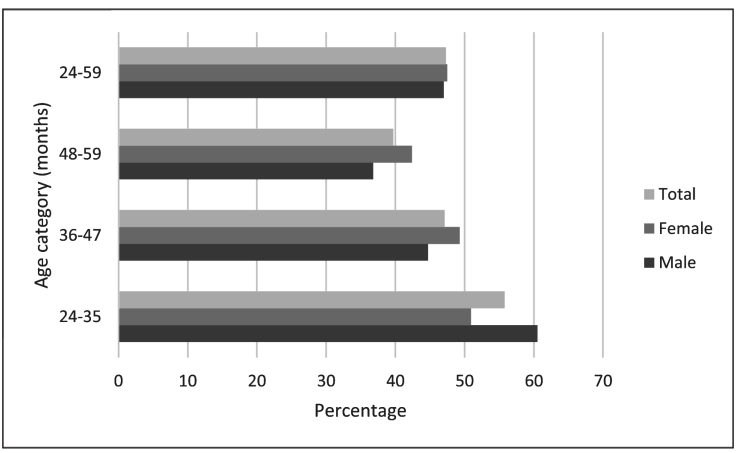

Figure 2. Distribution of Stunting in Children by Gender and Age Group.

Table 2. Predictors of Stunting Among Bangladeshi Children Aged 24 to 59 Months.

	Stunting		
Variables	Odds ratio	*p* value*	95% CI
Child's gender			
Male	Ref		
Female	1.022	0.73	0.90–1.16
Age groups (months)			
24–35	Ref		
36–47	0.711	**3e–5**	0.61–0.83
48–59	0.521	**5e–16**	0.45–0.61
By region (division)			
Dhaka	Ref		
Barisal	1.444	0.0035	1.13–1.85
Chittagong	1.406	**0.0015**	1.14–1.74
Khulna	1.101	0.42	0.87–1.39
Mymensingh	1.436	0.0057	1.12–1.84
Rajshahi	1.254	0.081	0.97–1.62
Rangpur	1.394	0.0049	1.11–1.76
Sylhet	2.168	**5e–7**	1.61–2.93
Income			
Addition of 100 US$/month	0.894	**9e–8**	0.86–0.93
Household size			
≤4	Ref		
≥5	1.030	0.64	0.91–1.17
Household floor type			
Poor quality	Ref		
Better quality	0.513	**2e–16**	0.44–0.60
Source of drinking water			
Safe	Ref		
Unsafe	0.859	0.35	0.62–1.18
Lavatory (toilet) facilities			
Sanitary	Ref		
Unsanitary	0.815	**0.0023**	0.72–0.93
Mother's education level			
Unschooled	Ref		
Primary (grade I–V)	1.010	0.91	0.85–1.20
Secondary (grade VI–X)	0.707	**4e–5**	0.60–0.83
Grade 10 & above	0.399	**7e–15**	0.32–0.50

(Table 2 continued)

(Table 2 continued)

	Stunting		
Variables	Odds ratio	*p* value*	95% CI
Father's education level			
Unschooled	Ref		
Primary (grade I–V)	0.919	0.32	0.78–1.09
Secondary (grade VI–X)	0.691	**5e–5**	0.58–0.82
Grade 10 & above	0.429	**3e–18**	0.35–0.52
Received vitamin A capsule			
No	Ref		
Yes	0.705	**0.0014**	0.53–0.93
Fully vaccinated			
No	Ref		
Yes	0.614	**0.0013**	0.46–0.83
Food security status			
Food secure	Ref		
Mild or moderately insecure	1.886	**3e–9**	1.53–2.32
Severely insecure	1.473	**3e–5**	1.23–1.76
Occurrence of domestic violence			
No	Ref		
Yes	1.423	**2e–7**	1.25–1.62
Maternal employment			
No	Ref		
Yes	0.526	**0.00034**	0.37–0.75
Women's participation in making day-to-day purchase decisions			
No	Ref		
Yes	0.906	0.14	0.79–1.03
Child feeding practices quality			
Medium and below (0–8)#	Ref		
High (9–12)	0.672	**2e–7**	0.58–0.78
Maternal nutritional knowledge			
Low (0–7)	Ref		
Medium (8–14)	0.938	0.76	0.63–1.41
High (15–22)	0.750	0.15	0.51–1.11
Maternal nutritional practice			
Low (0–5)	Ref		
Medium (6–10)	1.044	0.77	0.78–1.39
High (11–15)	0.905	0.48	0.69–1.19

(Table 2 continued)

(Table 2 continued)

Variables	Stunting		
	Odds ratio	*p* value*	95% CI
Maternal cooking/cleaning knowledge			
Low (0–4)	Ref		
Medium (5–8)	0.452	0.051	0.20–1.00
High (9–11)	0.387	0.018	0.18–0.85
Maternal cooking/cleaning practice			
Low (0–5)	Ref		
Medium (6–9)	0.598	0.039	0.37–0.98
High (10–13)	0.508	0.0068	0.31–0.83

Notes: *The significance level is .0023.

#'Low' and 'Medium' categories have been combined due to the low count in the 'Low' category.

95% CI = 0.90–1.16, $p = .73$). In addition to gender, other factors that were found to not contribute significantly to stunting included household size, source of drinking water, women's participation in making day-to-day purchase decisions in the household and mothers' knowledge and practice related to nutrition and cooking/cleaning. Although not statistically significant, desirable categories of these variables (e.g., smaller household size and high scores in mothers' nutritional knowledge) were associated with lower risks of stunting in children.

Conversely, children's age had a significant effect on stunting, with older age groups having a lower risk. For example, the OR for children aged 48 to 59 months was 0.52 (compared to the reference category of children aged 24 to 36 months), with an associated 95% CI of 0.45 to 0.61 and a *p* value of 5e–16. This study also found children who received vitamin A capsules to have a 30% lower risk of developing stunting (OR = 0.705, 95% CI: 0.53–0.93, $p = .0014$). Similarly, children who completed a full course of immunisation had lower odds of being stunted (OR = 0.64, 95% CI: 0.46–0.83, $p = .0013$) than children who did not complete the full course. Better child-feeding practices were also associated with significantly lower odds (OR = 0.67, 95% CI: 0.58–0.78, $p = 2e–7$) of stunting in children.

Among parental characteristics, the educational level of both mothers and fathers was a significant predictor of stunting. Children of mothers having secondary education (OR = 0.70, 95% CI: 0.60–0.83, $p = 4e–5$) and education up to grade 10 (OR = 0.399, 95% CI: 0.32–0.50, $p = 7e–15$) had lowered odds of becoming stunted than mothers who only received primary education (OR = 1.01, 95% CI: 0.85–1.20, $p = .91$). Similarly, fathers who had completed grade 10 or higher had children with significantly lowered odds of stunting by 57% (OR = 0.43, 95% CI: 0.35–0.52, $p = 3e–18$). Also, maternal employment lowered the odds of childhood stunting by 47% (OR = 0.52, 95% CI: 0.37–0.75, $p= .00034$).

Significant household characteristics predicting stunting were income, floor quality, lavatory (toilet) facility, food security and domestic violence. An increase

in monthly household income (i.e., the addition of US$100 per month) significantly lowered the likelihood of stunting (OR = 0.894; 95% CI = 0.86–0.93, p = 9e–8). Children dwelling in houses with 'better' flooring had less probability of developing stunting (OR = 0.51, 95% CI: 0.44–0.60, p = 2e–16). Children from households with access to unsanitary toilets had 18% lower odds of stunting than children from households that reported access to sanitary toilets (OR = 0.82; 95% CI: 0.72–0.93, p = .0023). Food security status of the household was also found to be a significant predictor of childhood stunting: compared to households with food security, households experiencing moderate and severe food insecurity were 1.89 (OR = 1.89, 95% CI: 1.53–2.32, p = 3e–9) and 1.47 (OR = 1.47, 95% CI: 1.23–1.76, p = 3e–5) times more likely to have children with stunting, respectively. The reported occurrence of any domestic violence in a household was associated with increased odds (OR = 1.42, 95% CI: 1.25–1.62, p = 2e–7) of having a stunted child in that household.

Moreover, this study attributes childhood stunting to regions. The odds of childhood stunting were higher in all the divisions than in Dhaka; however, statistical significance was found only for Chittagong and Sylhet. The odds of childhood stunting in Chittagong and Sylhet were 1.41 (OR = 1.41; 95% CI: 1.14–1.74, p = .0015) and 2.17 (OR = 2.17; 95% CI: 1.61–2.93, p = 5e–7) times higher than in Dhaka.

Discussion

This study estimated the prevalence of stunting and identified the determinants of stunting in Bangladeshi children aged 24 to 59 months, utilising a nationally representative dataset from NHDSBD, 2013. We found that 47% of children aged 24 to 59 months are stunted; this prevalence is even higher (56%) in the youngest age group (i.e., 24 to 36 months). These prevalence estimates of stunting are higher than the WHO critical threshold level (WHO, 2014). In our logistic regression analysis, we have found that younger children's age, not receiving vitamin A supplementation, lack of full immunisation, poor child feeding practices, fathers or mothers with lower education levels, maternal unemployment, lower income, poor floor quality, inadequate lavatory (toilet) facilities, food insecurity, domestic violence and residence in regions of Chittagong and Sylhet are significant risk factors for stunting in children older than two years. By attributing a combination of individual (e.g., child's age), parental, household and geographical (e.g., region) factors to stunting, these findings substantiate the proverbial complexity of the mechanism of undernutrition. Our findings on determinants of stunting are similar to those of the previous studies conducted in South Asian countries (Bhowmik & Das, 2019b; Fenske et al., 2013; Khan et al., 2019; Mostafa, 2011; Sarma et al., 2017; Sultana et al., 2019).

The study revealed no significant association between a child's gender and stunting. Although this is unlike the previously reported findings from Ethiopia, Tanzania, Nigeria and Uganda cited by Dake et al. (2019), a nonsignificant association of a child's gender with stunting has been reported by studies in South Asian countries

(Fenske et al., 2013; Khan et al., 2019; Smith & Shively; 2019), including Bangladesh (Sultana et al., 2019), where this study was conducted. This study found that children become less likely to be stunted as they grow up. This result contradicts other findings in Bangladesh (Ahmed et al., 2012; Bhowmik & Das, 2019; Chowdhury et al., 2016; Sultana et al., 2019) and other South Asian countries (Fenske et al., 2013; Khan et al., 2019; Smith & Shively, 2019). This discrepancy may be explained by our study focusing on children older than two years, when stunting peaks, perhaps primarily because of the child's exposure to the macro-environment, coupled with inadequate complementary feeding beyond six months.

Beyond the nonmodifiable factors of a child's age and gender, optimal child-feeding practices and adequate coverage of the immunisation and vitamin A supplementation programmes are associated with decreased levels of stunted growth (Bhutta et al., 2013; de Onis et al., 2013). This is supported by our study, which found vitamin A supplementation, vaccination and better child-feeding practices to lower the risk of stunting among children aged 24 to 59 months. Such findings reinforce and underscore the importance of improving the coverage and fidelity of proven effective nutrition-specific interventions, including appropriate infant and young child feeding, immunisation and micronutrient supplementation.

Although one might expect to find a robust negative correlation between household size and growth outcomes, we found children living in larger families to have a decreased (statistically insignificant) risk of being stunted compared to those from smaller families. Bangladesh's high prevalence of joint (extended) family structures allows more time, money and caregivers for children's feeding and care, which might be a protective factor against stunting. Also, our model did not detect statistically significant effects of women's participation in making day-to-day purchase decisions in the household and mothers' knowledge and practice related to nutrition and cooking/cleaning, which are inconsistent with previous reports (Hoddinott et al., 2017; Huda et al., 2012; Rahman et al., 2015). This may be due to the poor construction of the proxy measures or less relevance of these measures to a long-term indicator (stunting). An alternative explanation—as our sample includes children aged only 24 to 59 months—might be the differences in the population distribution of variables (Pearce, 2011).

Our results substantiate positive associations between parental education and child growth and corroborate findings reported previously (Frost et al., 2005; Rahman et al., 2016; Sarma et al., 2017; Semba et al., 2008; Sultana et al., 2019; Urke et al., 2011). This is expected, as educated parents are likely to be aware of their offspring's nutritional and healthcare needs and the potential benefits of taking appropriate care of children (Frost et al., 2005; Khanal et al., 2013; Semba et al., 2008). Moreover, education enables parents to participate in income-generation activities, improving household food security, better dietary quality, greater access to nutritious foods and increased use of healthcare services (Ali et al., 2013; Khanal et al., 2013; Urke et al., 2011; Uthman, 2009). Educated parents are also likely to efficiently use limited household resources to afford their children nutritious diets and better healthcare services (Islam et al., 2013). Maternal

employment, in particular, is associated with increased decision-making autonomy, leading to improved nutritional outcomes in children (Rahman et al., 2015).

Nutritional outcomes in children are known to reflect the household's economic condition. Our data, in line with previous literature (Danaei et al., 2016; Fenske et al., 2013; Mostafa, 2011), confirms that children from households with less income have a greater risk of being stunted compared to those from higher-income households. Increased income improves household food security, dietary quality and health conditions (through access to healthcare services), improving nutrient consumption and nutritional outcomes. Our study also highlights household food security as a protective factor against stunting, which aligns with previous findings (Ali et al., 2013; Hackett et al., 2009; Naser et al., 2014). Household food insecurity leads to low consumption of foods and forces household members to adopt extreme coping strategies with consequential poor growth and stunting in children. Household flooring quality represents an indicator of the home's physical environment (i.e., dwelling quality), and it has been shown previously that dirt floors are associated with stunting (Vilcins et al., 2018). The present study also mirrors such findings; however, further investigations into the hazards of poor-quality flooring are needed to identify the causative agents for stunting. Domestic violence was examined as a psychosocial factor, and our study agrees with the prevailing literature citing domestic violence as detrimental to the growth of the affected women's children (Chai et al., 2016). Probable mechanisms for this relationship include abusive withholding of food, stress-mediated influences on a child's metabolic rate and limiting or stopping women's expenditure on food and health care.

Community-level water and sanitation factors have recently emerged as important determinants of nutritional outcomes in children. A lack of access to improved water supply and lavatory (toilet) facilities can contribute to altered immune function, increased odds of infection and undernutrition (Neira & Prüss-Ustün, 2016). However, we found no significant association between stunting and an unsafe water supply. This may be due to how we combined access to different water sources into a simple safe/unsafe binary variable, which may mask the protective/detrimental effects of access to a single source. While this is a probable explanation in the current study, the broad literature on the relationship between access to safe water and stunting is also inconclusive (Vilcins et al., 2018). Even more surprisingly, we observed unsanitary lavatory (toilet) facilities to be protective against stunting. This result is counterintuitive and requires further exploration rather than dismissing sanitation as an inconsequential matter for improved child nutrition.

We found stunting to vary across all the regions in Bangladesh. This disparity may be due to different dietary patterns and sociocultural and environmental variations. However, this study observed regional variation in childhood stunting, with statistical significance only for Chittagong and Sylhet. The Sylhet region's entire basin (locally known as haor) and the Chittagong region's hilly districts are identified as poverty 'hot spots' by the Bangladesh Bureau of Statistics. Children and women in these two regions are particularly vulnerable and disadvantaged by

poor communication and transportation, limited access to health facilities, education and employment and inadequate coverage of immunisation programmes (Mia et al., 2018). This finding supports advocacy as it highlights the regional inequalities in child nutrition.

One obvious limitation of our data is its cross-sectional nature, which provides only a snapshot, making it impossible to establish the temporality of events or draw a causal inference. However, as Markovitz et al. (2012) suggested, cross-sectional studies may be a better source of data for policy judgements in the public health community than longitudinal studies when risk factors vary more across space at a fixed moment than at a fixed location across time. Second, some proxy measures constructed in this study (e.g., mothers' knowledge and practice related to nutrition and cooking/cleaning) may not adequately capture the underlying construct, requiring cautionary interpretation of the effects of individual variables. Third, as we attempted to assess many different variables using an existing dataset, we found about 9% missing data (especially in the stunting variable), which may be a source of selection bias. Still, we consider our work to be novel as we employ a comprehensive framework of stunting (Stewart et al., 2013) to include as many potential determinants as possible, taking up the call of the systems approach of epidemiology. In our regression modelling, however, we did not account for the hierarchy implied by the framework. Furthermore, we used a discrete measure of stunting with a cutoff of HAZ < -2.0, which is arbitrary and has little biological basis for a threshold (Perumal et al., 2018). Using such a binary dependent variable to indicate stunting can mask and discard important information about the entire distribution of outcomes.

Conclusions

This study found a high magnitude of stunting in children aged 24 to 59 months in a national sample in Bangladesh. Such prevalence estimates of stunting are higher than the WHO critical threshold level and require urgent policy attention. This study also identified that not receiving vitamin A supplementation, lack of full immunisation, poor child feeding practices, fathers or mothers with lower education levels, maternal unemployment, lower income, poor floor quality, inadequate access to lavatory (toilet) facilities, food insecurity, domestic violence and regions of Chittagong and Sylhet are significant risk factors for stunting in children older than two years. Future research on the determinants of stunting should use multilevel modelling and a continuous measure of stunting for a more accurate prediction of the determinants of stunting.

Supplemental Material

Supplemental material for this article is available online.

Declaration of Conflicting Interests

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Article

India's National Sanitation Policies: Evolution, Impact and Recommendations

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Abstract

India has launched five national sanitation policies since independence, and among these, the Swachh Bharath Mission-Grameen is the world's largest sanitation campaign. Despite this achievement, the literature on understanding the evolution and impact of these policies is scarce. We are one of the earliest studies to address this literature gap. We find that as the campaign progressed, the programmes gained rigour in constructing toilets and in terms of behavioural change to induce people to use these toilets. However, despite the government's claim of India being declared an open defecation–free (ODF) nation at the end of SBM, other government of India data sources claim otherwise. Hence, tracing the evolution and impact of national sanitation policies gives us valuable lessons to make India ODF in the future: (a) efforts to implement context-specific behaviour change campaigns can bring a sustained change in the social attitudes of people regarding sanitation, (b) optimising toilet infrastructure and aligning its pace of construction, (c) allocating budget for upkeep of already-built toilets under government programmes will reduce and even eliminate reversion to open defecation and (d) moving the sanitation outcomes from access to adoption will present an actual state of the sanitation environment in India. This article is one of the earliest in exploring rural sanitation in India from a policy history perspective, considering how sanitation practices and trends changed every time there was a change in the rural sanitation policy.

Keywords

Sanitation policies, evolution, India, Swachh Bharath Mission, Total Sanitation Campaign, Central Rural Sanitation Programme, Nirmal Bharat Abhiyan

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Introduction

Eliminating open defecation (OD) is a public sector priority in India. To achieve this goal, India launched its first national sanitation policy [Central Rural Sanitation Programme (CRSP)] in 1986, with Swachh Bharath Mission-Grameen (SBM-G) being inaugurated in 2014. SBM-G is considered to be the world's largest toilet construction and behaviour change mission. Despite the scale of the policies launched, the literature on the comprehensive assessment of the development and impact of these policies remains scarce. In this context, this article studies the evolution of India's sanitation policies and their effectiveness in terms of sanitation outcomes such as access to and adoption of toilets. The lessons learned from this analysis are critical to providing recommendations that can be useful in designing future sanitation policies.

Sanitation has been a priority in India since ancient times (Dutta, 2017). This was substantiated by the discovery of remnants of toilets found in the sites of the Indus Valley. However, sanitation ceased being a priority during colonial times due to a general disinterest in managing rural water and sanitation issues (Dutta, 2017; Jangra et al., 2016). In 1947, the Indian population of 300 million people had less than 1 per cent sanitation coverage. These statistics remained stagnant for a considerable time, as the 1981 census reported that rural sanitation coverage in India was only 1 per cent, while urban sanitation coverage was 27 per cent (Government of India, 2014). Sanitation coverage is defined as the proportion of households owning a toilet in the community.

To combat this challenge, the Government of India (GOI) launched the first sanitation programme, the CRSP, in 1986 to improve the quality of life in rural areas and provide dignity and privacy to women. Financial subsidies were provided to the below poverty line (BPL) households to construct individual household latrines (IHHL). Research informs us that CRSP, although a significant step for India's sanitation landscape, was marred due to the slow construction of toilets and the exclusion of any component that was focused on transforming the sanitation behaviour of people (Alexander et al., 2016). Hence, it was decided that to provide sanitation for all, inculcation of some form of behaviour change communication (BCC)—which will change people's attitude towards OD—should become a part of the following sanitation policy.

In 1999, CRSP was restructured as a demand-driven, community-led and people-centric programme called the Total Sanitation Campaign (TSC). Besides continuing financial subsidies to BPL households, TSC emphasised information, education and communication (IEC) activities. Nirmal Gram Puraskar (NGP) (translated as clean village prize) was also introduced to recognise the achievements of the Gram Panchayats (GPs) (translated as village council) in attaining universal sanitation coverage and complete elimination of OD. Despite the restructuring, TSC was also found to be 'infrastructure-led' and lacking a thorough implementation of IEC activities (Hueso & Bell, 2013).

The TSC was succeeded by Nirmal Bharat Abhiyan (NBA) in 2012 and shared the common objectives of the previous two programmes. Within 18 months, the prime minister of India launched the SBM-G on October 2, 2014, to accelerate the

efforts to achieve universal sanitation coverage by 2 October 2019. The programme has achieved the construction of 10 crore or 100 million toilets, higher than in any previous sanitation programme. Still, the independent, nationally representative first phase of the National Family Health Survey (NFHS-5) 2019–2020 data found that only 77 per cent of households were using an improved source of sanitation. SBM-G has also been criticised for not emphasising BCC and using coercive tactics to construct the toilet (Gupta et al., 2019).

To our knowledge, ours is one of the earliest articles to detail the evolution of the sanitation policy in India and discuss the evidence regarding its effectiveness on sanitation coverage and adoption. A nuanced understanding of the lessons learned from the research on each of these policies will be helpful for future policymakers and programme implementers of sanitation campaigns in India. The conclusion from every round of policy has taught us that OD is enduringly prevalent in India. Why is that so? Empirical research has shown that there is a revealed preference for OD in rural India; that is, people will prefer OD even in the presence of toilets (Coffey et al., 2014). This can be attributed to multiple factors: low awareness of the health benefits (adverse impact) of using toilets (practicing OD), a misplaced conception that toilets will impose a huge cost and are unaffordable and a similar erroneous notion that emptying the pits of toilets will be expensive (Coffey et al., 2014). Using a toilet also requires at least 10 litres of water for flushing, and since the rural households in India use pit (not pour-flush) latrines, it imposes an additional burden on the members to fill and carry water.[1] As opposed to this, OD only requires a mug of water for anal cleansing, and hence, it is perceived to be a healthier, more sustainable alternative to toilets (Routray, 2017).

We now ask an important question: What policy lessons can be learned from research on the previous sanitation programmes? Our analysis suggests that future undertakings of SBM-G should refrain from deploying coercive tactics to build toilets and instead emphasise the dissemination of BCC messages that inform people not only about the ills of OD but also about the multitudes of benefits of sustainable use of toilets (Gupta et al., 2019). Future sanitation policies, unlike SBM-G, should not just provide subsidies for twin-pit toilets but also understand the regional heterogeneity. For instance, the latest sanitation technologies that utilise less water, like EcoSan toilets, should be harnessed for water-scarce regions (Exum et al., 2020; Moudgil, 2019).[2] International experience from Bangladesh, India's neighbouring country, which has successfully eliminated OD, teaches us that women can be the drivers of sanitation change. Their participation and leadership during community-led BCC will accelerate the pace of using toilets (Ahmad, 2019; Montu, 2016).

The following section details the evolution of India's sanitation policies and discusses their impact on sanitation outcomes. It also outlines the lessons learned from each policy and how the following policy improved upon those shortcomings. The third section enlists the policy recommendation from the analysis and discusses the limitations of the article. Finally, the fourth section concludes the article.

Evolution and Effectiveness of Sanitation Policies in India

India has had five national sanitation policies since 1986 (see Figure 1). We explore the details and discuss the research that has studied the impact on outcomes such as sanitation coverage and adoption. We also elucidate the lessons learned from each of these policies.

Central Rural Sanitation Programme (1986–1999)

The GOI launched the first national sanitation campaign, the CRSP, in 1986. The objective of the programme was to 'improve the quality of life of the rural people and also to provide privacy and dignity to women' (Government of India, 2007). Further, the programme was projected to increase rural sanitation by 25 per cent (Mohapatra, 2019). The programme was also the first to provide financial assistance to BPL households to promote the construction of toilets. Table 1 depicts the guidelines launched by the GOI to divide the cost of construction of toilets under CRSP (Government of India, 2007).

Besides the construction of IHHLs, the programme allocated ₹2 lakhs, or ₹0.2 million, for the construction of community sanitary complexes. The construction of these complexes will subsume adequate toilet seats for the community members, cubicles for bathing, washbasins, etc. and will be located in an area that is convenient and acceptable to the village members. Further, the programme acknowledged the role of children in bringing about sustained change as they are

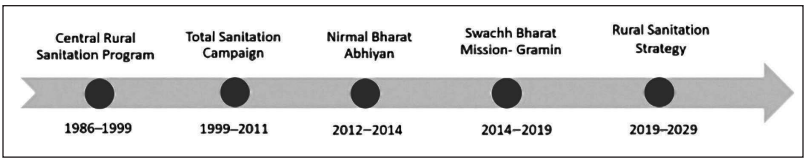

Figure 1. Timeline of the National Sanitation Policies in India.

Table 1. Cost for Construction of Toilets.

	Contribution Percentage					
	GOI		State		Household	
Basic Low-cost Unit Cost	BPL	APL	BPL	APL	BPL	APL
Model 1: Up to ₹1,500 (including superstructure)	60	Nil	20	Nil	20	100
Model 2: Between ₹1,500 and ₹2,000	30	Nil	30	Nil	40	100
Above ₹2,000	Nil	Nil	Nil	Nil	100	100

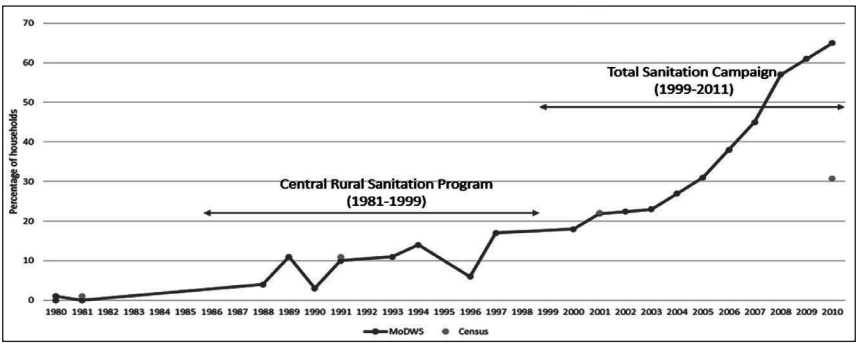

Figure 2. Progress in Sanitation Coverage for Rural Households Under the CRSP and TSC.

Sources: Ministry of Drinking Water and Sanitation (MoDWS) and Census of India (The World Bank, 2010).

more willing to learn and pass on the education to their families. The programme aimed to build gender-segregated toilets in all types of government schools.

The Planning Commission estimates that between 1986 and 1997, CRSP led to the construction of more than 4 million toilets (Datta, 2017). This translated to an increase in IHHL in rural areas from around 3 per cent in 1986 to 17 per cent in 1999, or around a 1 per cent increase annually (Government of India, 2008) (see Figure 2). This was 8 percentage points lower than the targeted 25 per cent increase in rural sanitation. Hence, the programme was criticised for its sluggish construction. Not only was the construction slow and below the target, but the rate of adoption was also abysmally low. The limited success of CRSP has been attributed to the lack of community participation, the complete absence of a behavioural approach to enhancing the adoption of toilets and poor construction standards (Mauro, 2015; Routray, 2017; The World Bank, 2010).

The programme was instrumental in providing key lessons for the future development of sanitation policies. It was learned that the construction of toilets did not lead to a concomitant increase in their adoption. Elimination of OD necessitated an emphasis on behaviour change communication (BCC), as OD was deeply ingrained in rural India. Considering all the lessons, the government replaced CRSP with TSC in 1999.

Total Sanitation Campaign (1999–2011)

The main objective of the TSC was to improve the general quality of life and provide universal sanitation coverage in rural areas by 2012 (Government of India, 2010a). This programme was renewed to make sanitation interventions community-led, people-centred, incentive-based and demand-driven (Hueso & Bell, 2013). A major part of the programme was a clearly defined focus on IEC

activities. The role of the IEC was to generate demand for sanitation through a one-time community-led BCC session with all the members of the community. To ensure adequate implementation of the IEC activities, 15 per cent of the programme's total budget was reserved for this purpose (Government of India, 2010a).

Similar to CRSP, BPL households were given subsidies for the construction of IHHLs. A model of cost-sharing for a toilet costing ₹2,500 was mentioned in the guidelines. If the beneficiary contributed ₹300, ₹1,500 and ₹700 were given from the central and state budgets, respectively. It is important to note that while IEC was to be disseminated among all the members of the community, the subsidies were offered to only the BPL households. Above poverty line (APL) households were expected to be sufficiently motivated after the IEC session to undertake the construction themselves. From CRSP, TSC also retained the construction of community sanitary complexes.

To celebrate the achievements gained through TSC, the GOI launched the NGP in 2003 (Government of India, 2010b). NGP was a monetary award to be given to the ODF village committees or GPs. The award was designed to bring sanitation issues in rural areas to the forefront of discussion and to recognise the efforts of regions that have achieved freedom from OD. These communities were envisioned to be highlighted and to serve as role models for other communities.

GOI's Ministry of Drinking Water and Sanitation (MoDWS), led by TSC, touted it as a successful sanitation strategy. Their official statistics reported that rural sanitation increased from 22 per cent in 2001 to 65 per cent in 2010 (The World Bank, 2010) (see Figure 2). However, the GOI's census data indicated that there was a modest rise in rural sanitation coverage from 22 per cent in 2001 to 31 per cent in 2011 (Government of India, 2011). The inconsistency between the two GOI data sources can be explained as MoDWS overestimated the toilets built under TSC. It is important to note that the 2011 census data indicates that progress under TSC was less than 1 per cent per annum, even lower than the 1 per cent increase per annum in rural sanitation coverage under CRSP. The rise in toilet usage was found to be even lower (Barnard et al., 2013; Coffey et al., 2014).

After the implementation of TSC, several independent studies have evaluated its impact on toilet coverage and use. In Table 2, we summarise the five studies that have used rigorous research designs and econometric methods [e.g., randomised control trials (RCT)] to assess the impact of TSC. Table 3 presents the results from four qualitative studies that have investigated the effects of TSC. Both quantitative and qualitative studies on TSC jointly conclude that (a) the increase in coverage under TSC was less than universal, (b) the toilets constructed were found to be lacking important structural components that inhibited their adoption, (c) personnel in charge of IEC activities also lacked the training to conduct the behavioral change activities and hence failed to motivate people and (d) the decline in OD was lower than the increase in toilets, as both technological and behavioural barriers impeded commensurate adoption.

Table 2. Summary of Quantitative Studies Assessing the Impact of Total Sanitation Campaign (TSC).

Study Reference	State and District	Intervention	Study Design	Follow-up Period	Sanitation Coverage		Net Change in Coverage	Sanitation Use		Net Change in Usage
					Treatment (T, %)	Control (C, %)	T − C (%)	Treatment (T)	Control (C)	T − C (%)
Pattanayak et al. (2009)	Bhadrak district, Orissa	TSC+ intensified IEC	CRCT	1 year	32	13	29	nr	nr	nr
Clasen et al. (2014)	Puri district, Orissa	TSC	CRCT	3 years	63	12	51	36	9	27
Patil et al. (2014)	Ten districts in Madhya Pradesh	TSC	CRCT	21 months	41	22	19	27	16	9
Hammer and Spears (2016)	Ahmednagar district in Maharashtra	TSC	CRCT	18 months	nr	nr	8	nr	nr	nr
Arnold et al. (2010)	Near the city of Tiruchirappalli, Tamil Nadu	TSC-like	Before-and-after	5 years	48	15	33	23	12	11

nr: not reported

Table 3. Summary of Qualitative Studies Assessing the Impact of the Total Sanitation Campaign (TSC).

Study Reference	Context	Findings
Barnard et al. (2013)	20 villages in the Puri district of Orissa	1. The programme managed a substantial gain in coverage (about 72% in treatment villages), yet about 40% were not used by any household member. 2. Over one-third of the household members who owned toilets reported never using them for defecation, and only slightly less than half of the households reported using them at *all* times for defecation. 3. Upon further investigation of the reasons for the toilets' abandonment, the authors found a preference for OD and poor-quality toilets. 4. About 47% of the constructed toilets met the bare minimum criteria of functionality, i.e., the presence of a door, four walls and a roof to ensure privacy. 5. The remaining toilets were either broken or missing certain parts, making them unfit.
Hueso and Bell (2013)	Villages in Haryana, Himachal Pradesh, Madhya Pradesh and Uttar Pradesh	1. Implementation of the TSC in the field was government-led, subsidy-based, infrastructure-centred and supply-led, as opposed to the established objective of the TSC being a community-led, incentive-based, people-centred and demand-driven programme. 2. The officials managing the project were often overworked and lacked motivation for achieving universal sanitation. 3. It was also found that the staff lacked proper training to conduct IEC with the communities. This impeded demand generation for sanitation. 4. Despite the clarity in the TSC guidelines that funds should be disbursed to the households only after construction and adoption, it was found that payment was made upfront to the households.
Coffey et al. (2014)	13 districts of five northern states of India (Bihar, Haryana, Madhya Pradesh, Rajasthan and Uttar Pradesh)	1. More than 60% of the households that received toilet construction materials from the government had at least one member practicing OD between 2012 and 2013. 2. Household members who built toilets entirely with government subsidies were twice as likely to practice OD as households that built self-financed toilets. 3. Finally, 47% of the people surveyed reported a preference for OD even in the presence of toilets, leading the authors to conclude that including BCC activities in any sanitation intervention is crucial to changing people's preferences and leading to sustained adoption of toilets. 4. The authors explained how the programme implementation and construction of toilets happened without taking into account people's preferences (such as ignoring preference for OD and desire for a large pit size). If it were to continue doing so, then the toilets would continue to remain unused.

(Table 3 continued)

(Table 3 continued)

Study Reference	Context	Findings
Routray et al. (2015)	Ten villages in Puri district of Odisha between July 2011 and September 2012	1. TSC had been implemented in these villages 3–5 years before the commencement of this study. 2. The authors found that most government-constructed toilets were unfinished, as they lacked an essential structure (door, roof and walls) to maintain privacy and a nearby water source. 3. Respondents complained that the pit size of the government toilets was too small. Further, self-financed toilets were found to have complete structures and higher adoption rates compared to government-subsidised toilets. 4. However, the poor quality of toilets built under TSC was not the sole reason for continued OD. People also stated their preference for OD, suggesting the need to develop programmes that overcome behavioural constraints to adoption.

Nirmal Bharat Abhiyan (2012–2014)

TSC was renamed Nirmal Bharat Abhiyan (NBA) in 2012 to increase sanitation coverage in rural areas (Government of India, 2012). Similar to TSC, the programme was structured as community-led and people-centred. Demand generation for toilets through rigorous implementation of the IEC activities was retained as the cornerstone of the programme. This sanitation programme was the first to extend financial support for the construction of IHHLs to APL households, a drastic shift from the previous policies that included only BPL households. However, the subsidies provided to the APL households were restricted to only 'SCs/STs, small and marginal farmers, landless laborers with homestead, physically handicapped and women-headed households' (Government of India, 2012). NBA increased the cost of the model toilet from ₹2,500 (in TSC) to ₹5,500. Central and state governments would contribute ₹3,200 and ₹1,400, respectively. The household would contribute the remaining in cash or labour.

Table 4 lists findings from the study that measured the impact of NBA in 10 villages in Odisha. The study found that, much like TSC, there was an inconsistent implementation of IEC activities. The study also went beyond the behavioural and technological barriers and brought forth another dimension, that is, complex caste politics, that further inhibited the adoption of toilets. Like its predecessors, the NBA's success was limited to the construction of toilets. 18 months after the launch of this programme, NBA was restructured and launched as SBM-G.

Swachh Bharat Mission Grameen (2014–2019)

SBM-G (translated as Clean Indian Mission (Rural)) was launched on 2 October 2014, to improve the general quality of rural life by eliminating OD in India by

Table 4. Summary of a Qualitative Study Assessing the Impact of Nirmal Bharath Abhiyan (NBA).

Study Reference	Context	Findings
Routray (2017)	Ten randomly selected villages (of the 50 project villages) in one district of Odisha	1. NBA was implemented one year before the study, and the results revealed an inconsistent implementation of the programme, a lack of adequate training of the IEC facilitation team and a lack of clarity on the role of government and NGOs in the entire process. 2. The caste and social divide dictated the campaign's effectiveness, as male upper-class members often dominated the sanitation meetings, excluding lower-caste members and women from the process. 3. The implementers estimated an increase in sanitation coverage from 7 percentage points in the baseline to 19 percentage points across the 50 villages one year after the NBA.

2 October 2019 (Government of India, 2014). In line with the TSC and NBA, SBM-G also focuses heavily on community-led BCC to generate awareness about the adverse impact of OD and bring about demand for toilets.

Financial incentives for the construction of toilets were provided to BPL and certain APL households (as mentioned under NBA). It was expected that the APL households not covered under the scheme would be sufficiently motivated to build one using their finances once IEC activities were conducted in their communities. The incentive or grant-in-aid for IHHLs was earmarked at ₹12,000, where the contribution of the central and state governments would be 3:1, respectively. The households were not expected to contribute any portion of the cost.

The SBM-G statistics suggest that while the sanitation coverage was achieved slowly during CRSP and TSC, it eventually gained momentum during SBM-G as India was declared an ODF nation based on these statistics. SBM-G statistics inform us that sanitation coverage increased from 39 per cent in October 2014 to 100 per cent in 2019 (see Figure 3). Over 10 crore or 100 million crore toilets were built during SBM-G, and all villages across the districts of India were declared ODF. However, the recently released first phase of another GOI dataset,

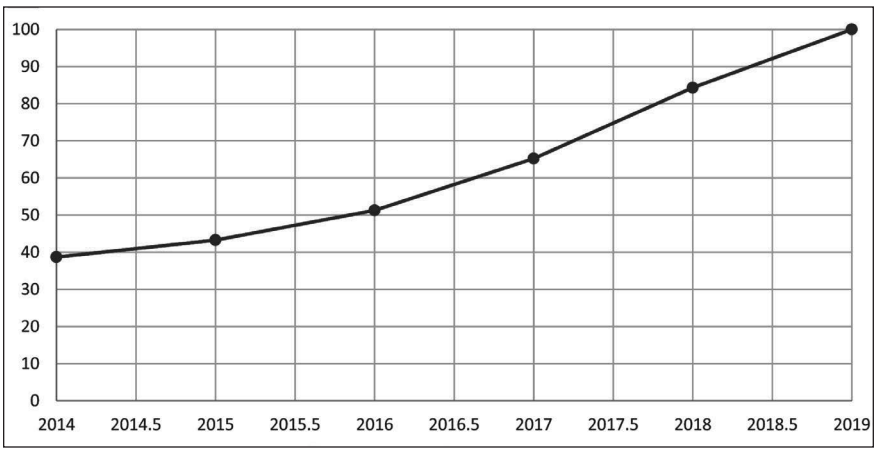

Figure 3. Progress in Sanitation Coverage Under SBM-G.

Source: https://swachhbharatmission.gov.in/SBM-Gcms/index.htm.

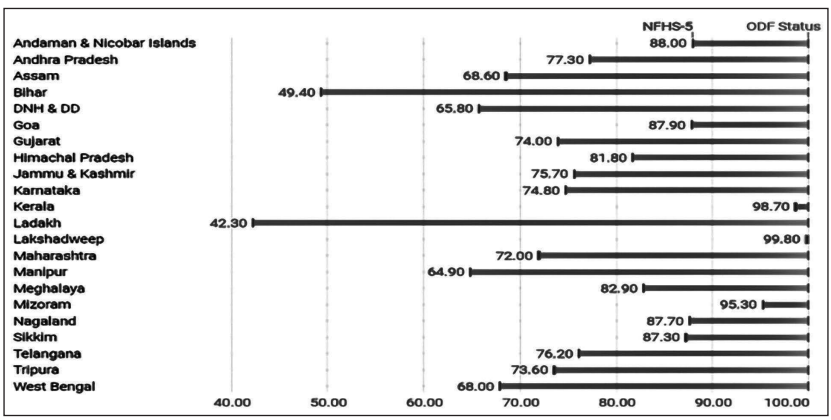

Figure 4. Difference in the Percentage of Households Using Improved Sanitation as Reported Under NFHS-5 and the ODF Status.

NFHS-5, questions the validity of these statistics (see Figure 4). Besides Kerala and Lakshadweep, no state is close to achieving the ODF status.

Independent studies have also raised similar doubts about the SBM-G data. We report the results from these studies in Table 5, which jointly conclude that the increase in toilet coverage is far from universal, and adoption is even lower than the toilets built. While this finding aligns with the previous sanitation programmes, SBM-G was noted for using coercive tactics on the ground to speed up the construction process. These included discontinuing government benefits (such as access to subsidised food rations, etc.), with a disproportionate burden falling on marginalised communities (Gupta et al., 2019). So, while the previous policies have taught us key lessons on the importance of using rigorous BCC and the

Table 5. Summary of Studies Assessing the Impact of the Swachh Bharath Mission (SBM-G).

Study Reference	Context	Findings
Gupta et al. (2019)	13 districts of five northern states of India (Bihar, Haryana, Madhya Pradesh, Rajasthan and Uttar Pradesh)	1. In a follow-up study to Coffey et al. (2014), Gupta et al. (2019) re-surveyed the same households in 13 districts in five northern states in India. 2. The authors report that between 2014 and 2018, i.e., the duration of the SBM-G, the percentage of people who owned a toilet and still practiced OD remained unchanged, at 23%. 3. Additionally, the households that received the money to build their toilet were 10% less likely to practice OD than those that owned a GOI-constructed toilet. 4. Finally, over 50% of the households complained of coercive tactics being employed to achieve construction and adoption. 5. The authors insist on ending the intimidation tactics to achieve sustained adoption. 6. They conclude that SBM-G could not address social attitudes towards OD and suggest a rigorous focus on BCC activities for future sanitation campaigns.
Andres et al. (2020)	200 Gram Panchayats (GPs) in rural PunjabThe study was conducted from 2015 to 2021	1. Multi-arm RCT: The first experimental arm had the regular implementation of SBM-G in GPs, the second arm included SBM-G in schools and regular SBM-G in GPs, and the third arm included an intense follow-up campaign besides regular SBM-G. 2. The authors report an increase of 6.8–10.4 percentage points in toilet coverage across different arms relative to the control group (households that did not receive any intervention). 3. The decline in OD was noted at 7.3–7.8 percentage points. 4. There was a limited impact on the use of soap for handwashing and other hygiene practices.
Exum et al. (2020)	Around 20,000 households in Rajasthan	1. Another study attempted to investigate the claim of the open defecation–free (ODF) status of Rajasthan by the GOI by assessing the OD trends from 2016 to 2018. 2. The study used four rounds of repeated cross-section data on household water and sanitation. 3. OD declined from 63% to 46% in rural households and from 13% to 9% in urban households. Hence, Rajasthan is far from achieving ODF status. 4. The study's insights suggest that water-stressed households practiced more OD than those with lower water stress. 5. The unavailability of water was the key reason for the persistence of OD in the region. 6. It is important to note that Rajasthan is a water-scare state, and the twin-pit model suggested for construction under SBM-G ignores the water required for its functioning and maintenance.

(Table 5 continued)

(Table 5 continued)

Study Reference	Context	Findings
Dandabathula et al. (2019)	Acute diarrheal disease (ADD) outbreaks for 9 years (2010–2018) retrieved from the Integrated Disease Surveillance Programme (IDSP), the Government of India's weekly outbreaks database	1. This study investigates the trend of ADD outbreaks occurring over 9 years and correlates with SBM's objective. 2. 2017 and 2018 recorded the lowest number of total ADD outbreaks. 3. In 2018, certain environmental corrections seemed to have happened, as these four months of monsoon- May, June, July, and August recorded a lesser number of outbreaks in comparison to previous years. 4. The authors attribute this to toilet construction under SBM-G and the mass-level behaviour change movement.
Singh et al. (2021)	Three publicly available population-level survey datasets in India: 1. District Level Household and Facilities Survey (DLHS), Round 4 (2013); 2. Annual Health Survey (AHS, 2013–2014); and 3. National Family Health Survey (NFHS), Round 4 (2015–2016). These surveys are representative at the district and state levels.	1. The study examines whether SBM-G is associated with reducing stunting (low height-for-age) among children under 5 years old in India. 2. Stunting declined by 0.06% with every percentage increase in households with toilets post-SBM-G. 3. Rural regions and districts with higher pre-SBM-G toilet availability show a greater decline in stunting post-SBM-G.

construction of quality sanitation facilities, SBM-G takes us a step further and introduces us to refraining from using such tactics (Cullet, 2018; Gupta et al., 2019). These results also highlight the need for more independent studies to evaluate the effectiveness of SBM-G, as the official statistics appear to be incongruent with the work of independent researchers.

However, it is equally important to be aware of the many benefits that the programme did have. The mission has brought about positive health impacts by promoting better hygiene practices. Increased access to toilets has decreased waterborne diseases and improved child height-for-age (stunting), contributing to overall improvements in community health (Dandabathula et al., 2019; Singh et al., 2021). SBM emphasised BCC to shift cultural norms and attitudes towards open defecation. This awareness campaign was crucial in encouraging communities to adopt healthier sanitation practices and abandon open defecation (Sumedh, 2023). Improved sanitation has broader economic and social benefits. It enhances the dignity and well-being of individuals, particularly women, by providing them with safe and private sanitation facilities. This, in turn, contributes to gender equality and empowerment (UNICEF, 2020). In general, SBM-G reflects a firm commitment from the government towards achieving sanitation goals. The mission's sustained efforts and continued support indicate a dedication to maintaining a positive momentum in the sanitation sector.

Rural Sanitation Strategy (2019–2029)

In 2019, the Government of India launched the 10-Year Rural Sanitation Strategy (2019–2029), which focuses on sustaining the sanitation behaviour change achieved under the SBM-G and increasing access to solid and liquid waste management (Government of India, 2019). The 10-year strategy also calls for targeted intervention in capacity building, IEC, biological waste management, water management and plastic waste management.

The elements of the strategy to achieve the ODF Plus status for villages are stated as follows:

1. Sustained usage of IHHLs
2. Ensuring no one is left behind and providing sanitation access to new households
3. Sanitation coverage of public spaces (through public and community toilets)
4. Implementation of Solid and Liquid Waste Management (SLWM) in rural areas
5. Visible cleanliness and solid and liquid waste management

We now assimilate the lessons learned from India's policy evolution and present policy recommendations.

Discussion and Policy Implications

The evolution of Indian sanitation policies and their impact are summarised in Table 6.

Table 6. Summary of National Sanitation Policies and Their Impact in India (as per Government Sources).

Years	Sanitation Policy	Policy Brief	Policy Impact
1986–1999	Central Rural Sanitation Programme	Improve the quality of life of rural people and also provide privacy and dignity to women. Increase rural sanitation coverage by 25%. For a ₹1,500 toilet model, the BPL households would receive 60:20 of the cost from the central and state governments; remaining to be covered by the households.	IHHL went from around 3% in 1986 to 17% in 1999 in rural areas.
1999–2011	Total Sanitation Campaign	Improving the general quality of life and providing universal sanitation coverage in rural areas by 2012. Apart from toilet construction, emphasis on information, education and communication activities (IEC). For a ₹2,500 model toilet, BPL households will get ₹1,500 and ₹700 from the central and state budgets, respectively; remaining to be covered by the households.	IHHL increased from 22% in 2001 to 31% in 2011.

(Table 6 continued)

(Table 6 continued)

Years	Sanitation Policy	Policy Brief	Policy Impact
2012–2014	Nirmal Bharat Abhiyan	Increase sanitation coverage in rural areas. IEC activities are retained as the cornerstone of the programme. First to include certain above-poverty line (APL) households. For a ₹5,500 model toilet, the eligible households will get ₹3,200 and ₹1,400 from the central and state budgets, respectively; remaining to be covered by the households.	Due to the short duration of the programme, there are no government statistics on the impact.
2014–2019	Swachh Bharat Mission-Grameen	Improve the general quality of rural life by eliminating open defecation in India by 2 October 2019. More flexibility is provided to the states. Inclusion of urban areas for the first time Continued inclusion of BPL and certain APL households Retained emphasis on IEC activities. For a ₹12,000 model toilet, the eligible households will get ₹9,000 and ₹3,000 from the central and state budgets, respectively.	Government statistics claim 100% coverage across rural and urban areas in India.
2019–2029	Rural Sanitation Strategy	Sustaining the gains of the SBM-G and ensuring sustained access to safely managed sanitation for all rural Indians; achieve a clean-living environment through solid and liquid waste management.	Yet to be determined

We now ask a pertinent question: what lessons do India's past sanitation policies teach us that can make India ODF?

Understanding the Context of BCC Implementation

The IEC strategies employed during the period from the 1980s to the 2000s primarily focused on health benefits, emphasising how the use of toilets could reduce the disease burden. While health-focused campaigns provided a rationale for toilet adoption, the slow pace of adoption suggests limitations in solely relying on positive reinforcement.

Post-2012, the government adopted a mixed approach to SBM, tailoring strategies to be context-specific. Some areas focused on promoting 'dignity', while others employed 'shaming'. Framing sanitation as a matter of dignity aimed to empower individuals, especially women, is a good strategy for promoting pride and ownership in using toilets. On the other hand, shaming or coercive tactics aimed at creating social pressure to conform to using the toilet can lead to backlash and resistance, potentially undermining the sustainability of behavioural change. Coercive tactics raise ethical concerns and might not be well received in certain

cultural contexts. For instance, in a paper titled 'Shame or Subsidy Revisited: Social Mobilization for Sanitation in Orissa, India', the authors found that subsidies can overcome severe budget constraints but are not necessary to spur action (Pattanayak et al., 2009). Hence, shaming can be very effective by harnessing the power of social pressure and peer monitoring in rural Odisha.

Besides choosing the right message, the implementers should also focus on selecting the right target group to whom the message would be communicated. Experience from Bangladesh, India's neighbouring country, which has successfully eliminated OD, has taught us that sanitation progress is accelerated if the demand for toilets comes from women, as they suffer disproportionately in its absence. Women also have the most influence on the hygiene practices of their children in households (Jha, 2003). Therefore, banking on the experience from other countries, any sanitation intervention should first incorporate a door-to-door initiation of contact with the women of the communities, separate focused group discussions with them to educate them about the benefits of toilets for them and their families, mandate their presence in the community-level sanitation meetings and ask for their decision regarding the location and type of toilet to be built.

India's diverse cultural landscape demands tailored approaches for different regions. Future sanitation policies might be more effective at promoting 'dignity' (i.e., fostering a sense of pride and self-respect associated with toilet use) in places (say, urban residences or residences where women are more likely to be dissatisfied with the current practice of OD) where communities are willing to embrace toilets as a symbol of improved living standards. However, in certain contexts, like rural areas, 'shaming' (i.e., creating social pressure and stigma around open defecation) may trigger behavioural change by leveraging social norms and community perceptions, although its sustainability and ethical implications require careful consideration.

Optimising Toilet Infrastructure and Aligning Its Pace of Construction

SBM-G recommends the construction of twin-pit toilets because the structure, if used properly, allows safe and inexpensive faecal sludge management. Since only one of the two pits is used at any given time, the first pit, after a couple of years of use, can be closed to let the faeces decompose. This converts the faeces into an organic compound that can be collected safely and used as a fertiliser for agriculture. Even though the intent behind SBM-G propagating the construction of twin-pit toilets was right, policymakers must realise that this design is not suited to all regions. For instance, twin-pit toilets should not be built in flood-prone areas as they contain a higher risk of leaching and contamination of drinking sources (Bharat et al., 2020). Similarly, banking on cost-effective waterless sanitation technologies like EcoSan toilets for water-scarce regions will be the right call. Accounting for the regional heterogeneity during construction is important to ensure safe sanitation for all.

Another crucial policy consideration centres around the interplay between the 'desired pace' of constructing and adopting toilets and the 'feasible pace' of such construction and adoption. When there is a misalignment between the desired and feasible paces, it raises pertinent questions about the effectiveness of the sanitation initiatives. In the context of the SBM, which set targets to achieve open-defecation-free status within 60 months (from 2014 to 2019), the article emphasises the need to assess the feasibility of reaching these targets within the same timeframe. This entails exploring the preparedness required to align the pace of implementation with the desired objectives. These considerations introduce interesting dimensions that sanitation professionals actively seek answers to, as they are pivotal in shaping effective policies and programmes.

Despite recognising the importance of financial resources, this article underscores the equally critical role of time as a resource often overlooked or taken for granted by the government. The analysis emphasises that while funds are undeniably crucial, the temporal dimension must not be neglected. This brings to light the vital issue of managing time and factoring it into the planning and administration of India's sanitation policies and programmes.

Upkeep of Already-built Toilets

Even after the successful implementation of BCC and people initiating the use of toilets, research has shown that people revert to OD (Evans et al., 2009). Reversion to OD occurs when the toilets are not structurally sound, are missing important components like doors or walls, become too claustrophobic or the owner cannot manage the waste collected over time (Bharat et al., 2020). A study of 116 African villages recommends sustainable toilet use only when adequate technical support is provided to communities after BCC, especially when the toilets begin to deteriorate (Tyndale-Biscoe et al., 2013). Just as toilet construction cannot be considered a stand-alone sanitation strategy for India, similarly, focusing on complementing BCC with good-quality toilets ensures that reversion to OD does not happen. Hence, we recommend that future sanitation policies allocate a budget for the maintenance of the already-built government toilets.

Moving the Sanitation Outcomes from Access to Adoption

It is important to note that India was declared an ODF nation based solely on the number of toilets. ODF means freedom from open defecation, which comes from using toilets on a sustainable basis. Hence, even if SBM-G data (which records only access) informs us about universal coverage, the first phase of NFHS-5 data reports that only 77 per cent of households use improved sanitation sources. Adoption lags behind access, which can be attributed to behavioural and technological barriers (Coffey et al., 2014). Since NFHS-5 is a more apt representation of the sanitation environment in India, sanitation outcomes must shift from access to adoption to measure India's ODF status in the future.

India's resolution to eliminate OD gives it a rich history of national sanitation policies, with SBM-G classified as the world's largest sanitation campaign. Yet, the literature on the comprehensive understanding of their evolution and effectiveness remains scarce. In this context, we summarise these policies, evaluate their development and study the impact on access to and adoption of toilets. While our study has recommended essential lessons for future sanitation strategies in India, it focuses on rural sanitation issues. The discussion of urban sanitation challenges differs from what the study has explored and can be taken up by researchers for future studies.

Conclusion

This study provides a comprehensive examination of the evolution and impact of India's sanitation policies, focusing on access to and adoption of toilets. From the inception of the CRSP in 1986 to the Rural Sanitation Strategy in 2019, we analyse the strengths and shortcomings of each policy, emphasising the need for a nuanced approach to addressing the persistent challenge of OD in the country.

Our findings underscore the importance of context-specific BCC implementation in sanitation policies, suggesting a shift from coercive tactics to empowering messages that highlight the health and societal benefits of using toilets. Additionally, the pivotal role of women as agents of change is emphasised, drawing insights from successful sanitation interventions in neighbouring countries, like Bangladesh. The significance of context-specific infrastructure construction, considering regional heterogeneity and leveraging waterless technologies like EcoSan toilets in water-scarce regions, emerges as a key recommendation. The analysis also highlights the critical interplay between the desired and feasible paces of implementation, urging policymakers to align objectives with realistic timelines. Moreover, we stress the need for ongoing support and maintenance of existing toilets to prevent reversion to open defecation, addressing structural issues and ensuring sustainable usage. Finally, we advocate for a paradigm shift in measuring sanitation outcomes from mere access to the widespread adoption of toilets, as reflected in the NFHS-5 data.

The evolution of India's sanitation policies offers valuable insights for shaping effective strategies, ultimately contributing to the nation's journey towards becoming ODF on a sustainable basis. Our hope is that policymakers, researchers and implementers can use these lessons to design more effective and inclusive sanitation initiatives for the diverse landscapes of India.

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Notes

1. Unlike flush toilets, pit latrines require the user to throw the water over the faeces after defecation manually. This enhances the user's burden, as they have to fill and carry the bucket of water to the toilet every time they want to use it.
2. The EcoSan is a dry toilet built on a raised platform. It is listed in the SBM guidelines as suitable for dry areas with scarce water supply, coastal and flood-prone areas with high water tables, and rocky areas. Excreta is not flushed out but stored in sealed chambers for later use as farm manure. Its success has been noted across several states in India (Moudgil, 2019).

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Article

Microfinance in Afghanistan: Trends, Impacts, and Challenges

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Abstract

Microfinance is important in a country's rural development and poverty alleviation. In underdeveloped countries where a substantial fraction of the labour force is not gainfully employed, and the poverty rate rises over time, microfinance development is needed. In Afghanistan, the formal microfinance channels became active in 2003, and so far, they have provided considerable financing services to individuals and businesses. This article attempts to draw a clear picture of the impact of this sector on income, employment, women empowerment, and poverty. The article also attempts to highlight the prevailing challenges hampering the development of microfinance in Afghanistan. The findings of this article show that the microfinance sector has seen dramatic development over the past 20 years, and many microfinance institutions that provide financial services for thousands of households have been established. It further finds that there are cases of positive impacts from microfinance on income and employment. The effect of microfinance on women's empowerment is less than expected; however, there is evidence of a positive effect for some women. The impact of microfinance on poverty is hard to conclude. In rural areas, impoverished people have not been targeted by microfinance because they might be unable to repay their debts.

Keywords

Microfinance effect, income and employment, women empowerment, Afghanistan

Introduction

Microfinance refers to a broad range of financial facilitation for poor individuals and small businesses that generally do not have access to formal banking services (Jain & Jain, 2012). By accessing microfinance, poor people can secure their lives by participating in productive activities and achieving a stable financial source to

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meet their needs. Historically, since the 1970s, the importance of microfinance has been amplified by targeting rural individuals who lacked formal financial services (Zaman, 2004). Agriculture is the dominant sector in rural areas in most developing and underdeveloped countries, and microfinance could play an important role in overriding the risks arising from seasonal changes and unpredictable climate conditions for those involved in this sector (Moll, 2005). Microfinance improves production and living standards by augmenting productivity and promoting capital investment (Augsburg et al., 2013).

More than half of the population lives in rural areas of Afghanistan, where agriculture and livestock constitute households' primary source of employment and income. However, the fragile agriculture sector with low productivity cannot provide employment opportunities for the increasing population. On the other hand, if the excess workforce is not redirected to other economic activity, food insecurity and poverty will jump due to an increase in hidden unemployment in the prevailing traditional agriculture sector. Adaptation of technology and capital accumulation in the agriculture sector is important to increase productivity. This will dramatically improve food security and help to decrease poverty and unemployment as a result. The development of small and medium enterprises could also play an important role in expanding employment opportunities in sectors other than agriculture. Currently, employment opportunities in economic subsectors such as fishing, tailoring, beekeeping, carpet weaving, aviculture, clay industry, and carpentry are potentially available in rural areas. Therefore, mobilising rural society with financial capital is essential for agricultural development and securing employment opportunities in other subsectors of the economy. Since providing financial resources through the banking sector in rural areas was difficult, microfinance development was a good alternative.

During the past 20 years, the microfinance sector has grown dramatically, and as a result, the coverage of microfinance facilitation has expanded from big cities to rural areas in Afghanistan. Considering this fact, several questions arise to be investigated. Did microfinance have a significant contribution to the rural development of Afghanistan? What challenges does this sector face in rural areas in Afghanistan? A limited number of studies and reports have tried to explain the impacts of microfinance in Afghanistan, yet a clear image of this sector's effects is hardly available. Therefore, this article is motivated to combine those findings to draw a clear picture of the microfinance industry and its impact in Afghanistan.

The following section of this article explains the dynamic of microfinance and its expected impact in Afghanistan. Next, the article sheds synoptic light on the development of this sector in Afghanistan. Later, the article examines the impact of microfinance in Afghanistan and the prevailing challenges the sector faces. Finally, the article closes with a brief conclusion.

The Dynamics of Microfinance in Afghanistan

The availability of sufficient financial resources is an important factor in enhancing economic and social development in a society. Economic theories characterise the lack of adequate capital as an important reason for slow economic development in

backward countries. In underdeveloped countries, due to the prevailing high unemployment rate, people's incomes are meagre, making it hard for businesses to be financed through local savings. Also, as per the dominant interaction in the financial environment, impoverished and marginalised segments of society find it almost impossible to access funds from the conventional banking system. On the other hand, many people in rural areas fall into this category. They are deprived of access to formal banking and financial facilitations, making them unable to establish a new business or develop an old one. Continuing the existing economic activity with the prevalent unproductive methods will make them vulnerable and poor. Changing this dynamic required the provision of financial resources in rural areas through microfinance institutions (MFIs). These institutions provide small loans to poor people who cannot access funds from the standard banking system. The access of poor and marginalised households to finance could switch them to start small businesses or improve the old ones with higher productivity.

Microfinance, in particular, could improve economic activities in rural areas of a country. In underdeveloped countries, a large population has condensed in rural areas, and the primary source of income is agriculture and livestock. Due to the social structure and low literacy rate, the birth rate is also relatively higher than in big cities. Therefore, the population is growing faster, and the capital–labour ratio is falling over time. The continuation of such a situation increases the unemployment rate and poverty. Availing them with microfinance will improve agricultural performance and allow people to find alternative self-employment opportunities by establishing small businesses.

Microfinance is also considered an important tool for women's empowerment as it allows women to play an active role in the national economy. It would also improve their role in society by enabling them to contribute to the well-being of their families and take part in socioeconomic decisions.

In Afghanistan, most women do not participate in formal economic activities. On the other hand, historically, Afghan women, especially those who live in rural areas, have been mainly involved in the handicraft sector, and they play an important role in income generation and employment. Unfortunately, in recent decades, the production of handicrafts in this country has dramatically decreased, negatively affecting women's economic activities. Among other factors, the lack of financial resources is an important reason for the collapse of this sector. If regular financing facilitation is provided for women, they would play an important role in employment and income levels in the country. This will also put their families in a higher standard of living.

The positive effect of microfinance development is not limited to the economy; it also contributes to positive changes in the social well-being of society. One such impact is a reduction in criminal activity in society. As expected, a higher unemployment rate would be associated with an increase in the level of crime in society; microfinance would significantly contribute to decreasing crime by providing job opportunities. To the extent that national policies effectively reduce the unemployment rate, the crime rate will also decrease.

There might be a link between microfinance and access to health care in society. Access to better health services requires the availability of adequate

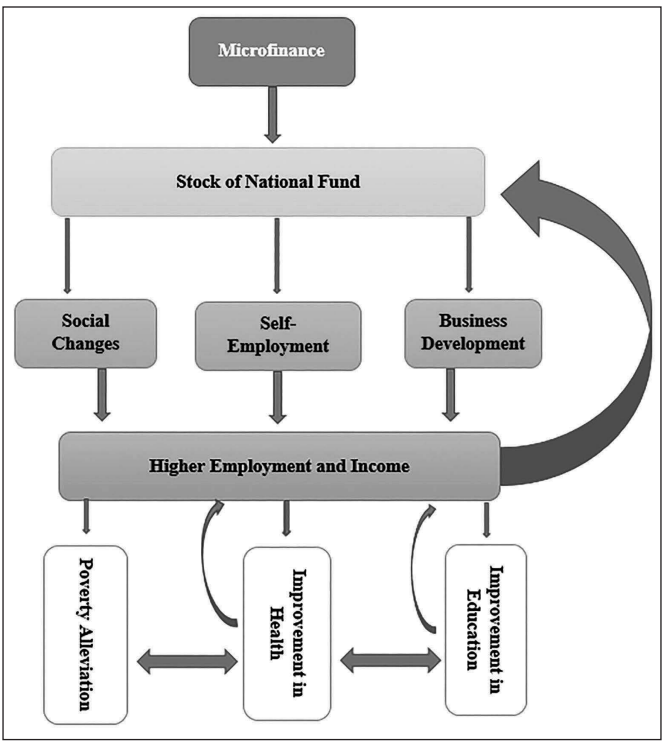

Figure 1. Impact Flow-chart of Microfinance.

finance. In rural areas, the low level of family income is an important determinant for the fragile healthcare services they access. If microfinance contributes to the household's income level, it should also improve their access to health care. There would be a bilateral link between income and health care. A higher income would enable the household to access quality healthcare services, and a healthier household, on the other hand, would be more creative and productive, allowing them to gain more from the available opportunities in the market.

Microfinance is expected to contribute to poverty alleviation. Poverty is a multi-dimensional phenomenon depending on many social and economic factors; income and education are its dominant determinants. A higher income and education are associated with lower poverty. Therefore, it is expected that microfinance would contribute to a reduction of poverty through improvement in the economic and health conditions of the society (Figure 1).

Literature Review

A bulk of research has focused on studying the impact of microfinance and rural development. Since the scope of microfinance is very broad, the available literature on this issue is also very diversified. Some literature focuses on explaining the institutional and policy issues as an important requirement for long

run sustainability and avoiding the sector's failure. For instance, Moll (2005) argues that for MFIs to be more effective in the long run, two important conditions are required: maintaining financial stability and financial expansion. Financial stability depends on the institution's profitability, which could be necessary for financial expansion (delivering financial services to a new group of individuals while keeping the old clients). He also suggests that the two components are not substitutable but necessary for each other. Besides institutional issues, consumer creditworthiness is essential for the system's sustainability.

Vetrivel and Kumarmangalam (2010) study the reason for failures in MFIs and suggest solutions for avoiding such failures. One of their main suggestions is to improve the borrower's creditworthiness by training them to repay the loan they received from financial institutions. Demand deficiency is supposed to be another obstacle to microfinance sustainability in rural areas. Kiiru (2007), while studying the dynamics of microfinance, entrepreneurship, and rural development in Kenya, suggests some policy implementation for the effectiveness and sustainability of microfinance in rural areas. One such policy is to increase entrepreneurs' demand for products in rural areas. This will augment the motivation and sustainability of borrowers and undermine the pressure of repaying their debt in the future.

Another group of literature has an impact-based look at microfinance, studying the role of microfinance on rural development, women empowerment, poverty alleviation, reduction in unemployment, and so on. The main finding of literature of this type suggests that microfinance improves the living standard of those deprived of access to regular financial facilitation. For example, Yadav (2014) states that poor and marginalised people who cannot access banking finance should be offered microfinance facilitation. Microfinance can increase the living standards of society's poor and marginalised segments. Jain and Jain (2012) also find that microfinance plays a vital role in women's empowerment in the Udaipur District of Rajasthan, India. The availability of microfinance motivated the participation of women in self-help groups in this province.

While a unifying and overall picture of the impact of microfinance in Afghanistan is hardly visible, several studies try to explain the effects of microfinance in some selected provinces of this country. Chandrashekhar and Sultani (2019), for example, examine the impact of microfinance on women entrepreneurs in Afghanistan using selected cases. This study uses secondary data from different sources to investigate the impact of microfinance on women's empowerment in Afghanistan. The findings of this study show that microfinance significantly impacts women's income and savings in Kabul province. Sultani and R. (2021) have studied the impact of microfinance on income and employment in the Bamyan Province of Afghanistan using the data collected from 220 individuals who received microfinance loans from The Microfinance Bank of Afghanistan. The study suggests that microfinance has a positive impact both on the level of income and employment. R and Sultani (2021) studied the effect of microfinance on enterprises in Afghanistan. It includes 28 successful cases of individuals who received loans from microfinance sources. The finding of this study shows that microfinance has dramatically increased clients' income after they gained access to financial services from these institutions. The article also suggests a positive

link between the availability of microfinance funds and employment. Microfinance programmes have played a crucial role in enabling female consumers to evaluate the recent performance of the microfinance institutes' loan programme in the Balkh Province of Afghanistan. Additionally, the involvement of both male and female community members in the workforce was considered essential for ensuring that families accomplish their goals (Echavez et al., 2012).

The existing evidence supports the notion that microfinance has a substantial potential to empower women, particularly in programmes targeting female entrepreneurs, by encouraging them to use loans and participate in income-generating activities (Greeley & Chaturvedi, 2007). Moreover, the research also

Table 1. Summary of Literature.

Author	Title	Method	Findings
Moll (2005)	Microfinance and rural development: A long-term perspective	Descriptive approach	MFIs are more effective in the long run. Two important conditions are required: maintaining financial stability and financial expansion. Financial stability depends on the institution's profitability, which could be necessary for financial expansion (delivering financial services to a new group of individuals while keeping the old clients). The article also suggests that the two components are not substitutable; they are necessary for each other
Greeley & Chaturvedi (2007)	Microfinance in Afghanistan: A baseline and initial impact study for MISFA	Household survey using structured questionnaire	This study attempts to assess the impact of microfinance in Afghanistan since 2003. It was discovered that microfinance has contributed to poverty reduction and economic empowerment in the country. The study found that microfinance loans are primarily used for beneficial reasons, such as starting or growing enterprises, which creates employment. Microfinance involvement has given women, in particular, greater control over their finances and access to health care
Echavez et al. (2012)	The impact of microfinance programmes on women's lives: A case study in Balkh province.	Primary data was collected through in-depth interviews, focus group discussions, informal conversations and observations.	The study focuses on women's involvement in a microfinance programme in Balkh Province. The analysis reveals that the MFI was not the main cause of changes in gender relations; rather, a variety of factors, including community environment, migratory experience, education, and individual traits, all contributed to female empowerment. Key findings include the positive effect of community acceptance of women's mobility and employment, the relevance of female solidarity, and reduced interest rates in boosting participation

(Table 1 ccontinued)

(Table 1 ccontinued)

Author	Title	Method	Findings
R & Sultani (2021)	Impact of microfinance on entrepreneurs in Afghanistan: An analysis of selected cases	Wilcoxon Sing Rank Test, a Nonparametric Test	The article studies the impact of microfinance on enterprises in Afghanistan. It includes 28 successful cases of individuals who received loans from microfinance sources. The finding of this study shows that microfinance has dramatically increased clients' income after they gained access to financial services from these institutions. The article also suggests a positive link between the availability of microfinance funds and employment
Sultani & R. (2021)	Impact of microfinance on Employment Opportunities and Income Generation in the Bamyan Province of Afghanistan	Primary data using a questionnaire The Wilcoxon Signed Rank Test	This article studies the impact of microfinance on income and employment in the Bamyan Province of Afghanistan using the data collected from 220 individuals who received microfinance loans from The Microfinance Bank of Afghanistan. The study suggests that microfinance has a positive impact both on the level of income and employment
Vetrivel & Kumarmangalam (2010)	Role of microfinance institutions in rural development	–	This article aims to study the reasons for MFI failures and suggest solutions for avoiding such failures. One main suggestion is to improve the creditworthiness of the borrowers by providing training on how to repay the loans they receive from financial institutions
Yadav (2014)	Significance of microfinance institutions in rural development of India	Empirical study	Poor and marginalised people who cannot access banking finance should be offered microfinance facilitation. Microfinance can increase the living standards of society's poor and marginalised segments
Jain & Jain (2012)	Does microfinance empower rural women? Empirical study in Udaipur District, Rajasthan	Survey and questionnaire on 100 respondents	Microfinance is important in women's empowerment in the Udaipur District of Rajasthan, India—The availability of microfinance motivated women to participate in self-help groups in this province
Kiiru (2007)	Microfinance, entrepreneurship, and rural development: Empirical evidence from Makueni District, Kenya	Panel data using the Logit Model	The article studies the dynamics of microfinance, entrepreneurship, and rural development in Kenya and proposes some policy implementations to improve the effectiveness of microfinance in society. An increase in demand for entrepreneurs' products will augment the motivation and sustainability of borrowers and undermine the pressure to repay their debt in the future

(Table 1 ccontinued)

(Table 1 ccontinued)

Author	Title	Method	Findings
Chandrashekhar & Sultani (2019)	Impact of microfinance on Women Entrepreneurs in Afghanistan: An Analysis of Selected Cases	Pair *t*-test	This study uses secondary data from different sources to investigate the impact of microfinance on women's empowerment in Afghanistan. Its findings show that microfinance significantly affects women's income and savings
Jumper (1979)	Wilted roses in Afghanistan: A study of the impact of microfinance initiatives on rights and opportunities for Afghan women	Descriptive approach	Microfinance fuels indigenous development in Afghanistan, allowing the government to expand its tax base by improving small businesses. This project will empower women in both economic and social areas

indicates that microcredit will have an impact on the independence of both women and men, as well as on the reduction of poverty. Women in Afghanistan have seen substantial advantages due to the microcredit programme, improving their socioeconomic standing. Furthermore, this assertion about microfinance initiatives is substantiated in many regions around the globe, particularly in South Asia (Greeley & Chaturvedi, 2007) (Table 1).

The Development of Microfinance in Afghanistan

Microfinance plays an important role in rural development and poverty alleviation in Afghanistan. Providing financial opportunities for women in the rural economy constitutes one of the important goals for the government of Afghanistan, which is emphasised in Afghanistan's national development strategy (ANDS, 2008). Since 2001, Afghans have implemented various microenterprise initiatives, primarily modelled after the architecture of the Grameen Bank. These programmes provide modest loans to women's home-based business communes (Jumper, 2016). In 2003, the Microfinance Investment Support Facility for Afghanistan (MISFA) was established to increase the effectiveness of microfinance and to establish coordination between different institutions. The important objectives of this organisation were to provide technical assistance for various financial institutions and to prepare reports on microfinance developments regularly. The organisation was established with the financial support of the World Bank, and it worked under the management of the Ministry of Finance of Afghanistan.

After MISFA was established, the first microfinance bank was established. Consequently, several other MFIs started working in various provinces, providing financial facilitation to businesses and individuals. In 2008, 15 MFIs worked in 24 regions of Afghanistan. MFIs' coverage increased from 13 districts in 2005 to 113 districts in 2008 (Hussein & Hamid, 2009).

As seen in Figure 2, the number of borrowers from MFIs increased from 160 thousand in 2005 to a peak of 365 thousand in 2007. Between 2008 and 2014, the

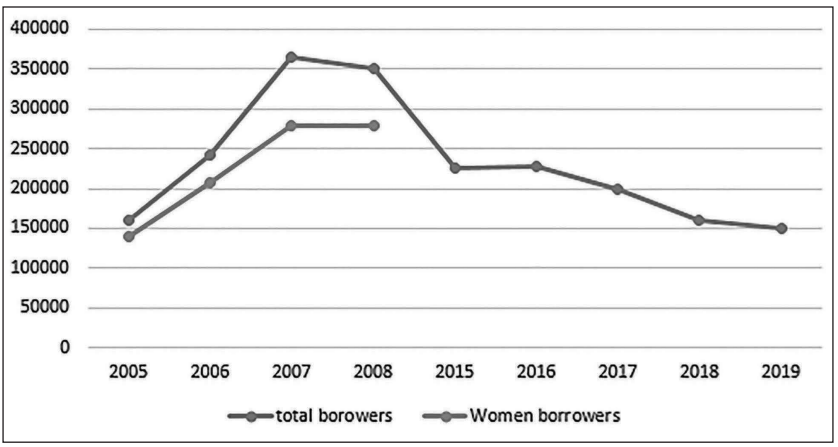

Figure 2. The Change in the Number of Borrowers From MFIs in Afghanistan.

Source: Constructed from the data collected from the annual reports of the AMA.

Note: AMA stands for Afghanistan Microfinance Association.

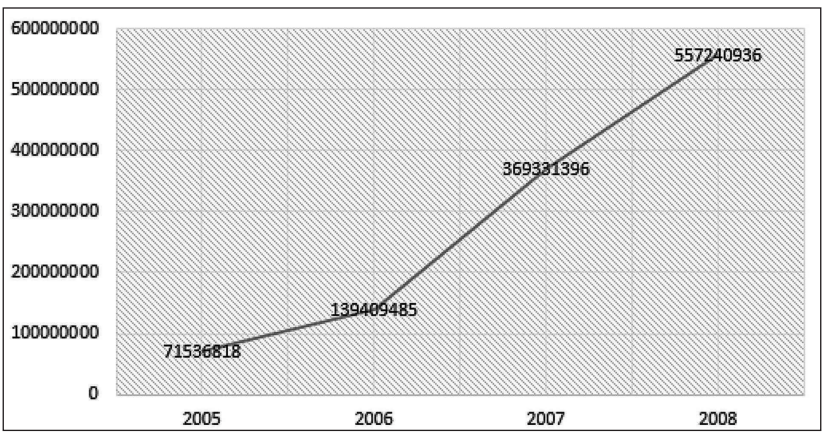

Figure 3. The Trend of Loans Granted by MFIs in Afghanistan (USD).

Source: Constructed from the data collected from the report of AMA.

data was not found. However, after 2015, the number of borrowers subsequently decreased. This may arise because the security situation has deteriorated in rural areas of Afghanistan during this period. Therefore, MFIs have shifted focus to big cities like Kabul and Mazar. Up to 2008, 60%–70% of the total borrowers were women. After that, the share of women borrowers has dramatically declined.

The amount of loans granted to individuals and businesses has dramatically risen from 71 million dollars in 2005 to 557 million in 2008 in cumulative form (see Figure 3). The loans granted to clients are based on the Afghan microfinance model in which the institutions use two broad frameworks: individual and group

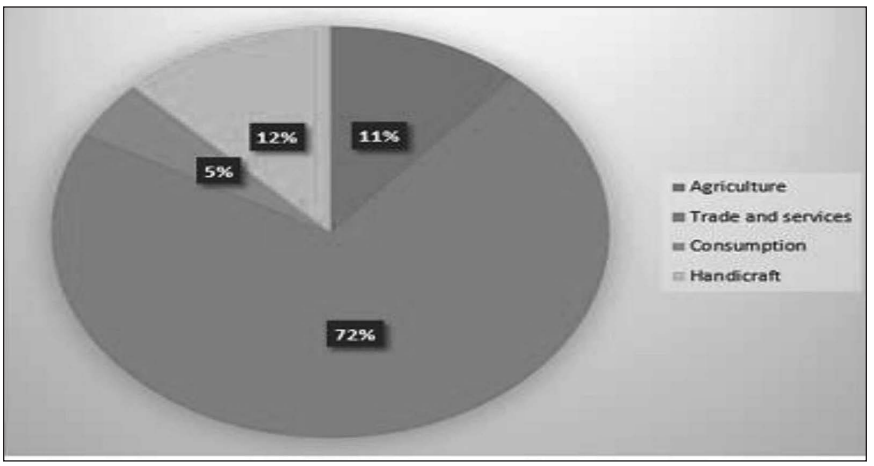

Figure 4. The Distribution of Loans Between Sectors.

Source: Constructed from the data collected from the report of AMA.

loans. Some MFIs focus on individual clients, while others offer group loans. The objective of group loans is to increase the credibility of borrowers. In other words, under the group loan, the risk of repayment decreases, as if one borrower from the group avoids repaying, the other group member will have to pay on behalf of their group member; otherwise, the lending services for all group members will be stopped. Another advantage of this system for MFIs is the decline in operational costs.

The distribution of microfinance across economic sectors in Afghanistan shows that service and trade sectors occupy more than half of the total loans from MFIs, followed by handicrafts, agriculture, and livestock. A small part of the microfinance loan has been given for consumption purposes. The distribution of microfinance loans in 2008, for example, is shown in Figure 4.

Besides formal banking and MFIs, informal finance has been another important source of lending in Afghanistan, and it has played a vital role in the mobilisation of resources in the community. Informal finance was dominant in the rural economy before MFIs emerged in this country. Even after establishing a formal financial system, informal financing still plays a vital role in rural areas of Afghanistan. The report indicates that in 2005, 42% of the households in rural areas of Afghanistan received loans from informal networks (Parto & Regmi, 2008).

Informal loans are predominantly used to meet the consumption needs of households, as most families in rural areas of Afghanistan rely on agricultural sectors to receive seasonal income. Therefore, families working in the agriculture sector earn income in the specific seasons when they sell agricultural products. In contrast, they finance their needs in other seasons by taking loans from traditional networks if they face financial shortcomings. In rural areas of Afghanistan, informal loans are mostly used to meet consumption needs, while in urban cities, they could be used predominantly for business purposes. In 2005, 96% of the informal loans in Paktya Province were used for consumption (NRVA, 2007). Although consumer loans do not play a role in increasing people's income, they will play an important role in reducing poverty by helping people in difficult situations to meet their essential needs.

Microfinance on the Rural Developments in Afghanistan

A unifying conclusion related to microfinance's impact in Afghanistan is hardly observed. Generally, it is expected that the availability of microfinance services is associated with higher levels of employment, improvement in households' incomes, poverty reduction, and, more importantly, improvement in women's economic condition. Due to the unavailability of sufficient data, it is tough to draw a clear image of how MFIs have played a significant role in improving welfare and reducing poverty, especially in rural areas in Afghanistan. The available studies provide different information on the impacts of microfinance in Afghanistan. For example, (Sultani & R., 2021), while studying the effects of microfinance on income and employment in Bamyan province using a survey of 220 individuals who received microcredit from the First Micro Finance Bank of Afghanistan, reported that the median income of a household doubled after they have received microcredit. In other words, while the median income of a household was 5000 before availing of a loan, it has increased to 10,000 a year after they receive a loan.

Figure 5 represents some successful entrepreneur women from different provinces of Afghanistan who received loans from MFIs. Based on the data in Figure 4, microfinance significantly improves women's income in Afghanistan. On average, the income after a loan is three times greater than that before receiving a loan. It is worth mentioning that this figure only represents the impact of microfinance on the income of successful women. The effect would be different if one conducted a more comprehensive range of surveys, including successful and unsuccessful ones. Additionally, individuals who borrow from nuclear households have a stronger correlation with economic empowerment than those who reside in a joint family (Sultani, 2023). These results demonstrate that microfinance promotes socioeconomic advancement and significantly alleviates poverty. MFIs offer

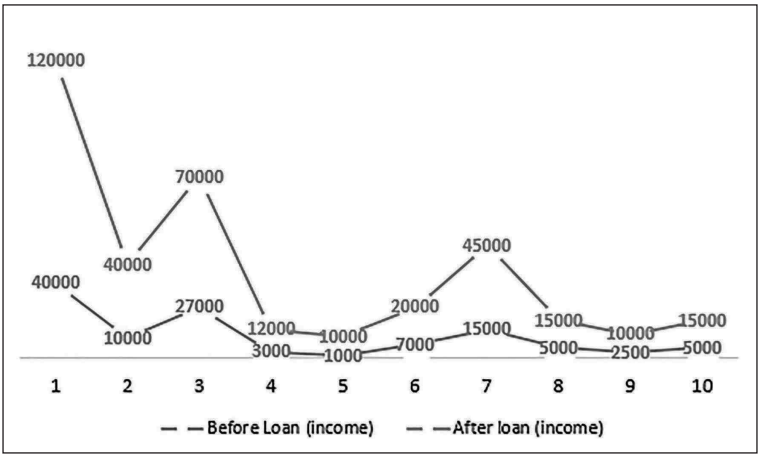

Figure 5. The Change in Income After Receiving Microcredit.

Source: Constructed from the data collected from R and Sultani (2019).

financial services to small and medium-sized enterprises and individuals in need. Additionally, MFIs create employment opportunities for women.

As it is expected for microfinance to be effective in job creation by enabling individuals to run businesses, some studies have been conducted to examine if microfinance has improved employment in Afghanistan. Sultani and R. (2021) argue that microfinance has positively impacted 88.2% of clients in the Bamyan province survey. In the case of successful entrepreneur women, it seems they have a relatively greater contribution to job creation in Afghanistan. As it is reported, on average, every woman has generated 10 employment (Chandrashekhar & Sultani, 2019). Approximately 1.5 employment opportunities are created for each client due to the expansions and new ventures (Greeley & Chaturvedi, 2007). Extrapolating this data to encompass all MISFA clients would result in 500,000 employment. The data indicates that customers saw a notably greater enhancement in their economic condition compared to non-clients and individuals who discontinued the programme. This conclusion is supported by the savings data obtained from all three groups. Some reports find that from 2008 to 2018, MFIs created around one million jobs (Microfinanza, 2019).

Figure 6 explains the changes in the flow of employment created by microfinance loans. The blue line shows the number of jobs created with newly established businesses financed by MFIs. The upper lines show the difference in business employment when connected with microfinance and after exit from the institutions. The number of jobs in firms associated with microfinance fell from

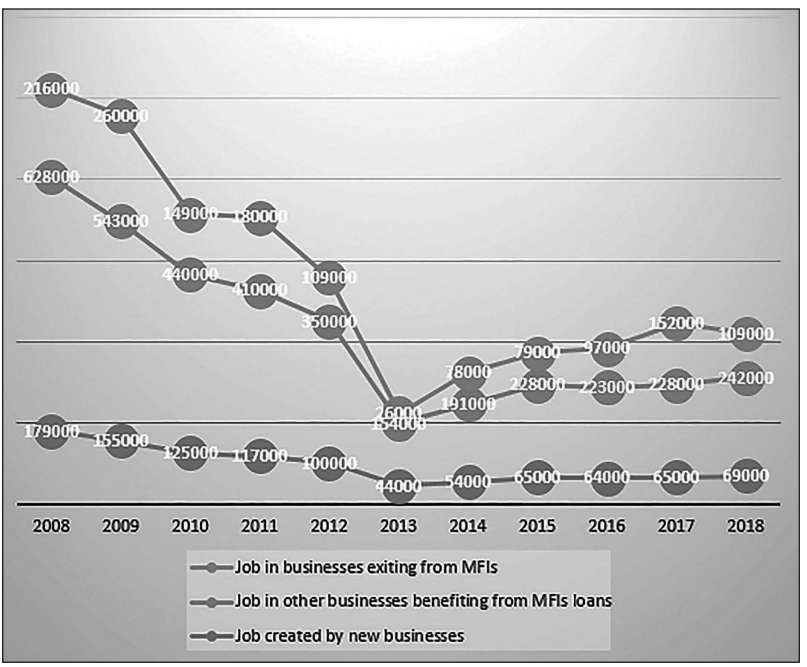

Figure 6. The Flow of Jobs in Business Received Loans From MFIs.

Source: Constructed from the data collected from Microfinanza.

2008 to 2013, and it slightly rose afterward. This fall could be due to security deterioration, which made MFIs shrink their outreach. During 2012 and 2013, the exit of American and NATO forces from Afghanistan affected the overall business in this country, including those financed by MFIs.

Microfinance is expected to positively impact women's empowerment in economic and social lives, as one of the main objectives of microfinance is to mobilise resources to enable women to participate in business activities and social decision-making. From 2005 up to 2008, between 60% and 70% of microfinance clients were women (Hussein & Hamid, 2009). However, this ratio dropped to around 40% in 2019 (Microfinanza, 2019). The logic behind targeting women was that most of the women living in rural areas were vulnerable. Economically, they are not self-sufficient but have the potential to be so. Microfinance is expected to put them in a better economic and social position. Several studies have examined if there is a significant improvement in women's social and economic conditions after the availability of microfinance loans. Some studies have investigated the impact of microfinance on women's empowerment in Afghanistan. A clear picture is not available for the same, however. Since there are no unique indicators for measuring women's empowerment in the studies, it is difficult to conclude the overall impact. For example, Microfinanza (2019) reports that less than half of the women in its survey have stated being empowered in the sense that there was an improvement in their feeling of them having the role of deciding on how many children to bring and they face with wider consumption choices after availing micro loan.

The impact of microfinance on the state of women in their families depends on how the loan is used. For those who established their own business, microfinance tends to have a greater influence on women's financial independence and their state in the family (Lyby, 2006). Due to the lack of skills, many women do not use money in business alone; instead, they put it on their male family members (Echavez et al., 2012). MFIs can only contribute to the complex empowerment process. Improving gender relations would require combining many initiatives across diverse domains of Afghan society. Microfinance has the potential to be one of these contributing activities. Loan accessibility is only one of several factors that might impact gender dynamics. The women who possessed a better social standing within their families and enjoyed greater opportunities to engage in public activities were the ones who derived the greatest benefits from their involvement in microfinance initiatives. Microfinance programmes have had limited impact on altering decision-making authority or the gender-based work allocation (Zand, 2011). Women remain predominantly confined to domestic tasks, while males predominantly work outside the household. The community setting significantly influenced the success of the MFIs' loan programme in assisting its female clients (Echavez et al., 2012). The ladies residing in an outer suburb of Mazar-i-Sharif in Balkh Province exhibited a profound feeling of togetherness and mutual support. Their primary objective was to assist one another and exchange knowledge on essential life skills. The MFI's female staff performed a successful door-to-door information campaign, effectively informing community members and encouraging them, particularly women, to utilise its services.

A recent study has revealed a notable enhancement in the economic condition of women following their acquisition of loans from MFIs (Sultani, 2023). The women borrowers saw improvements in several aspects, including personal income, credit accessibility, promotion of saving habits, capacity to provide for their families, expansion of their businesses, women's empowerment in resource management, and increased employment prospects. Women borrowers' economic and social empowerment was initially low before their involvement with MFIs but significantly increased following their association with MFIs. In addition, Sultani (2023) a notable enhancement in female borrowers' social status was observed after obtaining loans from MFIs. Furthermore, they enhanced societal equity, domestic choices, societal accountability, self-assurance, familial decision-making, understanding women's legal entitlements in Afghanistan, and familial bonds. On the other hand, Zand (2010) discovered no significant alterations in decision-making authority, gender-based division of work, or the scope and whereabouts of women's endeavours in the village of Sabz Guzar in Parwan Province. Women are predominantly confined to domestic tasks, while males continue to primarily engage in labour outside the household, even in cases when women have made financial investments through loans.

The MFIs have focused on promoting women's financial independence from their husbands and their contribution to the family economy. However, it has narrowly defined women's role as merely 'helping', thereby missing the chance to empower women by enabling them to take on more prominent or different economic roles. In addition, women who took part in the loan programme in the village of Sabz Guzar in Parwan Province reported an increase in their 'courage' and 'awareness' (Zand, 2010). The connection between this transformation and the chance to casually interact with other women in the loan office and gain knowledge from them has been established. Women reported experiencing heightened self-esteem and bravery as a direct outcome of their involvement. Some women also considered it necessary to contribute more to the overall well-being of the home and have greater influence over household finances (Zand, 2011). In addition, Sultani (2023) found that many female borrowers express contentment with the microfinance services offered.

Another expectation from microfinance loans in rural areas is that they contribute to poverty alleviation and improvement in food security. In rural areas, unemployment is high, and most people are unemployed. Lack of financial resources might be one of the reasons for this situation. Providing financial resources for rural communities is expected to enable them to set up new businesses or improve their existing ones. This would help mitigate poverty and improve food security by increasing job opportunities. The National Risk and Vulnerability Assessment Report 2005 shows that more than 60% of microfinance loans in rural areas were used for consumption (NRVA, 2007). Using loans for financing consumption could be helpful as a short-term strategy, nullifying the negative impact of changes in income resulting from seasonal fluctuation and other unexpected shocks. It would not reduce poverty when it is used as one of the primary sources of financing for daily consumption. Because, in such cases, it will increase the depth of poverty after repayment of the loan with its accumulated

interests in the future. In 2010, around 66% of the households at the national level used loans as one of the options for coping with unexpected shocks (Fadul, 2019). In the sense that microfinance smooths the consumption of households against income fluctuation, it will contribute to food security, especially for those farmers who earn income in one or two seasons of the year.

Challenges of the Microfinance Sector in Afghanistan

Although the reports provided by the MFIs draw an optimistic image of the effectiveness of these institutions in Afghanistan, it cannot be ignored that the sector faces some challenges that undermine the expected impacts. In this part, the article sheds light on some of the prevailing difficulties in minimising the effectiveness of microfinance facilitations in this country. One of the challenges arises from the availability of insufficient financial resources from MFIs. Although the minimum amount of loan for opening a business could vary from one business to another, the complaint of microfinance clients reported the amount of loan to be inefficient for their business (Parto & Regmi, 2008). Each MFI offers a different loan interval depending on the type of business, the socioeconomic state of the clients, and so on. In several MFIs, loans vary from 20,000 to 120,000 Afghanis (Microfinanza, 2019). However, it is not clear what frequency the clients have received the minimum loan limit. It could be argued that for those who availed 20,000 Afghani, the chance of doing business is very limited.

The religious position of the people in the villages has also caused them to block and challenge the development of debt because, in many cases, people hate debt and, for this reason, pay interest against the debt. It happens that they do not turn to loans. Some people have good ideas for business, but due to religious restrictions, they cannot finance their activities through debt. Although recently, some institutions have been providing financing services in villages called Islamic financing, the level of Islamic financing is up to 5% of the market demand. The founding of the Islamic Bank of Afghanistan (IBA) in 2018 was a notable achievement, as it became the nation's first fully operating Islamic bank. It is important to emphasise that despite experiencing economic growth since 2001 and strong demand for Islamic banking and finance, the country has only managed to construct one fully operational Islamic bank and six Islamic windows (Rostan et al., 2021). IBA possesses 40% of the $365.5 million (AFS. 27.8 billion) total investments in Islamic banking products (Vizcaino, 2018). The Islamic windows of six banks collectively owned the remaining 60%.

Islamic microfinance plays a vital role in Afghanistan by offering practical solutions to improve the financial situation of disadvantaged households, both at the individual and family levels. Explicitly designed for underprivileged persons excluded from traditional financial systems, this platform enables their involvement in economic activities, increasing their income, creating assets, and promoting investments. The importance of Islamic microfinance lies in its ability to reduce poverty, stimulate private initiatives, boost demand, generate employment opportunities, diversify household income, empower women,

decrease unemployment rates, contribute to exports, and foster regional development by addressing inequalities and unlocking resources in remote regions (Hammas, 2023).

Sultani (2022) mentioned nine major obstacles encountered by MFIs in Afghanistan, including 'Management Issues', 'Administrative Issues', 'Loan Procedure Issues', 'Lack of Technology', 'Lack of government support', 'High-interest rates', 'Security issues', 'Lack of Promoting', and 'Political instability.' The initial element, 'Management Issue', includes 13 factors: inadequate management skills in MFIs, insufficient management skills in MFIs, and the absence of standardised reporting and monitoring systems in MFIs. The staff's unprofessionalism and lack of dedication to the organisation, their limited understanding of the MFI's financial procedures, the non-sustainability of future operations owing to insufficient funding, and their lack of legal awareness. The second issue, referred to as the 'Administrative Issue', includes eight factors, such as inadequate collaboration among MFIs in delivering retail microfinance services to millions of impoverished individuals and ineffective methods and inspectors for monitoring and evaluating the performance of MFIs—insufficient funding for performing the training programmes, Unhealthy rivalry among MFIs, and so on. The factor of 'high-interest rate' consists of four variables: borrower dissatisfaction with a high-interest rate, the high loan interest rate of microfinance, the financial unsustainability of MFIs to offer loans at a lower interest rate to borrowers, and borrower dissatisfaction with the repayment period for their loan instalments.

Another serious problem facing the microfinance sector in Afghanistan, especially in rural areas, is the traditional community with strong religious beliefs. The belief that interacting with interest is sinful has made many individuals avoid doing businesses financed through loans. The dominance of this faith may deprive many talented individuals of participating in productive economic activities they otherwise deserve. The development of Sharia-based financial support could be an alternative solution to the challenge, but it is still far from being a perfect substitution for conventional financing systems. Contrary to other study communities, prohibiting such (the collection of interest, which is banned in Islam) did not significantly impede people's involvement in the loan programme in an outlying suburb of Mazar-i-Sharif, Balkh Province (Echavez et al., 2012).

During the past 20 years, in line with the Afghanistan National Development Strategy, one of the objectives of the microfinance sector was to empower women by providing financial resources that enable them to participate in socioeconomic activities in the country. The positive effects of microfinance on women's empowerment cannot be ignored. However, women seem to be less affected than what was expected. This might result from the society's prevailing social structure and the MFIs' attitude as the other part of the dynamic. In the rural society of Afghanistan, the dominant role of men, the low level of education of women, and the negative attitude toward women's work outside their houses are the major problems that arise from the social structure of the society.

In most cases, granting a loan to a woman should not necessarily be considered that she is financially in a better position. Studies also confirm that many women handed over the loan to their husbands after receiving it from microfinance. In this

case, the loan will not directly affect women's economic condition; it could increase the family's overall welfare only if their family members spend it on productive activity. In such a situation, women would indirectly be affected either because of the improvement in the economic condition of the family or by feeling proud of being part of the reason for the improvement.

The attitude of MFIs could also be part of the reason for the sector's failure to empower women effectively. Based on the Afghanistan microfinance model, microfinance loans were to be granted in an individual-based and group-based strategy. Group loans would enable women to learn from each other and increase their confidence in establishing their businesses. Many MFIs have concentrated on individual loans, as it is reported that 90% of loans were granted in individual form (Microfinanza, 2019). Providing training programmes for women on creating and managing a business could have increased the effectiveness of loans on women's empowerment. MFIs have almost ignored this issue.

The interest rate of microfinance loans is also high, and clients could face challenges while repaying. Although there is no unifying information about the interest rate charged for micro-loans (as each institution sets different rates), MFIs' interest rate is generally very high relative to those prevailing in commercial banks of Afghanistan. For the clients to be able to repay their debt in the future, they need to invest in businesses with high returns. In most rural areas, establishing a high-yielding business is hardly looking. Therefore, it is difficult for many small entrepreneurs to generate income that is more than what they need to repay. Interest burden does not only harm the individuals, but it is also a challenge for the overall system. A higher interest burden on individuals may decrease their credibility, and as a result, the risk of capital return for MFIs would increase.

Discrimination in the distribution of loans is also a problem that some borrowers complain about. The local staff from the same area usually carry out consumer-related activities, including distributing loans in rural areas. Since rural relationships largely influence the staff, they use family and social relationships to distribute loans (Microfinanza, 2019). This kind of attitude may cause the misallocation of resources in society. Some people who do not deserve it would be granted a loan based on family relations, while others would be deprived of access to finance despite having good business ideas. Such an attitude is harmful and unhelpful for the microfinance sector. In addition, other problems, such as increasing insecurity, corruption in the financial sector, and low literacy levels in villages, are among the major challenges that have directly or indirectly influenced the sector.

Conclusion

During the past 20 years, the development of MFIs has been significant in Afghanistan. Despite the poor security situation in many provinces, MFIs were active even in rural areas. The impact of microfinance on the economic condition of individuals is different depending on the purpose of receiving micro-loans and how individuals have used it. In the cases where micro-loans are used for business purposes, they have played an important role in income, employment, and poverty

mitigation. When microfinance is used for consumption purposes, it will not improve income and employment unless used to smooth consumption by bridging the income fluctuations resulting from seasonal and unexpected changes. In the latter case, microfinance could reduce food security and poverty, at least in the short run. As per the available information, the impact of microfinance on income and employment in urban areas tends to be greater than that of rural areas. Because in urban areas, microfinance is mostly used for business purposes.

The prevailing challenge hampering the impact of microfinance in rural areas might arise from the fact that most individuals do not have business ideas. Therefore, providing training on how to develop a business before granting a loan would increase the effectiveness of microfinance in rural areas. However, most MFIs have almost ignored this.

Women's empowerment is a need for sustainable development as they constitute nearly half of society and play an important role in socioeconomic development. In countries like Afghanistan, special consideration is needed to empower women economically and socially. The previous attempt by MFIs to empower women was good, and it has had a significant impact on the socioeconomic status of some women. However, further effort is required to enable women in their social and economic lives. Increasing group loans and establishing self-help groups for women could leverage women's empowerment, especially in rural areas.

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