Aims and Scope

Asia-Pacific Journal of Rural Development is a peer-reviewed journal that provides a platform for publication of articles in all areas of rural development. The aim of this journal is to provide a platform for policy makers and academicians to promote, share and discuss various new issues and developments in different areas of rural development. The journal publishes conceptual, empirical and review papers in the form of research articles, reports of ongoing research, analyses of current and topical practice, policy issues relating to rural development field notes and book reviews. The journal is peer-reviewed and adheres to a rigorous double-blind reviewing policy in which the identity of both the reviewer and author are always concealed from both parties.

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:

- Sustainable use of natural resources
- Management of rural areas in transition
- Land and water resources management
- Agro processing and rural market
- Rural livelihoods and poverty reduction
- Education and skill development
- Entrepreneurship and financial inclusion
- Climate change
- Local governance
- Food and nutrition
- Health and hygiene
- ICT and geospatial technology for rural development
- Renewable energy for rural consumption
- Rural transportation
- Sustainable rural tourism

Asia-Pacific Journal of Rural Development

Khalid Johari, *Unit for Rural Education Research, School of Education and Social Development, Universiti Malaysia Sabah, Malaysia*

Nowshad Khan, *Department of Agricultural Sciences, Allama Iqbal Open University, Pakistan*

Myo Kywe, *Yezin Agricultural University (YAU), Myanmar*

Motiei Langrodi, *Center of Excellence for Rural Studies and Planning, University of Tehran, Iran*

Somkit Lertpaithoon, *Thammasat University, Thailand*

Hira Bahadur Maharjan, *Tribhuvan University, Nepal*

Worsak Kano-Nukulchai, *Asian Institute of Technology (AIT), Thailand*

Hoang Manh Quan, *Centre for Rural Development, Vietnam*

Wakil Ahmad Sarhadi, *Agriculture Faculty, Kabul University, Afghanistan*

Sithong Thongmanyvong, *Research Division, Faculty of Forestry, National University of Laos, Lao PDR*

Contents

Book Review

Occupational Strategies in Coastal Villages of the Lower Bengal Delta: Questions for Sustainability

Dilip Kumar Datta[1], Israth Rabeya[1] and Bishawjit Mallick[2]

Abstract

Occupations in the Lower Bengal Delta have been disrupted for various reasons, such as natural disasters, social degradation, economic crisis, and political revenge. It results in changing their traditional occupations. This study discusses how traditional occupations can be made sustainable in the future. An empirical study has been conducted in two villages in the Shyamnagor subdistrict of Satkhira district in southwestern coastal Bangladesh. The empirical methods included 310 household surveys, focus group discussions, and key informant interviews. Results show that 15 professions have been recorded and grouped into four categories: zero-capital instant wage occupations, minimum capital-end rewarding occupations, intellectual occupations, and capital-based occupations, depending on the type of capital. These categories accommodate mainly hand-based occupations—a trend most experienced in stressed environmental conditions. The intellectual occupations desire more institutional support for their sustainability. However, the sustainability of current occupational strides can be achieved by healthy external subsidies for applying knowledge and tangible inputs with information, communication, and technology support, as suggested by households (HH) involved in capital-based occupations. These HH suggested an integrated approach for occupational stride; however, such occupations are primarily land-based. The current climate-induced hazards to land and water's physicochemical attributes suggest an uncertain return from such capital-based, land-oriented occupations. Thus, this study suggests that hand-based occupations have a better chance for sustainability than subsidised capital-based land-oriented occupations.

[1]Environmental Science Discipline, Khulna University, Khulna, Bangladesh
[2]Department of Human Geography and Spatial Planning, Faculty of Geosciences, Utrecht University, Utrecht, The Netherlands

Corresponding author:
Bishawjit Mallick, Department of Human Geography and Spatial Planning, Faculty of Geosciences, Utrecht University, Utrecht, The Netherlands.
E-mail: b.mallick@uu.nl

Introduction

Coastal Bangladesh covers 32% of the country's total area and is the habitat of 44 million people (Huq & Rabbani, 2011; Mallick et al., 2017). Approximately 97.10 % of this coastal area and over 35 million of its population are exposed to multiple climate change-induced hazards such as tropical cyclones and storm surges (Huq et al., 2015) due to its locational actuality (Charabi et al., 2010), and thus it is globally regarded as a climate hotspot location. Dependence on climatic variability, natural resources, and poor resilience to environmental stress render livelihood support systems vulnerable to climatic hegemony, as exemplified on many occasions in coastal Bangladesh (Biswas & Mallick, 2020; Gain et al., 2012; Karim et al., 2012).

Occupation provides means of living that enhance materials and social resources. An unhindered occupation against socio-climatic stresses maintains and intensifies net economic gain using scopes and wealth, maybe enlisted as the sustainable one (Chambers & Conway 1992; Priodarshini et al. 2021). Thus, the criteria that determine an occupation to be sustainable are social and environmental: *environmental sustainability* reviews all external impacts by local and global actors that lead to stewardship of natural resources, and *social sustainability* reviews the internal capacity of livelihood patterns to withstand shock and stresses that lead to resilience (United Nations Development Programme, 2017). Here, the sustainable livelihood approach (SLA) comes into the application, and it deals with the livelihood strategies that allow resilience and empowerment of the community to strive and adapt to adversities and mutate hardship into opportunities. SLA advocates opportunities for future generations (Mallick et al. 2020), for instance, farmers' enhancement (Huq et al., 2015), aquaculture diversity (Ahmed et al., 2010; Islam et al., 2014), cost-effective resource modelling (Alam et al., 2013 a, b), and conflicts over resource utilisation (Swarnokar et al., 2020). Such SLAs focus either on aquaculture or agriculture that advocates land-based support depending on High Yielding Varieties, and such support encourages uncontrolled access to natural resources and accreted lands (Brammer, 1996; Paul, 2009).

However, the coastal land and water in the Lower Bengal Delta are already degrading due to salinity and land immaturity (Datta et al., 2018). Approach to hand-based (skill-based) occupational alternatives generally only require a few natural resources (land and water) but need to be more focused in the literature. However, the multiplication of cropping patterns at current ambient conditions is not environmentally supportive because of salinity contamination in groundwater irrigation and occasional drought conditions (Haque, 2006). Perception from the community also does not suggest aqua-based efforts with periodicity between shrimp (*Penaeus monodon*) and prawn (*Macrobrachium rosenbergii*) because of

their conflicting requirements for survival (Humphreys et al., 2015). However, expanding market facilities for artisanal handicrafts and tailing would be a plausible option. Certainly, an agrarian community's productive land or asset endowment can directly raise household income. However, in a landlessness context, such reliance is problematic, and certain off-farm activities can be promoted to absorb the promising labour power (Quasem, 2001). Thus, these occupations may be clustered into four major categories based on the *Mode of Capital* following Ali (2005) and Islam et al. (2011), as presented below:

Category I: occupations that do not need any initial capital and one can earn a good sum instantly, defined as *Zero Capital-Instant Wage Occupations*. Examples are post-larval (PL) collection from tidal rivers, day labouring at lease farms and so on.

Category II: occupations that require the least initials to explore with and are defined as *Minimum Capital-End Reward Occupations*. Examples are agricultural and livestock farming, handicrafts and so on.

Category III: occupations that require skill and knowledge to perform and are defined as *Intellectual Occupations* and

Category IV: occupations driven by recent socio-environmental trends require intensive capital, vigorous maintenance, and uncertainty in benefitting. Such occupations are defined as *Capital Based Occupations*, for example, business and trading, shrimp farming and pisciculture and so on.

Considering these four categories of occupation and relevant strategies, this study identifies the occupational pattern in two villages, Bara Kupat and Henchi, located in southwest coastal Bangladesh, and assesses how these occupations can be sustainable and the possible alternatives for sustainable occupation in the study villages. In the following, section 2 describes the empirical study settings and methodology. Section 3 presents the results, followed by a discussion in section 4, and section 5 concludes.

Methods and Materials

Study Area

This coastal region is experiencing—during the last 50 years—an overall increase in maximum and minimum annual temperature with excessive precipitation during monsoon and post-monsoon (Rimi et al., 2009). The alteration of the geophysical environment of this region during the 1960s by constructing enclosures (called polders)—initially meant for protecting crop-agriculture in the tidal floodplain from saline invasion—soon become waterlogged saline wetlands because of congestion of the natural drainage system (Gain et al., 2012; Seijger et al., 2019) that leads to changes in the geochemical environment as well. Such changes in physicochemical conditions of the environment have driven households (HH) to shift from agro-based to non-agro-based occupations (such as aquaculture supported by saline/brackish water) (Pouliotte et al., 2009). Salinity-tolerant

occupations such as shellfish farming (shrimp and crab) then started replacing the crop-agro-based occupations pursued by HH. However, such practices enhanced salinity more to soil and contamination of shallow aquifers by salinity and agrochemicals (Datta et al., 2010; Islam et al., 2019; Paul & Vogl, 2011; Primavera, 1997). Because of constructed physical barriers for water management, the migration of aquatic faunal species was delimited, and many indigenous fish varieties initiated experiencing stress in breeding and sufferings from diseases (Cochrane et al., 2009). With time, many also disappeared (Gain et al., 2008). This compelled the peasants to succumb to pisciculture with exotic species such as *Clarias gariepinus, Pangasius giganticus, Tilapia mossambica* and so on. Although the yield from such pisciculture is quite lucrative, many regard such dominance of exotic species in the natural system as a biological explosive (Barua, 1990) that may risk both humans and the environment (Sapkota et al., 2008).

The study region lies in the Ganges Tidal Floodplain (Brammer, 1996) as a broad bend of shallow land—barely a meter above the sea level and may be termed an immature delta (Rashid, 1991). The immature delta is included in the country's Sundarbans and the Sundarbans Reserve Forest agroecological zone. Geochemically, the soils are primarily noncalcareous grey floodplain and acid sulphate soils (saline). Both of the villages (*Bara Kupat* and *Henchi*) were devastated by Category IV tropical cyclCycloneR (November 15, 2007), Category I Cyclone AILA (May 25, 2009) (Paul, 2009; Roy et al., 2009) and Category IV tropical cyclone AMPHAN (May 16, 2020) (WMO, 2020) and were left defenceless. However, being experienced in extreme climatic events, the community is aware of coastal hazards with their peers.

The study villages *Bara Kupat* and *Henchi* are located on the bank of *Khalpetua* River in *Atulia* Union of Shyamnagar Upazila (subdistrict), Satkhira, and are peripheral to the Sundarbans of the Lower Bengal Delta (Figure 1). They are geographically situated around latitude 22°18′ N to 22°22′ N and longitude 89°08′ E to 89°14′ E and included in Polder 15 (Polders are enclosures with earthen embankments meant for protecting tidal floodplains from saline invasion). The *Henchi* is separated from *Bara Kupat* by a small distributary of *Khalpetua* named *Arpangashia-Henchi Khal* (canal). The region experiences a humid subtropical climate; the maximum temperature reaches up to 35.5°C during summer, and the minimum temperature is 12.5°C during winter (Bangladesh Meteorological Department, 2016). The average annual rainfall is around 1,710 mm (BMD 2016). Extreme climatic events such as storm surges, salinity invasion, and waterlogging are frequent in this region (Mallick et al., 2017).

Data Collection

Procedures for Participatory Action Research (Pretty et al., 1995) were followed to capture data for this research. Preceded with a reconnaissance survey, the primary field attributes were collected through a semi-structured questionnaire survey, Focus Group Discussion (FGD), Key Informant Interview (KII), and expert consultation. The questionnaire was pretested, and the surveyors were trained before field activities. The recorded total number of 948 HH in *Bara Kupat* and 158 in
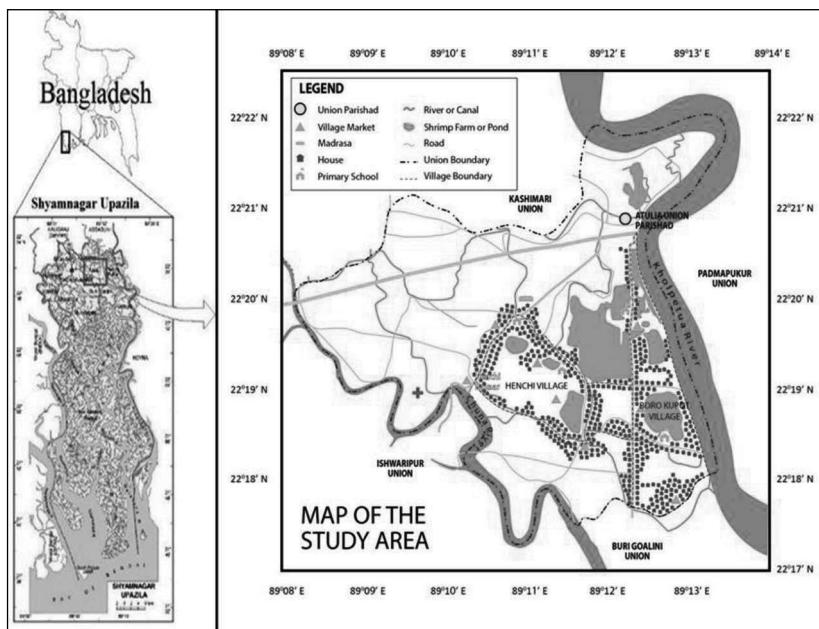
Figure 1. Location of the Villages *Bara Kupat* and *Henchi*, Union *Atulia*, Shyamnagar, Satkhira.

Henchi reported 15 different primary and secondary occupations, as shown in Table 1. The primary occupation is where the household devotes the highest period in a year. All occupations supplementary to the primary occupations are regarded as secondary occupations.

Land provides the primary livelihood support system for an agrarian community in coastal Bangladesh, and its degradation causes major financial losses (BCAS, 2001). A statistically significant positive relationship is observed between household arable land area and household income (at 95% confidence level) both in *Bara Kupat* ($r = 0.559$, Figure 2a) and *Henchi* ($r = 0.73$, Figure 2b). Considering such a relationship, we have stratified the total population (HH), and after determining the sample size (n) following Kothari (2004), they were selected randomly from each stratum according to weightage. We have observed that 12 HH in *Bara Kupat* and 22 in Henchi lie outside the cluster (Figure 2a and 2b) and are sampled separately. Following such estimation, the sample size (n) for *Bara Kupat* is $(190 + 12) = 202$ HH, and that for *Henchi* is $(86 + 22) = 108$.

Semi-structured questionnaire—focusing on demography, resource availability-vulnerability, occupation-income, land-use, cropping pattern-intensity, livelihood demand-requirements, health and sanitation, food and nutrition, culture, infrastructure, transportation and so on—was constructed for all 310 HH (202 in *Bara Kupat* and 108 in *Henchi*) and was surveyed given equal importance and time to all HH.

Four FGDs were held at *Henchi* Govt. Primary School premises (*Henchi*), *Bangabandhu* High School premises (*Henchi*), *Bara Kupat* Krishna Temple (*Bara*

Table 1. The Identified Primary and Secondary Occupations of the Households Engaged Within the Villages *Bara Kupat* and *Henchi* of Atulia *Union* in Shyamnagar Upazila of Satkhira District, Lower Bengal Delta, Bangladesh.

Serial No.	Household Occupations	Serial No.	Household Occupations
01.	PL (post-larvae) collection from tidal rivers	09.	Tailoring
02.	Daily labourer	10.	Teaching
03.	Van pulling (driving)	11.	Local service (private jobs)
04.	Crop-agricultural (*Kharif* I: *aman*)	12.	Shrimp (*Baghda*) aquaculture
05.	Olericulture on dykes	13.	Pisciculture with exotic species
06.	Animal husbandry at the homestead scale	14.	Small-scale irregular trading
07.	Wild fishing/capture fishing	15.	Crab fattening
08.	Artisanal handicraft		
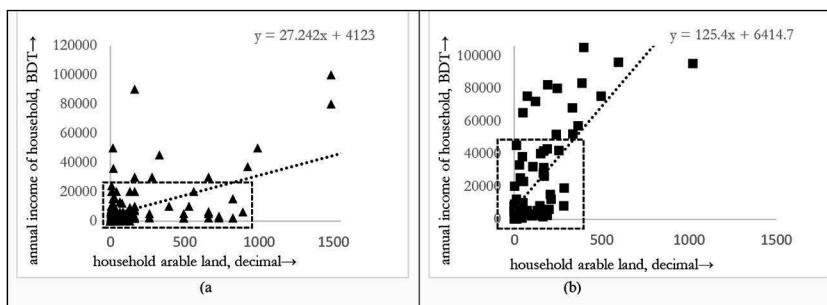
Figure 2. Correlation Coefficient Between Arable Land Area and Total Income of Households in Villages: (a) *Bara Kupat* and (b) *Henchi* of Atulia *Union*, Shyamnagar, Satkhira, Lower Bengal Delta, Bangladesh.

Kupat), and *Bara Kupat* Primary School premises (*Bara Kupat*). Each FGD has been participated by around 18–22 members maintaining gender balance, generating a composite perception of issues on sustainable occupation (Figure 3).

The FGD sessions of 90–120 minutes concentrate primarily on occupational sustainability concerning the past-present-future status and options about locational attributes (discourses), actors' involvement in particular options, and its effect on society, environment, economy (actors), variety of knowledge and resources that is required for executing an occupational option (resources), the vulnerability, resilience, and sustainability of occupational choice (influences) and perception on the potential of sustainability of the opportunity.

Five KIIs and expert consultations were also performed with an agro-farm owner, a shrimp farmer, a full-time wage labourer, a local government official, and a forest and fisheries department executive.
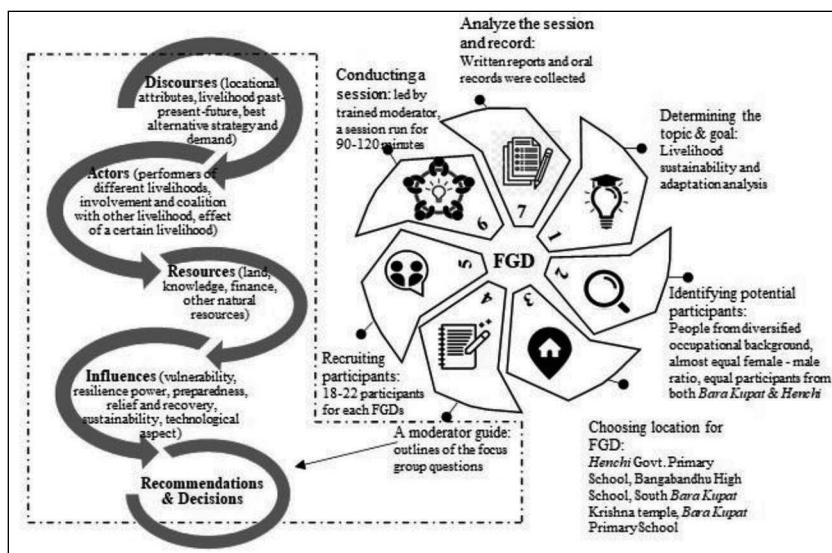
Figure 3. A Flash of Four FGDs Performed in Four Locations of *Bara Kupat* and *Henchi*, Outlining Major Steps and Focuses That Have Been Performed.

Results and Discussions

Demographic Profile

We have recorded a total population of 1,698 in *Bara Kupat* and *Henchi* with a male-female ratio of 47:53 (Table 2). The number of HH in *Bara Kupat* is 948, with an average size of 5 (~4.9), while the *Henchi* accommodates 158 HH and average size is 4. The age group between 27 and 35 years is quite significant (around 37% and 40%, respectively, in *Bara Kupat* and *Henchi*). A promising share of the workforce population (between 15 and 64 years old) was identified (66% in *Bara Kupat* and 61% in *Henchi*) who financially support their HH. Around 61% of children in *Bara Kupat* and 67% of children in *Henchi* (of age < 14 years) attend primary and junior educational levels, and the overall literacy rate is 54% in *Bara Kupat* and 65% in *Henchi*. A significant proportion of the population (around 53% in *Bara Kupat* and 67% in *Henchi*) is directly involved in farming activities such as agro-based, aqua-based, and livestock farming.

Occupational Profile

The primary occupation and income status in different occupational categories are presented in Table 3. The percentage of HH involved in other secondary occupations and the primary ones belonging to different categories are shown in Table 4.

The usual *Zero Capital-Instant Wage* (Category I) occupations in villages *Bara Kupat* and *Henchi* are day labouring (31% HH in *Bara Kupat* and 34% HH in *Henchi*) and post-larvae (PL) collection from the wild. However, a range of

Table 2. Demographic Profile of Households in *Bara Kupat* and *Henchi, Atulia* Union, Shyamnagar, Satkhira, the Lower Bengal Delta, Bangladesh.

Demographic Parameters		Bara Kupat	Henchi
		Total number	
Total household		948	158
Household size		4.9	4.1
Total population		1320	378
		% of the total population	
Male–female ratio	Male	46.89	47.08
	Female	53.10	52.91
Children (0–18)		33.70	36.60
Working force (15–64 yrs of age)		66.20	61.10
Major representing age group.		37 (27–35 yrs)	40.1 (22–33 yrs)
School attending (0–14 yrs of age)		61.10	67.20
Persons with disability		2.40	2.30
Literacy rate		54.80	65.80
Farmers		53.50	67.20
	Male	25.20	31.10
	Female	28.30	36.10

activities is observed in *Minimum capital* -End *reward* occupations (Category II). Among them are mono-crop (mainly *aman*) agriculture, livestock farming, and wild fishing (prominent in villages *Bara Kupat* and *Henchi*). Other activities of Category II encompass olericulture, crafting, and tailoring. Professional engagement with *Intellectual Occupation* (Category III) is scarce in the villages; however, few are engaged with traditional teaching and services. The seductive pull for tempting financial profit draws a group of community members to *Capital Based Occupation* (Category IV), where the commanding practices are year-round shrimp (*Penaeus monodon*, called *Baghda* in Bangla) farming (24.9% HH in *Bara Kupat* and 11% HH in *Henchi*), pisciculture with exotic species (6% of HH in both *Bara Kupat* and *Henchi*) and crab (*Scylla olivacea*) nursing/fattening (5.9 % HH in *Bara Kupat* and 4.8% HH in *Henchi*).

The secondary occupations where the community is involved mainly fall into the *Zero capital-Instant wage* and *Minimum Capital -End Reward* categories (Category I and Category II, respectively) (Table 4). The HH in *Henchi* are more involved in secondary occupations than Bara Kupat's. It is observed that a significant number of HH are involved with more than one occupation, as observed in Tables 3 and 4.

The financial outcome from the four occupational categories suggests that the highest share in Bara Kupat (BDT 1.00 Lac per HH per year) is achieved from Capital Based Occupations (Category IV); however, in Henchy, the dominant

Table 3. Occupation and Income Status Recorded in Villages *Bara Kupat* (n = 202) and *Henchi* (n = 108) at the Household (HH) Level Through a Semi-structured Questionnaire Survey.

Occupational Category	Primary Occupations	Bara Kupat (n = 202)			Henchi (n = 108)		
		% of Total HH	Income/Year/HH (BDT)		% of To-tal HH	Income/Year/HH (BDT)	
			Max	Mode		Max	Mode
Zero capital-instant wage occupations	PL collection in tidal rivers	4	50,000	5000	6	35,000	10,000
	Daily labourer	31			34		
	Van puller/driver	1			1		
Minimum capital -end reward occupations	Crop-agriculture (*Kharif* II: *Aman*)	6.7	40,000	2000	10.7	65,000	5,000
	Olericulture on dykes	1			4.4		
	Animal husbandry at the household level	1.4			10.4		
	Wild fishing/capture fishing	5.8			5.5		
	Artisanal handicraft	1			2		
	Tailoring	3.8			1		
Intellectual occupations	Teaching	1.4	25,000	5000	1	15,000	2,000
	local service (private jobs)	3.4			1.7		
Capital based occupations	Shrimp (*Bagdha*) aquaculture	24.9	1,00,000	2500	11	55,000	11,000
	Pisciculture with exotic species	6			6		
	Small-scale irregular trading	2.7			0.5		
	crab fattening	5.9			4.8		

Table 4. Percentage of Households Involved in Primary and Secondary Occupations in Villages Bara Kupat and Henchi.

Bara Kupat (n = 202)		Occupational Category	Henchi (n = 108)	
Percentage of HH Engaged in Multiple Occupations.			Percentage of HH Engaged in Multiple Occupations.	
Primary (HH %)(n = 202)	Secondary (HH %) (n =145)		Primary (HH %) (n = 108)	Secondary (HH %) (n = 88)
36	42	Category I: Zero Capital-Instant Wage Occupations	41	46
19.7	38	Category II: Minimum Capital -End Reward Occupations	34	37
4.8	0	Category III: Intellectual Occupations	2.7	0
39.5	19	Category IV: Capital-based occupations	22.3	17

income share (BDT 65,000 per HH per year) is acquired from *Minimum Capital -End Reward* (Category II) occupation. The second highest income comes in *Bara Kupat* from *Zero capital-Instant Wage* (Category I) and in *Henchi* from *Capital Based Occupation* (Category IV) (Table 3).

Occupational Shift: Facts and Preference

Perception regarding frequent changes and barriers in maintaining a livelihood support system is presented in Figure 4. A sizeable number of HH diagnosed salinity invasion (92%) and cyclonic events (95%) as the most instinctive driver responsible for changes in land use patterns. Reduced soil fertility—as perceived by 82% HH—is a significant cause for the decrease in productivity of rice crops. The HH perceived that such hazardous events were not an everyday experience two decades ago. About 80% of the HH perceived that the region is experiencing prolonged drought periods, which was not a poor freshwater region even two decades ago.

Such barriers in maintaining occupational sustainability are responsible for the current food crisis for 63% of HH. Occupational instability was also reported as accountable for declination in social coherence; for example, 61% of HH referred to social violence, and 68% of HH claimed that women insecurity either at the household or community level.

The perceived environmental stressors contributing to occupational uncertainties are sorted through expert consultations and transect walking and semi-quantified in a Likert scale following Joshi et al. (2015). The occupational preferences are classified and charted in Figure 5. The exercise suggests poor choices (score ≤ 4 out of 10) for several currently practiced capital-based occupational options such as shrimp aquaculture and crab nursing, requiring saline water, pisciculture with exotic species and so on (Category IV). Instead, the community is more inclined toward (score ≥ 5 out of 10) nonfarming activities such as daily labouring, van pulling, PL collection, tailoring, crafting and so on. (Category I and Category II).

However, it is essential to note that almost all HH demand migration from their current settlement to a place perceived as free from antagonistic environmental attributes.

The community people desire an economical and environment-friendly change in current occupational practices. This urge is mainly pronounced with women folk in kitchen assemblies. A strategy for integrated agriculture or aquaculture, pisciculture with major and minor indigenous carp species, and indigenous catfish (preference score 9.5 out of 10, Figure 5) is suggested instead of existing mono-crop rice by intense irrigation. Economic migration to sort-of occupations that are not vulnerable to environmental stresses is highly prioritised (score 10 out of 10). However, many community members also favour self-owned van driving, boatmen, labouring, recycle-reuse-based SMEs, self-motivated tailor-trainers, and dry food (fish, fruit, and spices) processing, as revealed by FDGs and HH survey.
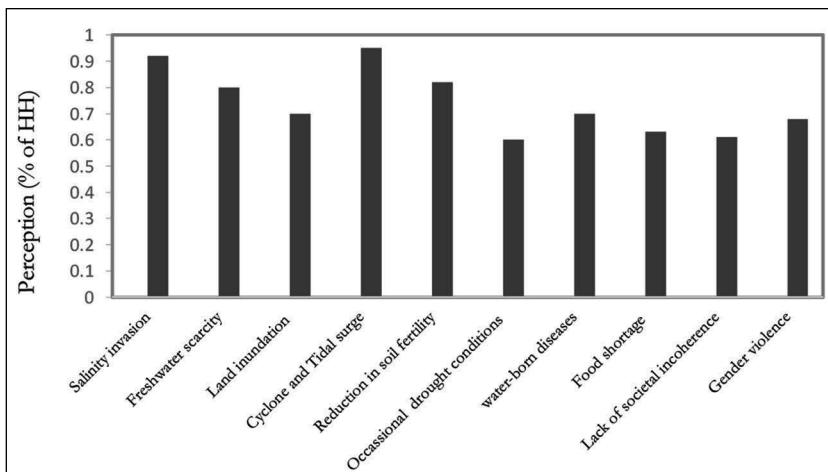
Figure 4. Hindrances in Maintaining the Sustainability of Current Occupations as Perceived by the Households of *Bara Kupat* and *Henchi*.
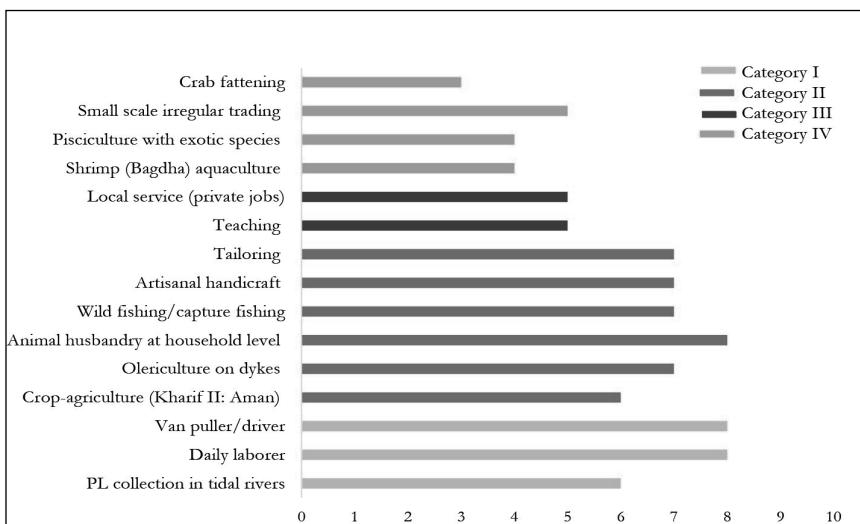
Figure 5. Perceived Household Preferences for Occupational Options on a 1–10 Scale.

Occupational Sustainability Analysis

Analysis from FGDs, semi-structured HH questionnaire surveys, and expert opinions are consulted to filter options for better alternative occupational strategy and thus sustainability analysis of livelihood. Table 5 represents the current occupational strategy along with three alternatives following Edjossan-Sossou et al. (2014) and designated as follows:

Occupational Strategy I: do nothing to the status of the existing occupational options,

Table 5. Strategy for Occupational Sustainability as Perceived from Analysis of HH Questionnaire Survey, FGDs, and KII in Four Contextual Cases for Coastal Village *Bara Kupat* and *Henchi* in the Lower Bengal Delta, Bangladesh.

Major Occupational Categories	Occupational Strategy	Occupational Strategy II	Occupational Strategy III	Occupational Strategy IV
Zero capital-instant wage occupations	PL collection from tidal rivers	PL collection at optimal tidal opportunities	PL collection at the optimal tide, along with juvenile and adult crab collection	Small-scale PL collection, with storage and delivery centre supported by ICT
	Daily labourer	Daily labourer with a maximum wage	Daily labourer with a maximum wage	Wage labour, Monsoonal labouring in the sea, food for work
	Van puller	Minimum rent for Van	Facilities for driving at multiple slots	Driving self-owned vans
Minimum capital-end reward occupations	Crop-agriculture (*Kharif* II: *Aman*)	*Kharif* I(*Aush*), *Kharif* II (*Aman*), and *Rabi* by groundwater irrigation on demand	*Kharif* I (*Aush*), *Kharif* II (*Aman*), and *Boro* rice with harvested rainwater and groundwater irrigation	Integrated agriculture such as salinity and waterlog tolerant crop varieties (e.g., BRRI 47, BRRI 23) with prawn (*Golda*) and pisciculture with indigenous carp with the surface (harvested rainwater) and groundwater irrigation facilities supported by ICT climate services.
	Olericulture on dykes	Expansion of olericulture at the homestead	Olericulture with diverse species on dykes and homesteads	Olericulture with various species on dykes and home-steads and with hydroponic facilities in waterlogged locations
	Animal husbandry at the household level	Animal husbandry at an expanded scale	Large-scale animal husbandry with marketing facilities	Animal husbandry at entrepreneurship level with diversity in the product.
	Wild Fishing/Capture fishing (mainly in coastal rivers)	Extended wild fishing/ capture fishing at continental shelves	Developed wild fishing/catch fishing with weather forecast facilities	Capture fishing with survival kits along with weather forecast and cyclone warning facilities
	Artisanal handicraft	Handicraft marketing facilities	Small-scale handicraft entrepreneur-ship with recyclable material	Local resource-based small-scale handicraft entrepreneurship with recyclable material
	Tailoring	Tailoring, sewing (needle-work)	Tailoring and stitching for branded clothes	Trainer for the trainees in tailoring and stitching for branded clothes supported by ICT

(Table 5 Continued)

Major Occupational Categories	Occupational Strategy I	Occupational Strategy II	Occupational Strategy III	Occupational Strategy IV
Intellectual occupations	Teaching	Teachers with environmental knowledge	Teacher with knowledge of coastal hazards	Teacher with knowledge of coastal livelihood and coastal hazards
	Local services (private jobs)	Locally available regular paid job	Jobs in the Local Government sector and NGOs	Jobs in the public sector, community clinics, executives of Local Public authorities
Capital-based occupations	Shrimp (Bagdha) aquaculture	Shrimp (Bagdha) aquaculture with species diversity	Shellfish aquaculture with a variety of seeds from hatchery	Integrated aquaculture with salinity tolerant crop supported by climate information services
	Pisciculture with exotic species	Pisciculture with exotic species and raw feed	Pisciculture with indigenous major and minor carp	Integrated aquaculture with indigenous major and minor carp supported by climate information services
	Small-scale irregular trading	Small-scale regular trading	Miniature-scale trading and entrepreneurship, such as poultry farming	Investment in extended entrepreneurship supported by ICT
	Crab fattening	Crab fattening with nursery knowledge	Crab fattening with crablets from hatchery	Environment-friendly crab fattening supported by ICT

Occupational Strategy II: maintaining the status quo with existing resources and power,

Occupational Strategy III: in collaboration with the status quo, explore new occupational options with proper adaptation strategy and

Occupational Strategy IV: treating the status quo with proper adaptations and innovating new occupational options with a disaster defence mechanism.

Toward Occupational Sustainability

Occupational Strategy I

The current occupational strategy pursued by Baro Kupat and Henchi HH reflects a compromise with the ambient processes governing the physical environment that support the livelihood system. The physical actuality of the *Atulia* union currently favours a saline ambient condition (Datta et al., 2018; Ullah & Rahman, 2015). Persisting occupations with such an ambient environment require an adequate capital base, and a sizeable number of *Baro Kupat* (39.5%) and *Henchi* (22.3%) HH are currently involved with such *Capital Based Occupations* (Tables 03ab & 04) who own a good size of arable land as well. Table 4 suggests that the stressed environmental conditions compelled a significant number of HH to be involved with *Zero Capital-Instant Wage* and *Minimum Capital-End Reward* Occupations (36% and 19.7%, respectively, in *Bara Kupat* and 41% and 34% in *Henchi,* respectively). However, such occupations are mostly hand-based, and our intuitive perception is that these HH own a meagre size of arable land and depend on secondary occupations to maintain their livelihood support (Table 3). Thus, the occupational strategy that the HH follow is not subsidised by the environmental contributors and therefore needs to be sustained by seeking alternative and improved options.

Occupational Strategy II

Our observation from contextual analysis of the household survey, FGD, and expert consultation suggested a range of reallocations of internal resources and energy optimisation to sustain the current occupational strategy. The occupations categorised as *Zero Capital-Instant Wage* prioritise hand-based activities where environmental subsidies such as benefit from optimal tide for PL collection from coastal tidal rivers and minimum van rent and maximum wage are deserving. The HH involved with *Minimum Capital-End Reward* occupations also urge to optimise the occupational benefit by multiplication, expansion, and extending their current occupation at least spatially (Table 4). Households involved in *Intellectual Occupations* perceive that acquiring current knowledge of the environment and consistency in engagement may guarantee sustainability in their occupation. Boosting occupational support for households engaged in *Capital Based* occupations perceives their sustainability through innovation and extension of their efforts through compromise with saline ambient conditions such as selecting *Baghda* and practicing exotic fish species for pisciculture with small-scale trading, thus abandoning crop-agriculture (Table 4).

Occupational Strategy III

The community desires external contribution and support to internal resource and energy optimisation efforts to sustain the current occupational support system as a third strategy. The major hand-based *Zero Capital-Instant Wage* occupations desire to expand the diversity of PL collection, crablets, and relaxed time slots for performing additional occupational activities with tools (such as vans) from the owners. This would provide the space for involvement with secondary occupations at convenient time slots. HH involved with mostly hand-based *Minimum Capital-End Reward* occupations expect external contribution in expanding crop-agriculture by harvested rainwater and groundwater irrigation with quality assurance, an extension of olericulture both in dykes and homesteads, and capture fishing at continental shelves with weather forecast facilities. This group is also inclined to scale their efforts in animal husbandry and artisanal handicraft with entrepreneurship. The HH involved in *Intellectual* occupations desire sustainability of their current occupation by fortification when rendered to public authority. Much innovation for the sustenance of current occupation may be observed from the perception of HH involved in *Capital Based* occupations.

However, such perceived sustainability effort for current capital-based occupations is mostly land-based and meant for community members who own large arable land. The land is dedicated to aquaculture diversity in hatchery-based shellfish (such as shrimp and crab) culture, pisciculture with indigenous carp, and entrepreneurship (Table 4). Success in pisciculture with indigenous species without eliminating the exotic species is doubtful, as many experts perceive, because the latter have a predatory habit (Barua 1990). Similar is the situation that may hinder success in the diversity of prawn (*Macrobrachium rosenbergii)* as favoured by many HH in place of shrimp (*Penaeus monodon*), but their survival conditions are environmentally conflicting (Sarwar, 2005).

Occupational Strategy IV

Including defence mechanisms against climate-induced environmental hazards is the main focus for the perceived sustainability of the current occupational strategy, which is important in Occupational Strategy *IV*. This strategy also upholds the need to optimise resource and information, communication, and technology (ICT) tools input from external and internal sources that enhance the inherent ability of quest for sustainability of the current occupational pattern. HH involved with *Zero Capital-Instant Wage* occupations suggest a hazard-proof storage and delivery system for their collections, support from the social safety net promulgated by the public authority, and ownership of paraphernalia required to keep their occupational strive. These HH seem to be less worried about climate-induced perceived environmental hazards. The HH involved in *Minimum Capital-End Reward* occupations perceive sustainability of their current occupational efforts through integrated agriculture and integrated aquaculture, olericulture through hydrophonic assemblages, small-scale animal husbandry, and product diversity secured capture fishing and also local resource base artisanal handicraft and tailoring - all with an urge for developing entrepreneurship. The HH engaged in

intellectual occupations perceive their current occupational sustainability by striving to enhance knowledge and incorporation in the public sector. The HH of capital-based occupations perceive their current occupational sustainability through external input by expertise and reliance on tangibility with the ambient environmental biophysical attributes (Table 4).

It is worth mentioning that various social, cultural, and economic factors influence the gender dynamics of all sorts of occupation in our study villages, which, like many other places in the coastal region, often exhibits distinct patterns in the types of jobs and employment opportunities available to men and women. The traditional gender roles were prevalent, where men were often associated with tasks such as fishing, agriculture (including shrimp farming), and other physically demanding activities, but women were often involved in household chores, small-scale agriculture, and working in the informal sector. For instance, men were more commonly engaged in commercial fishing, while women were more involved in smaller-scale, subsistence fishing and aquaculture. Besides, limited resource access restricts women's participation in certain economic activities, which is increasingly recognised for its importance in building resilience, poverty reduction, and sustainable development in the region. Promoting gender equality and empowering women economically can lead to more inclusive and prosperous coastal communities.

Conclusion

The current attributes of villages *Bara Kupat* and *Henchi* are perceived as an *ecological backlash*—the consequence of human interference with the natural system. Thus, the sustainability of the current occupation—with innovation and subsistence—is complicated when it is considered antagonistic environmental support. Land-based occupations—where investment facilities are perceived as hazardous—should be replaced with hand-based occupations supported by ICT tools.

As a compromise to the current antagonistic environmental attributes, the land-based occupations may strive with integrated agriculture/aquaculture fortified with saline and waterlog tolerant rice varieties such as BRRI 47, BINA 8, BRRI 23, 41, 53, and 54, along with fish species such as *Harpadon nehereus, Liza parsia, Mugil cephalus, Chanos chanos* and so on. *Macrobrachium rosenbergii* and rice varieties may also be a practical occupational option with harvested rainwater for irrigation where possible. The introduction of crab fattening also is suggested by many. Olericulture may be considered as occupational fortification against climate change-induced hazardous conditions. HH engaged in nonfarm occupation—primarily those in *Zero Capital Instant Wage* and *Minimum Capital End Reward* occupations—have no or less access to arable land and perceived hand-based occupations as a practical option for sustainability for their current engagement. Thus, Occupational Strategy IV could be the most viable option for sustaining the current occupational engagement.

While these findings are based on two villages may not provide an exhaustive picture of the entire region, it can still offer valuable insights into the specific context and circumstances of those villages.

The results are not just unique to those particular villages but may have broader implications. It's important to note that replicability does not necessarily guarantee the accuracy or truthfulness of the findings. The results of a replicated study could still be subject to variation due to differences in contextual factors, variations in data collection, or the inherent complexity of the subject being studied. However, if multiple researchers can independently replicate the study and achieve consistent results, it enhances the robustness and credibility of the findings, and later can be generalised. Researchers should be cautious about making sweeping generalisations and should instead focus on contributing to the understanding of the specific areas under study. The more robust the research design and the more carefully the study villages represent the larger population; the more confident one can be in the relevance of the findings to that part of Bangladesh.

Acknowledgments

Declaration of Conflicting Interests

Funding

References

Ahmed, N., Allison, E.H. & Muir, J.F. (2010) Rice fields to prawn farms: A blue revolution in southwest Bangladesh? *Aquaculture International*, *18*, 555–574. https://doi.org/10.1007/s10499-009-9276-0

Alam, M., Ahammad, R., Nandy, P., & Rahman, S. (2013a). *Climate change adaptation actions in Bangladesh*. 253–276. https://doi.org/10.1007/978-4-431-54249-0

Alam, M., Ahammad, R., Nandy, P., & Rahman, S. (2013b). Coastal livelihood adaptation in changing climate: Bangladesh experience of NAPA priority project implementation. In Shaw, R., Mallick, F., Islam, A. (eds), *Climate change adaptation actions in Bangladesh: Disaster Risk Reduction* (pp. 253–276). Springer. https://doi.org/10.1007/978-4-431-54249-0_14

Ali, A. (2005). *Livelihood and food security in rural Bangladesh: The role of social capital*. Wageningen University and Research.

Bangladesh Meteorological Department. (2016). *Climate data portal: Satkhira station*. Ministry of Defence, Government of Bangladesh.

Barua, S. P. (1990). The status of alien invasive species in Bangladesh and their impact on the ecosystems. *World*, 1–7.

Brammer, H. (1996). *Geography of the soils of Bangladesh*. University Press Limited.

Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. Institute of Development Studies, UK.

Charabi, Y. (2010). *Indian Ocean tropical cyclones and climate change*. Springer & Business Media.

Cochrane, K., De Young, C., Soto, D., & Bahri, T. (2009). Climate change implications for fisheries and aquaculture. *FAO Fisheries and Aquaculture Technical Paper*, *530*, 212.

Datta, D. K., Roy, K., & Hasan, N. (2010). Shrimp Culture: Trend, Consequences, and Sustainability in the Southwestern Coastal Region of Bangladesh. In Ramanathan A. L., Bhattacharya P., Dittmar T., Bala Krishna Prasad M., Neupane B. R. (Eds.), *Management and sustainable development of coastal zone environments* (pp. 227–244). Springer with Capital Publishing Company.

Datta, D. K., Ghosh, P. K., & Aktar, M. (2018). Bio-physical attributes of coastal villages under climate stressed environmental conditions in Bengal Delta, Bangladesh. *Journal of Climate Change*, *4*(1), 71–83. https://doi.org/10.3233/jcc-180008

Edjossan-Sossou, A. M., Deck, O., Alheib, M., & Verdel, T. (2014). A decision-support methodology for assessing the sustainability of natural risk management strategies in urban areas. *Natural Hazards and Earth System Sciences*, *14*(12), 3207–3230. https://doi.org/10.5194/nhess-14-3207-2014

Gain, A. K., Uddin, M. N., & Sana, P. (2008). Impact of river salinity on fish diversity in the south-west coastal region of Bangladesh. *International Journal of Ecology and Environmental Sciences*, *34*(1), 49–54.

Gain, A. K., Giupponi, C., & Renaud, F. G. (2012). Climate change adaptation and vulnerability assessment of water resources systems in developing countries: A generalized framework and a feasibility study in Bangladesh. *Water*, *4*(2), 345–366. https://doi.org/10.3390/w4020345

Haque, S. A. (2006). Salinity problems and crop production in coastal regions of Bangladesh. *Pakistan Journal of Botany*, *38*(5), 1359–1365.

Humphreys, E., Tuong, T. P., Buisson, M. C., Pukinskis, I., & Phillips, M. (2015). *Revitalizing the Ganges coastal zone: Turning science into policy and practices*.

CGIAR Research Program on Water, Land, and Ecosystems. https://cgspace.cgiar.org/bitstream/handle/10568/66389/Revitalizing%20the%20Ganges%20Coastal%20Zone%20Book_Low%20Version.pdf?sequence=1?galog=no

Huq, N., Hugé, J., Boon, E., & Gain, A. K. (2015). Climate change impacts in agricultural communities in rural areas of coastal Bangladesh: A tale of many stories. *Sustainability*, *7*(7), 8437–8460. https://doi.org/10.3390/su7078437

Huq, S., & Rabbani, G. (2011). Adaptation technologies in agriculture: The economics of rice-farming technology in climate-vulnerable areas of Bangladesh. *Technologies for Adaptation: Perspectives and Practical Experiences, UNEP, Roskilde*.

Islam, M. M., Marandi, A., Fatema, S., Zahid, A., & Schüth, C. (2019). The evolution of the groundwater quality in the alluvial aquifers of the southwestern part of Bengal Basin, Bangladesh. *Environmental Earth Sciences*, *78*(24), 1–20. https://doi.org/10.1007/s12665-019-8714-1

Islam, M. M., Sallu, S., Hubacek, K., & Paavola, J. (2014). Limits and barriers to adaptation to climate variability and change in Bangladeshi coastal fishing communities. *Marine Policy*, *43*, 208–216. https://doi.org/10.1016/j.marpol.2013.06.007

Islam, G. M. N., Yew, T. S., Abdullah, N. M. R., & Viswanathan, K. K. (2011). Social capital, community based management, and fishers' livelihood in Bangladesh. *Ocean & coastal management*, *54*(2), 173–180. https://doi.org/10.1016/j.ocecoaman.2010.10.026

Joshi, A., Kale, S., Chandel, S., & Pal, D. (2015). Likert Scale: Explored and explained. *British Journal of Applied Science & Technology*, *7*(4), 396–403. https://doi.org/10.9734/bjast/2015/14975

Karim, M. R., Ishikawa, M., Ikeda, M., & Islam, M. T. (2012). Climate change model predicts 33% rice yield decrease in 2100 in Bangladesh. *Agronomy for Sustainable Development*, *32*(4), 821–830. https://doi.org/10.1007/s13593-012-0096-7

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Mallick, B., Ahmed, B., & Vogt, J. (2017). Living with the risks of cyclone disasters in the southwestern coastal region of Bangladesh. *Environments*, *4*(1), 13. https://doi.org/10.3390/environments4010013

Mallick, B., Sultana, Z., & Bennett, C. M. (2020). How do sustainable livelihoods influence environmental (non-)migration aspirations? *Applied Geography*, *124*, 102328. https://doi.org/10.1016/j.apgeog.2020.102328

Paul, B. G., & Vogl, C. R. (2011). Impacts of shrimp farming in Bangladesh: Challenges and alternatives. *Ocean and Coastal Management*, *54*(3), 201–211. https://doi.org/10.1016/j.ocecoaman.2010.12.001

Paul, B. K. (2009). Why relatively fewer people died? The case of Bangladesh's cyclone Sidr. *Natural Hazards*, *50*(2), 289–304. https://doi.org/10.1007/s11069-008-9340-5

Pouliotte, J., Smit, B., & Westerhoff, L. (2009). Adaptation and development: Livelihoods and climate change in Subarnabad, Bangladesh. *Climate and Development*, *1*(1), 31–46. https://doi.org/10.3763/cdev.2009.0001

Pretty, J. N., Guijt, I., Scoones, I., & Thompson, J. (1995). *A Trainer's Guide for Participatory Learning and Action* (pp. 131–260). https://pubs.iied.org/sites/default/files/pdfs/migrate/6021IIED.pdf?

Primavera, J. H. (1997). Socio-economic impacts of shrimp culture. *Aquaculture Research*, *28*(10), 815–827. https://doi.org/10.1046/j.1365-2109.1997.00946.x

Priodarshini, R., Biswas, B., Sánchez Higuera, A.M., & Mallick, B. (2021). Livelihood challenges of 'double strike' disasters: Evidence from rural communities of south-

west coastal Bangladesh during the Covid-19 pandemic and cyclone Amphan. *Current Research in Environmental Sustainability*, *3*, 100100-100100.

Quasem, M. A. (2001). Landlessness in Bangladesh: A case study in the coastal region of Bangladesh. *The Bangladesh Development Studies*, *27*(1), 105–121. http://www.jstor.org/stable/40795623

Rashid, H. R. (1991). *Geography of Bangladesh*. University Press Ltd., Dhaka, Bangladesh.

Rimi, R. H., Rahman, S. H., Karmakar, S., & Hussain, S. G. (2009). Trend analysis of climate change and investigation on its probable impacts on rice production at Satkhira, Bangladesh. *Pakistan Journal of Meteorology*, *6*(11), 37–50.

Roy, K., Kumar, U., Mehedi, H., Sultana, T., & Ershad, M. D. (2009). *Initial damage assessment report of cyclone AILA with focus on Khulna district*. Unnayan Onneshan-Humanity Watch- Nijera Kori, Khulna, Bangladesh. https://doi.org/10.13140/RG.2.1.5193.3925

Sapkota, A., Sapkota, A. R., Kucharski, M., Burke, J., McKenzie, S., Walker, P., & Lawrence, R. (2008). Aquaculture practices and potential human health risks: Current knowledge and future priorities. *Environment International*, *34*(8), 1215–1226. https://doi.org/10.1016/j.envint.2008.04.009

Sarwar, M. G. M. (2005). *Impacts of sea level rise on the coastal zone of Bangladesh* [Master's thesis]. Lund University, Sweden. https://static.weadapt.org/placemarks/files/225/golam_sarwar.pdf

Seijger, C., Datta, D. K., Douven, W., Halsema, G.V., & Khan, M. F. (2019). Rethinking sediments, tidal rivers and delta livelihoods: Tidal river management as a strategic innovation in Bangladesh. *Water Policy*, *21*(1), 108–126. https://doi.org/10.2166/wp.2018.212

Swarnokar, S.C., Ashik -Ur- Rahman, M., & Mou, S.I. (2020) Conflict of resource use among different livelihood group in coastal villages of South western Bengal Delta, Bangladesh. *International Journal of Sustainable Development and Planning*, *15*(7), 1089–1099. https://doi.org/10.18280/ijsdp.150713

Ullah, M., & Rahman, M. (2015). Assessing vulnerability and adaptation to climate change by farming communities in southwestern coastal Bangladesh. *Journal of Environmental Science and Natural Resources*, *7*(2), 31–35. https://doi.org/10.3329/jesnr.v7i2.22200

United Nations Development Programme. (2017). *Application of the Sustainable Livelihoods Framework in Development project*. https://www.latinamerica.undp.org/content/rblac/en/home/library/poverty/guidance-note–application-of-the-sustainable-livelihoods-framew.html

Spatial Variation of Quality of Living in Selected Blocks of Murshidabad District in West Bengal, India

Manab Ghosh[1] and Debjani Roy[2]

Abstract

Quality of living conditions refer to the general well-being of individuals and societies, which includes education, family health, employment, wealth, satisfaction, safety, religious belief, freedom, etc. This research paper deals with spatial variation of quality of living regarding various basic services and amenities in selected blocks of Murshidabad district in West Bengal, India. A composite index was developed based on 19 indicators to measure the actual scenario of the living condition of households there. Different indices, such as the human capital index, financial capital index, physical capital index and housing index, have been used to measure block-level disparity and were categorised based on composite score value. As expected, the level of development is unequal, with vast areas of backwardness interspersed with micro zones of development. The findings reveal that the northern part of this region is more developed as compared with other parts of this region. The quality of living and development of a particular region depends not only upon a single criterion but also on the interplay of several socio-economic factors that determine that region's development level. This study suggests that the backward blocks need urgent improvement in most indicators to enhance the households' living conditions.

Keywords

Spatial variation, living condition, human capital index, Murshidabad, planner, and policy makers

[1]Berhampore College, Berhampore, West Bengal, India
[2]Post Graduate Department of Geography, Nirmala College, Ranchi, Jharkhand, India

Corresponding author:
Manab Ghosh, Berhampore College, Berhampore, West Bengal 742101, India.
E-mail: manabghosh37@gmail.com

Introduction

Quality of living conditions refers to the general well-being of individuals and societies, outlining negative and positive features of life (Forbes, 2013). Well-being is a multidimensional approach in the literature (Sarriera & Bedin, 2017). There are various approaches to life, such as education, family health, employment, wealth, satisfaction, safety, religious belief, freedom, etc. (Pal & Kumar, 2005). The United Nations Sustainable Development Goals (SDGs 2019) are considered a blueprint to achieve a better, peaceful, and sustainable future for the world. Sustainable development can only be achieved by ensuring an improved standard of living (SL) for individuals. Common people need assets and services to fulfil their basic needs by providing good conditions housing, adequate structural materials, proper drinking water, sanitation facilities, banking facilities and drainage facilities. It can enhance the quality of living (Koh, 2018). These basic assets and services assist individual households in enhancing their SL (Prakongsai, 2006). In India, many people living below poverty are deprived of the availability of several basic services.

From a geographical perspective, there is a spatial variation in the quality of living at the state, district, and block levels (Sam & Chakma, 2016). Several researchers have studied the quality of living, identified the component of quality living and compared various geographical areas such as states, nations, districts and cities (Ruzevicius, 2007). This study assessed people's living conditions using the Composite Index score (Krishnan, 2015). Multidimensional composite indices have been used to assess people's quality of living since 1990 (Greyling & Tregenna, 2017). For example, UNDP (United Nations Development Programs) developed a composite index based on Sen's (1985) 'Capability and Functioning Approach' to measure the Human Development of the countries (Stanton, 2007). In many other previous studies, some composite indices were largely used to measure the living condition of the people from both subjective and objective perspectives (Das et al., 2020). For example, the physical quality of life index (Dasgupta & Weale, 1992), the index of economic well-being (Osberg & Sharpe, 2000) and the combined quality of life indices (Diener, 1995) are some of the widely used measures. In this study, the living conditions of the households across the district and block levels have been measured from the objective approach to well-being (Martinez, 2019).

This study is carried out to determine the quality of living conditions in the selected blocks of Murshidabad district, one of the most backward districts in West Bengal. The selected blocks have some unique identities in terms of their socio-cultural background as physically; they occupy a plainland along the river Padma bounded by the Indo-Bangladesh Border (Figure 1). This district was identified as one of the most 'backward regions' and has a poor 'human development index' by the Government of India (GOI) and the Planning Commission of India, also known as NITI Aayog (Ministry of Panchayati Raj, Government of India., 2009). In India, 205 districts were identified as the most backward districts, this is one of them. In this regard, measuring quality of living

conditions of people in selected blocks of Murshidabad district becomes more important and pertinent. This study aims to:

1. Measure the availability of basic amenities and services in different blocks of the study area,
2. Examine the variation in the quality of living conditions in the selected blocks and
3. Identify the most backward areas in terms of SL (Standard of Living) and suggest policies for the concerned agencies of State and Central Government.

Materials and Methods

Study Area

Murshidabad district is in the central part of West Bengal in Eastern India. Geographically this region lies between 24°00′ and 24°40′ north latitudes and 88°00′ and 88°40′ east longitudes. This district border area comprises 10 community development blocks (C.D. Block). These are Farakka, Samserganj, Suti-I, Suti-II, Raghunathganj, Lalgola, Bhagawangola-I, Bhagawangola-II, Raninagar-II and Jalangi. The Padma River demarcates the region and forms a natural international boundary with Bangladesh (Figure 1).
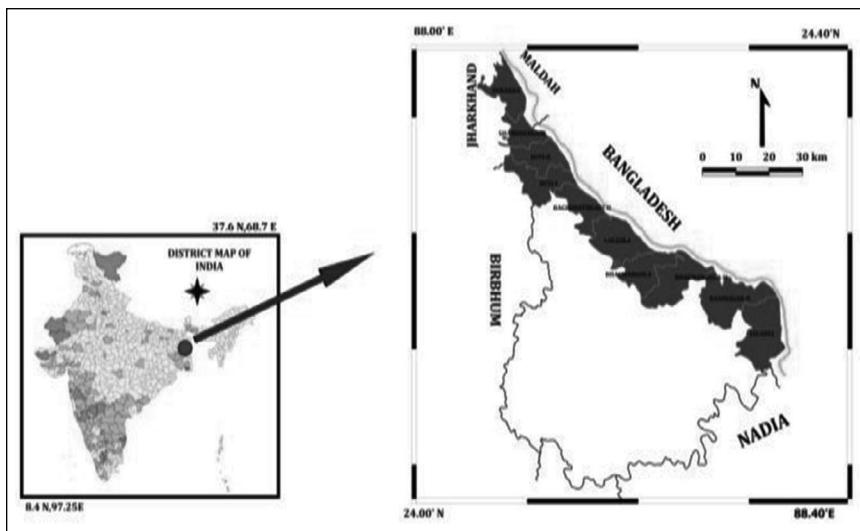
Figure 1. Location Map of the Study Area (Murshidabad District).
Source: Authors create using Q-GIS software version 3.14. Deep blue colour indicates the study area.

Data Source and the Methods

This research was conducted based on major sources of secondary data.

- These data were collected from the Primary census abstract (PCA, 2011), the Housing listing Primary census abstract (HLPCA, 2011) and District Statistical Handbook (2018).
- Housing listing primary census abstract, which provides data related to the condition of the house, materials of the house, availability of drinking and sanitation facility, availability of electricity, types of fuels used for cocking, various types of assets (such as TV, radio, laptop, mobile, cars, etc.) and so on. One of the major advantages of using house-level primary census abstract (HLPCA) is that it helps examine the development level based on the basic amenities and services. The SL cannot be enhanced without these.
- In this study, 19 indicators have been considered under four major domains, namely human capital index (HCI), financial capital index (FCI), physical capital index (PCI), and housing index (HI) to construct the composite index of living conditions of the households. Census data provides the percentage of literate people, male literate, female literate people, and main workers, which creates the HCI.

Selection of Domains and Indicators

Four domains are taken (HCI, FCI, PCI, and HI) to calculate the composite index. These domains comprise different socio-economic indicators and basic amenities (Table 1).

It was mentioned that the living condition of households is a multidimensional phenomenon, and it depends on several factors (Sarriera and Bedin, 2017). First, in this study, to keep the research objective, those relevant indicators are selected and reflect the actual scenario of the living condition of the households. Second, Millennium Ecosystem Assessment (MEA, 2005) proposed human well-being such as access to housing, drinking water, access to education, etc. The selected indicators are considered for assessing the living condition of the households that should be correlated with each other. Third, the choice of indicators should be made based on the availability of the data source. In this study, indicators were selected considering above mentioned issues under four major domains, namely HCI, FCI, PCI, and HI, respectively. The HCI (such as male literacy, female literacy, and main worker) indicates overall development. The housing condition of the households (such as good housing conditions, permanent house, own house, number of dwelling rooms) not only influences the economic condition of the households rather, it has the clear-cut indication of income level, that is, households having higher income are likely to have larger houses, single-family dwellings and good housing conditions (Vijaya & Krishnan, 2014). Overall, the housing conditions of the households affect different living conditions.

Table 1. Selection of Major Domains and Indicators Used in This Study.

Domains	Variables ID	Name of Variables	Explanation	Data Source
Human Capital index (HCI)	LP	Literate people	% Percentage of literate people	Census Data 2011, District Statistical Handbook 2018
References	FLP	Female literate people	% of female literate people	Census Data 2011, District Statistical Handbook 2018
Rahaman et al. (2011) and Siddiqui (2008)	MLP	Male literate people	% of male literate people	
	MW	Main worker	% of the main worker	Census Data 2011, District Statistical Handbook 2018
Financial capital index (FCI)	BS	Banking service	% of HHs have Banking service	House level Primary Data 2011
References	S/M	Scooter/ moped	% of HHs having scooters/moped	House level Primary Data 2011
Costanza et al. (2007), Haq et al. (2010) and Slottje (1991	MF	Mobile facilities	% of HHs having mobile facilities	House level Primary Data 2011
	C/L	Computer/laptop	% of HHs have a computer/laptop	House level Primary Data 2011
	TV	TV	% of HHs have a TV	House level Primary Data 2011
Physical capital index (PCI)	DW	Drinking water	% of drinking water within the premises	House listing primary census abstract 2011, Census Data 2011
References	ElEC	Electricity	% of electricity	House listing primary census abstract 2011, Census Data 2011
Haq (2009), Haq and Zia (2008) and Kingdon and Knight (2006)	LAT	Latrine	% of latrines within premises	House listing primary census abstract 2011, Census Data 2011
	DS	Drainage system	% of the closed drainage system	House listing primary census abstract 2011, Census Data 2011
	LPG/ PNG	LPG/PNG	% of LPG/PNG facilities	House listing primary census abstract 2011, Census Data 2011
Housing index (HI)	CH	Census house	% of the good condition of the census house	House listing primary census abstract 2011, Census Data 2011

(Table 1 Continued)

(Table 1 Continued)

Domains	Variables ID	Name of Variables	Explanation	Data Source
References Kingdon and Knight(2006), Li et al. (2010), Ura et al (2012), and Das et al. (2019a, 2019b)	PH	Permanent house	% of HHs living in a permanent house	House listing primary census abstract 2011, Census Data 2011
	OH	Own house	% of HHs living in their own house	House listing primary census abstract 2011, Census Data 2011
	BB/CB	Burn bricks/ cement block	% of wall material with burned bricks/cement block	House listing primary census abstract 2011, Census Data 2011
	CM	Concrete material	% of the roof which concrete material	House listing primary census abstract 2011, Census Data 2011

Source: Authors create. Nineteen variables under four indications.

It was well documented by MEA (2005) that basic materials for life, such as access to housing, drinking water, etc. play a significant role in the well-being of the people. In this study, those indicators that play a crucial role in improving the living condition of the households were named physical capital indicators. In many previous research studies, these indicators were used to assess the well-being of the households (Haq & Zia, 2008; Rahman et al., 2012; Zorondo-Rodríguez et al., 2012). The availability of assets to the households is one of the important indicators of good condition of living. For example, a household with a scooter or motorcycle indicates relatively higher income and good economic conditions. Thus, consideration of the availability of assets plays a crucial role in assessing the living condition of the households.

Normalisation or Standardisation is an important multivariate statistical analysis. Here some variables have a large range of variance, and some of a small range of variance. Scale 1 will indicate an individual parameter's highest level of diversity, and scale 0 will indicate the least diversity. The scale equivalence technique has been applied to create a strong relationship among the data set (Das et al., 2019a, 2019b; Ketchen & Shook, 1996; Kundu et al., 2002; Mazziotta & Pareto, 2016; Miller & Roth, 1994; Quackenbush, 2002). Standardisation is conducted with the help of the following equation-

$$Xid = (Obval - MINval) / (MAXval - MINval)$$

where *Xid* is the Range Equalisation Method, *OBval* stands for the actual value of *i*th block; *MINval* represents the minimum value of the *i*th block, and *MAXval* represents the maximum value of the *i*th block.

In the Frakka block, HCI is prepared based on Literate people, male literate people, female literate people, and the percentage of the main worker. The literate

people variable is a standardised value calculated by the above equation (observed value – minimum value)/(maximum value – minimum value) = (56.3–39.76)/ (70.9–39.76) = 0.5519. This calculated value (0.5519) is multiplied by the first principal component score coefficient (0.5519 × 0.134 = .0739). This first principal score coefficient (PC1) was used as weight because it explains the maximum percentage of variance. For this study, 19 variables have been used under four domains (Table 1). Every variable is normalised through the above formula.

The principal component analysis (PCA) is a multivariate statistical technique used to extract composite indices to measure the well-being of the people in this research. This method was used to reduce inter-correlated variables into a smaller set of independent uncorrelated variables. The weightage for each variable was computed with the help of this analysis to form the composite index (Biswas & Caliendo, 2002; Krishnakumar & Nagar, 2008; Lai, 2003). The first principal component score coefficient was used as weight because it explains the maximum percentage of variance.

Analysis of Variance (ANOVA)

In this research, one-way ANOVA was used. One-way ANOVA was used to assess whether there is a significant variation of various basic amenities and services across the 10 blocks of the Murshidabad districts exist or not. But through the analysis of one-way ANOVA, only the significant differences within and between variables can be addressed, and it never tells us where this difference exactly lies. To test this, a null hypothesis was formed, that is, there are no significant differences in the availability of basic services and amenities across the 10 blocks of Murshidabad district along the Indo-Bangladesh border.

One-way ANOVA analysis was performed using the following equation:

$$F = MST / MSE \tag{1}$$

$$MST = \sum_{i=1}^{k}\left(t_i / n_i\right) - G_2 / n / \left(k - 1\right) \tag{2}$$

$$MSE = \sum_{i=1}^{k}\sum_{j=1}^{k}Y2_{ij} - \sum_{i=1}^{k}\left(ti / ni\right) / k - 1 \tag{3}$$

where F is the variance ratio for the overall test, MST is the mean square due to treatments/groups (between groups), MSE is the mean square due to error (within groups, residual mean square), Y_{ij} is an observation, T_i is a group total, G is the total of all observations, ni is the number in group i and n is the total number of observations. To validate this, the null hypothesis was drawn as H_0 = no significant difference in the availability of basic services and amenities across the 10 blocks.

Table 2 shows an analysis of variance between four variables like HCI, FCI, PCI, and HI. HCI is an independent variable; the other three indicators are

Table 2. Result of One-way ANOVA.

		Sum of Squares	df	Mean Square	F	Sig.
Financial capital index	Between groups	.000	8	.000	.062	.996
	Within groups	.001	1	.001		
	Total	.001	9			
Physical capital index	Between groups	.014	8	.002	47.154	.112
	Within groups	.000	1	.000		
	Total	.014	9			
Housing index	Between groups	.003	8	.000	.186	.951
	Within groups	.002	1	.002		
	Total	.005	9			

Source: Authors' calculation using SPSS, version 26.0.

dependent variables. Table 2 is also shown that there are no significant differences between the four means.

Developing a Composite Index

Composite Development Indicator is a multidimensional concept (Saisana & Tarantola, 2002) of development used in this research paper considering four major domains such as HCI, FCI, PCI, and HI (Haque, 2016):

$$HCI = (CSc1 \times SDv1) + (SCc2 \times SDv2)\ldots SCnx \times SDnx \mathbin{/} N \tag{4}$$

$$HI = (CSc1 \times SDv1) + (SCc2 \times SDv2)\ldots SCnx \times SDnx \mathbin{/} N \tag{5}$$

$$PCI = (CSc1 \times SDv1) + (SCc2 \times SDv2)\ldots SCnx \times SDnx \mathbin{/} N \tag{6}$$

$$FCI = (CSc1 \times SDv1) + (SCc2 \times SDv2)\ldots SCnx \times SDnx \mathbin{/} N \tag{7}$$

where HI, HCI, PCI and FCI are individual indexes; SCc1 is the component score coefficient; SDv1 is the Standardised value of the indicator; and N is the number of indicators considered for computation of each index, respectively.

The composite Index was computed as follows:

$$CIx = \left(\sum HI + \sum HCI + \sum FCI + \sum PCI \mathbin{/} Nind \right) \tag{7}$$

where CIx is the Composite Index; HI, HCI, PCI and FCI are the final output of the individual index; and N_{ind} is the number of indices. The Composite Index is the average of four dimensions.

In this study, statistical software SPSS, version 26.0 was used for PCA, and Q-GIS software (version 3.14) was used for map-making of the study area.

Results and Discussion

Basic Amenities Available

In the 10 selected blocks of Murshidabad district, 93.05% of people have drinking water facilities within the premises (2018, Statistical Handbook). In Raghunathganj-II block, 97.22% of households have drinking water within the premises, ranked first among this study's other blocks (Table 3). The drinking water sources of this block are handpumps (62.5%), tubewell (21.5%), tap water from the treated source (6.2%) and tap water from the untreated source (2.2%). Raghunathganj-II is situated between the Padma River and the Bhagirathi River, where groundwater is abundant. On the contrary, the Farraka block and Samserganj block have, respectively, 85.54% and 90% drinking water within premises which ranks comparatively lowest than other selected blocks (Table 2,3). These blocks are a part of the Rarh region (Chotonagpur plateau). Here groundwater is down. The percentage of drinking water availability in other selected blocks varies between 91% and 96% [Suti-I (95.01%), Suti-II (94%), Lalgola (91.78%), Bhagawangola-I (96.04%), Bhagawangola-II (94.11%), Raninagar-II (92.33%), and Jalangi (92.44%)]. These blocks are situated between Padma and Bhagirathi rivers. Groundwater is abundant in this plain. After analysing the percentage of drinking water availability within households in selected blocks, it would be concluded that the overall percentage of drinking water availability in households is average in Murshidabad districts.

Electricity is one of the basic civic amenities for a country. The country often boasts of 100% electrification. Shockingly, in the study area, only 27.15% of the households are electrified on average. The highest electricity facility is recorded in Raghunathganj-II (41.6%), and the lowest electricity facility is found in Bhagwangola-II (12.25%) (Table 3) and Raninagar-II (19.3%) where, respectively, 87.2 and 80 percent of lights are lit through kerosene. In these blocks, most of the people live below the poverty line. They need access to electricity for a house that has adequate electrical infrastructure. They get their light through kerosene. These reasons are the same in most of the selected blocks. Electricity connection to households is poor in Farakka (28.49%), Samserganj (30.02%), Suti-I (30.02%), Suti-II (25.42%), Lalgola (33.4%), Bhagawangola-I (22%), Bhagawangola-II (12.25%), and Jalangi (28.99%), respectively. But Raghunathganj-II block has a relatively good condition in the case of electrification (50.2%) because people can take electricity.

Table 3. Availability of Basic Amenities of Household (%).

	Minimum	Maximum	Average
Basic amenities			
Drinking water within the premises	85.54 (Farakka)	97.22(Raghunathganj-II)	93.0520
Electricity	12.25 (Bhagwangola-II)	41.6(Raghunathganj-II)	27.1528
Latrine within premises	0.09 (Suti-I)	4.05(Jalangi)	1.6090
Closed drainage system	0.62 (Bhagawangola-II)	2.95(Lalgola)	1.9640
LPG/PNG facilities	0.34 (Bhagwangola-II)	4.87(Farakka)	2.1520
Housing Condition			
Good condition of the census house	11.3 (Bhagawangola-II)	28.4(Jalangi)	21.680
HHs living in a permanent house	23.21(Bhagawangola-II)	79.57(Raghunathganj-II)	52.736
HHs living in their own house	92.1 (Bhagwagola-I)	97(Samserganj)	95.630
Wall material with burn bricks/cement block	23.2 (Bhagwangola-II)	74.2(Raghunathganj-II)	50.420
A roof which concrete material	7.5 (Bhagwangola-II)	30.5(Raghunathganj-II)	20.310
Assets			
HHs have Banking service	24.82(Lalgola)	44.17(Farakka)	33.995
HHs having scooter/moped	2(Suti-I)	7.5(Farakka)	3.0490
HHs have mobile facilities	19.97 (Raninagar-II)	33.16 (Raghunathganj-II)	26.015
HHs having computer/laptop	0.08 (Raghunathganj-2)	0.52(Farakka)	0.212
HHs having a TV	5.84 (Bhagawangola-ii)	14.35(Jalangi)	10.268

Source: Authors created. Maximum and minimum, and average percentage values of selected indicators.

The blocks of Bhagawangola-I(68.6%), Jalangi (55.8%), and Raghunathganj-II (42.3%) have the highest well-organised latrine facility. In these blocks, the educational rate of people is high. As well as they are also health-conscious and benefited from the 'Nirmala Yojana'. On the contrary, Samserganj (29.9%), Suti-I (23.3%), and Suti-II (23.3%) do not have well-organised latrine facilities. Some people could not take advantage of the government scheme till now.

Most blocks still need a drainage system for wastewater outlets. Rural people are not conscious of this matter. The percentage of closed drainage systems could be higher in Bhagawangola-I (1.5%), Bhagawangola-II(0.6%), and Raninagar-II (0.8%).

The percentage of people using LPG/ PNG fuel for cooking could be much higher. Most people have used firewood, crop residue, and cow dung cake as fuel for cooking because LPG refilling is very expensive. They are unable to purchase LPG. So 'Ujjala Yojana' scheme failed in this area. The highest percentage of LPG/PNG is Farraka (8.4%) and Raghunathganj-II (4.8%) blocks.

Household Assets

The asset of households is a stock of resources that determine household property and living quality. Different researchers have categorised assets from different perspectives. It may be a financial, non-financial, human, social, natural, or physical asset. The modern gadgets of households such as computers/laptops with or without Internet connection and mobile phones are introduced. The use of computers and laptops can be noticed in almost every block, such as Farakka (5.6%), Samserganj (5.8%), Lalgola (6.4%), and Jalangi (5.6%) blocks, although the percentage is very low. The use of computers and laptops in every block is increasing daily, especially in the homes where children are studying a little. It is also used in trade and commerce.

There is a use of banking facilities in each block. The percentage of the customer is sufficient, especially in Farakka (44.7%), Jalangi (49.7%), and Suti-II (43.5%) blocks, respectively, because people of these blocks worked as household industry labourers outside of the state (Such as Kerala, Odisha, Maharashtra, and Gujrat) or abroad (Saudi Arabia and Kuwait). As a result, they send money to their families through these banking accounts.

In this area, people use bicycles and motorbikes as a mode of transportation. Bicycles and motorbikes are used in almost every block - however, the predominance of bicycles in rural areas is obvious. Farakka (57.1%), Bhagawangola-I (55.9%), Jalangi (53.2%), and Raninagar-II (51.5%) blocks have predominantly used bicycles. On the contrary, financially advanced peopled use motorbikes to travel. However, this percentage is much lower. The highest percentage is seen in Farakka (7.5%), and Raghunathganj-II (3.7%) blocks, respectively. Farakka (2.6%) block has the highest percentage of four-wheelers.

The other two important assets in this research are mobile phones and televisions. These two social media are necessary for the current world to be useful. These two social mediums are present in almost every block. The highest percentage of mobile phones and television are used in Farakka (34.1%,17.6%), Raghunathganj-II (35.4%,16.4%), and Jalangi (29.9%,14.3%) blocks.

Housing condition of the households.

According to data, the percentage of housing conditions in some blocks is good and liveable. A relatively high percentage is seen in Bhagawangola-II (70.1%), Samserganj (61.3%), Farraka (56.2%), Jalangi (56.6%) and Raghunathganj-II (57.6%) blocks.

Table 4. Correlation Among Various Variables Selected for the Study (Bold Indicates Highly Correlated Positively).

Variables	LP	FLP	MLP	MW	BS	S/M	MF	C/L	TV	DW	ELC	L	DS	LPG/PNG	CH	PH	OH	BB/CB	CM
LP	1.000																		
FLP	**0.855**	1.000																	
MLP	**0.833**	**0.870**	1.000																
MW	−0.596	−0.805	−0.632	1.000															
BS	−0.574	−0.628	−0.306	**0.680**	1.000														
S/M	0.272	0.118	0.426	0.141	0.337	1.000													
MF	0.359	0.093	0.363	0.280	0.266	**0.765**	1.000												
C/L	0.027	−0.089	0.248	−0.045	0.339	**0.787**	0.461	1.000											
TV	0.424	0.185	0.518	0.194	0.305	**0.687**	**0.941**	0.410	1.000										
DW	0.023	0.151	−0.165	0.027	−0.356	−0.615	−0.291	−0.896	−0.272	1.000									
ELC	0.012	−0.309	−0.074	**0.636**	0.303	0.281	**0.739**	0.029	**0.735**	0.072	1.000								
L	**0.654**	0.767	**0.646**	−0.706	−0.267	0.083	0.021	0.014	0.120	−0.088	−0.436	1.000							
DS	−0.216	−0.485	−0.202	0.554	0.480	0.436	**0.717**	0.448	0.663	−0.293	**0.817**	−0.415	1.000						
LPG/PNG	−0.089	−0.285	0.156	0.310	0.553	**0.743**	**0.708**	**0.834**	**0.706**	−0.683	0.523	−0.264	**0.794**	1.000					
CH	0.305	0.171	0.518	0.272	0.364	**0.649**	**0.789**	0.300	**0.906**	−0.141	0.688	0.002	0.542	**0.631**	1.000				
PH	−0.425	−0.753	−0.541	**0.814**	0.484	0.290	0.501	0.254	0.362	−0.126	**0.762**	−0.733	**0.850**	0.585	0.292	1.000			
OH	−0.269	−0.483	−0.267	0.398	0.353	0.087	0.166	0.294	0.199	−0.585	0.356	−0.214	0.449	0.395	0.118	0.372	1.000		
BB/CB	−0.387	−0.712	−0.493	**0.786**	0.463	0.311	0.548	0.270	0.415	−0.128	**0.796**	−0.712	**0.883**	**0.616**	0.339	**0.997**	0.371	1.00	
CM	−0.568	−0.660	−0.474	**0.827**	0.563	0.189	0.434	0.052	0.368	0.099	**0.763**	−0.735	**0.771**	0.500	0.457	**0.836**	0.258	**0.846**	1.000

Note: bold indicates highly correlated positively.
Source: Authors' calculation using SPSS version 26.

The percentage of ownership and permanent households in these study areas differ in different blocks. However, the block level percentage is very close. The highest percentage of own households is seen in Samserganj (97.5%), Raninagar-II (96.7%), and Lalgola (96.6%).

The house's walls, roof, and floor have been made of different materials in this area. Different materials are used on the house's roof, like hand-made tiles, asbestos sheets, concretes, etc. Almost every block has been used with hand-made tiles and concrete as the roof materials for the house. It has a comparatively close percentage as it is lowest in Jalangi (12%, 16.2%), Raninagar-II (17.2%,13%) and highest in Farakka (45.6%, 24.9%), Suti-II (45.9%, 33%), Lalgola (44.7%, 20.4%) blocks. Almost every house here is made of burnt bricks. The percentage is highest in Raghunathganj-II (78.4%) and lowest in Bhagawangola-II (22.7%). If some house walls are made of grass/thatch/bamboo. Due to floods on the banks of the river, Padma, Jalangi, and Raninagar blocks are flooded almost every year. In that case, local people of this area have been using tiles and asbestos sheets for making house roofs. House Walls have been used as grass/thatch/bamboo and mud. Table 4 provides the degree of correlation of all selected indicators of this article.

The settlements have been used in separate kitchens and bathrooms. However, the percentage could be more eye-catching. The highest percentage has been seen in Farakka (39.4%, 13.6%), Samserganj (32.8%,10%), Suti-I (33.3%,10.5%) blocks, and the lowest has been seen in Bhagawangola-I (20.8%,7.3%), Bhagawangola-II (21%,3%) blocks. Houses are much better organised in Farakka, Samserganj, Suti, Raghunathganj blocks. People of these blocks have been working outside the state as mason labour. They have enough monthly income, so their house is much better organised. On the contrary, the houses along the bank of the Padma River, especially the part of Raninagar, Jalangi, Bhagawangola blocks, could be better organised. The reason is that floods occur here almost every year.

The Disparity in Selected Blocks

To understand the inter-block variations, a comparative analysis was done among different blocks of the region based on the indices (Table 5 and Figures 2–5) selected for this study. This study needs more blocks regarding basic assets, basic services, and amenities. The condition of the Jalangi (92%, 40.7%, 4%) block is good enough in terms of availability of basic services such as drinking water, banking services, latrine facility, etc. which is followed by Farakka (85%, 44%, 1%), Raghunathganj-II (97.22%, 33%, 35%), Bhagwangola-I (96%, 29%, 2.02%), Lalgola (91%, 24%), etc. The housing conditions are relatively good in some blocks such as Jalangi (HI .0.078), Raghunathganj-II (HI .0597) and Samserganj (HI .0593). Financial capital (two-wheelers, mobile, computer/ laptop, etc.) is considered to assess the financial status of households. The result of the study is that the maximum financial capital has in Farakka (FCI .0449) blocks, followed by Jalangi (FCI .0314), Raghunathganj (FCI .0242) and Lalgola (FCI .0196).

Table 5. Component Score Coefficient Matrix.

ID	1	2	3	4	5	6
GCH	.045	.097	.063	.108	.028	−.183
LOH	.070	−.006	.023	−.072	−.144	.218
TDR	−.033	.096	.084	−.255	.151	−.003
BMBB	.069	−.005	.028	−.064	−.164	.216
RCM	.067	−.027	.049	−.141	.038	−.145
OH	.016	−.103	.068	.337	−.179	−.032
RCU	.034	−.078	−.044	.151	.172	.523
DWP	−.018	−.075	.156	−.214	.197	.029
EL	.061	.004	.115	.009	−.164	−.022
LT	−.031	.100	.099	−.043	.269	.240
CDS	.068	.012	−.041	.037	.011	.113
LPG	.063	.066	−.069	−.053	−.043	−.033
TWTS	.038	.036	−.156	.030	.072	−.218
PSS	−.038	.022	−.114	.125	.046	.162
PWS	.026	.077	.150	−.045	.235	.166
B	.067	.034	.065	.099	.019	−.134
K	−.010	−.043	.117	.384	.182	−.019
BI	−.022	.131	−.078	.068	.066	.202
BS	.049	.036	.005	.187	.456	−.201
SMMR	−.022	.131	−.078	.068	.066	.202
MB	.050	.089	.082	.064	−.187	.036
LP	.031	.108	−.122	−.061	−.085	−.039
R	.057	−.014	−.104	.091	.162	.005
LP	−.042	.082	.090	.160	−.256	.199
FLP	−.061	.073	.067	.046	−.108	−.072
MLP	−.040	.115	.046	.118	−.129	−.164
MW	.067	−.029	.031	−.049	.129	−.034
FMC	.070	.055	−.015	−.022	.059	−.006
PH	.070	−.006	.023	−.072	−.144	.218
TV	.054	.097	.057	.070	−.090	−.075
Eigenvalues	13.362	6.209	4.607	1.709	1.254	1.154
% of variance	44.541	65.236	80.594	86.291	90.472	94.318

Source: Authors' calculation using SPSS version 26.0. All variables on the component score coefficient.
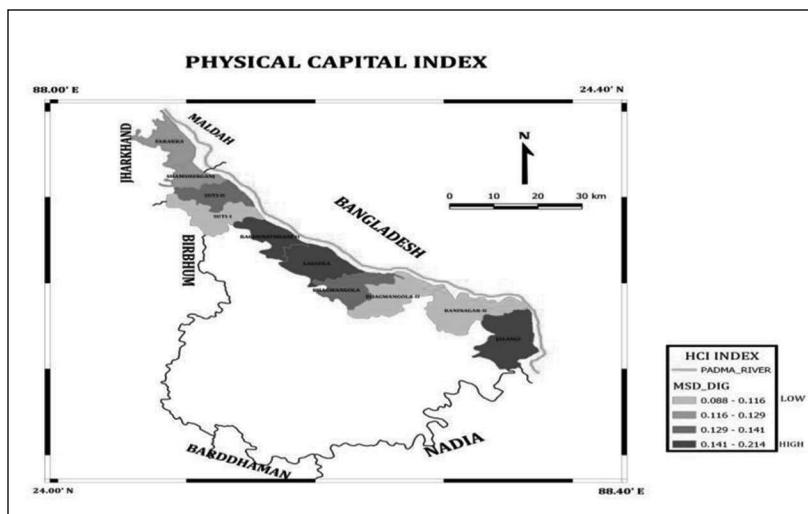
Figure 2. Spatial Distributions of Blocks of Physical Capital Index (PCI).

Source: Authors created using Q-GIS Software Version 3.14. Physical Capital Index value of the selected 10 blocks.
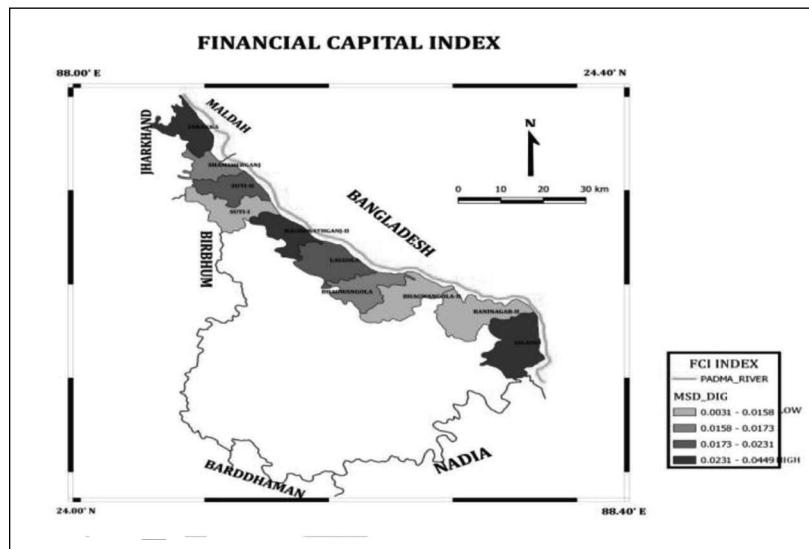
Figure 3. Spatial Distributions of Blocks of Financial Capital Index (FCI).

Source: Authors created using Q-GIS software Version 3.14. Financial Capital Index value of the selected 10 blocks.
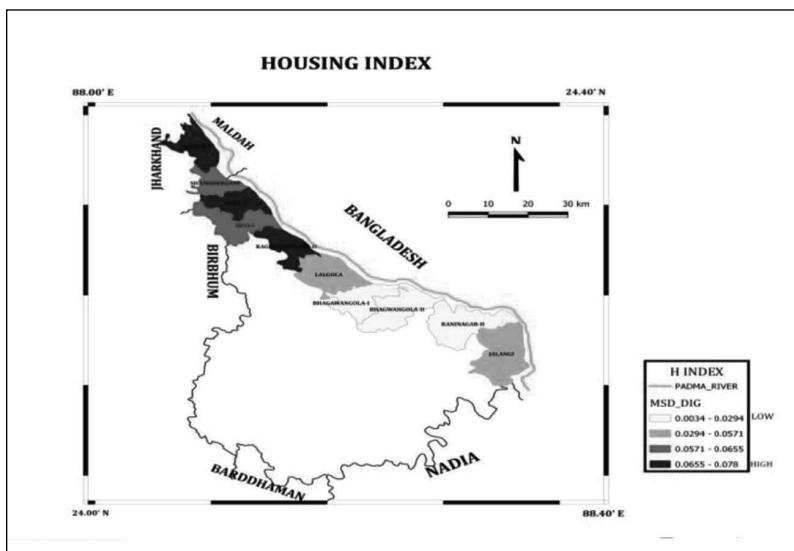
Figure 4. Spatial Distributions of Blocks of the Housing Index (HI).

Source: Authors created using Q-GIS software version 3.14. Housing Index value of the selected 10 blocks.
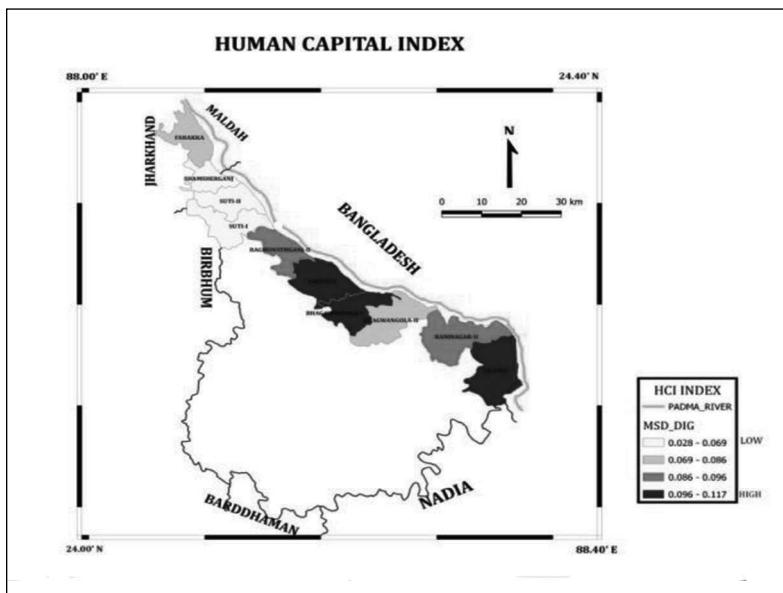

Figure 5. Spatial Distributions of Blocks of the Human Capital Index (HCI).

Source: Authors' create using Q-GIS software Version 3.14. Housing and human capital index value of the selected 10 blocks.

Table 6. Descriptive Statistics of the Variables.

Variables ID	Minimum	Maximum	Mean	SD
LP	39.76 (Suti-Ii)	70.09 (Jalangi)	60.391	9.599
FLP	43.82 (Suti-Ii)	65.89 (Bhagawangola-I)	57.120	7.767
MLP	52.97 (Suti-Ii)	69.36 (Jalangi)	62.973	4.669
MW	22.82 (Bhagawangola-II)	36.28 (Raghunathganj-II)	29.174	4.587
BS	24.82 (Lalgola)	44.17 (Farakka)	33.995	7.167
S/M	2 (Suti-I)	5.12 (Farakka)	3.049	0.904
MF	19.97 (Raninagar-II)	33.16 (Raghunathganj-II)	26.015	5.255
C/L	0.08 (Raghunathganj-2)	0.52 (Farakka)	0.212	0.121
TV	5.84 (Bhagawangola-II)	14.35 (Jalangi)	10.268	3.085
DW	85.54 (Farraka)	97.22 (Raghunathganj-II)	93.052	3.198
ELC	12.25 (Bhagwangola-II)	41.6 (Raghunathganj-II)	27.152	8.051
L	0.09 (Suti-I)	4.05 (Jalangi)	1.609	1.248
DS	0.62 (Bhagawangola-II)	2.95 (Lalgola)	1.964	0.791
LPG/PNG	0.34 (Bhagwangola-II)	4.87 (Farakka)	2.152	1.225
CH	11.3 (Bhagawangola-II)	28.4 (Jalangi)	21.680	5.125
PH	23.21 (Bhagawangola-II)	79.57 (Raghunathganj-II)	52.736	20.645
OH	92.1 (Bhagwagola-I)	97 (Samserganj)	95.630	1.575
BB/CB	23.2 (Bhagwangola-II)	74.2 (Raghunathganj-II)	50.420	18.183
CM	7.5 (Bhagwangola-II)	30.5 (Raghunathganj-II)	20.3100	7.3746

Source: Authors' calculation using SPSS version 26. The table indicates the statistics of all variables.

Table 7 shows the Jalangi block (HCI .1173, FCI .0315, PCI .2139, HI .0780) ranked highest in terms of overall performance, followed by Lalgola (HCI .0962, FCI .0196, PCI .1901, HI .0716), Raghunathganj-II (HCI .0944, FCI .0242, PCI .1435), Farakka (HCI .0790, FCI .0449, PCI .1243, HI .0692) blocks, etc.

The Quality of Living in Selected Blocks of Murshidabad District

Based on the composite index (Table 8 and Figure 6), 10 blocks of Murshidabad district have been divided into four categories of level of development shown in the table. A higher composite index value shows a higher level of development and vice versa. It may, therefore, be concluded from the above analysis that the general level of development in Murshidabad district could be better. From Table 8, one can easily observe (Figure 6) the quality of living. As per as composite score value, it is observed that three blocks carry a high quality of living, namely Jalangi (CS .0986), Raghunathganj-II (CS .0902), Farakka (CS .0793) for the composite score,

Table 7. Inter-block Disparity of Selected Blocks of Murshidabad District.

Rank	Name of Blocks	HCI	Name of Blocks	FCI	Name of Blocks	PCI	Name of Blocks	HI	Name of Blocks	CS
1	Jalangi	0.1173	Farakka	0.0449	Jalangi	0.2139	Raghunathganj-II	0.0780	Jalangi	0.0986
2	Bhagawangola-I	0.1056	Jalangi	0.0314	Lalgola	0.1901	Farakka	0.0692	Raghunathganj-II	0.0902
3	Lalgola	0.0962	Raghunathganj-II	0.0242	Raghunathganj-II	0.1435	Suti-II	0.0674	Farakka	0.0793
4	Raghunathganj-II	0.0944	Lalgola	0.0196	Bhagawangola-I	0.1353	Suti-I	0.0597	Lalgola	0.0716
5	Raninagar-II	0.0921	Suti-II	0.0175	Suti-II	0.1343	Samserganj	0.0593	Samserganj	0.0646
6	Farakka	0.0790	Bhagawangola-I	0.0170	Farakka	0.1243	Lalgola	0.0550	Suti-II	0.0618
7	Bhagawangola-II	0.0790	Samserganj	0.0164	Samserganj	0.1178	Jalangi	0.0318	Suti-I	0.0588
8	Samserganj	0.0651	Suti-I	0.0156	Bhagawangola-II	0.1158	Bhagawangola-I	0.0286	Raninagar-II	0.0518
9	Suti-I	0.0622	Raninagar-II	0.0055	Suti-I	0.0977	Raninagar-II	0.0211	Bhagawangola-I	0.0503
10	Suti-II	0.0281	Bhagawangola-II	0.0031	Raninagar-II	0.0884	Bhagawangola-II	0.0034	Bhagawangola-II	0.0503

Source: Authors' calculation using SPSS version 2. Value of Four index and composite score.

Table 8. Classification of Blocks Based on the Composite Score Value.

Composite Score (CS)	Level of Quality of Living	Name of Blocks	No. of Blocks
.0504–.0536	Comparatively Backward region	Bhagawangola-I, Bhagawangola-II, Raninagar-II	3
.0536–.0633	Comparatively low	Suti-I, Suti-II	2
.0633–.0836	Comparatively medium	Samserganj, Lalgola	2
.0836–.0986	Comparatively high	Jalangi, Farakka, Raghunathganj-II	3

Source: Author's calculations based on available data.
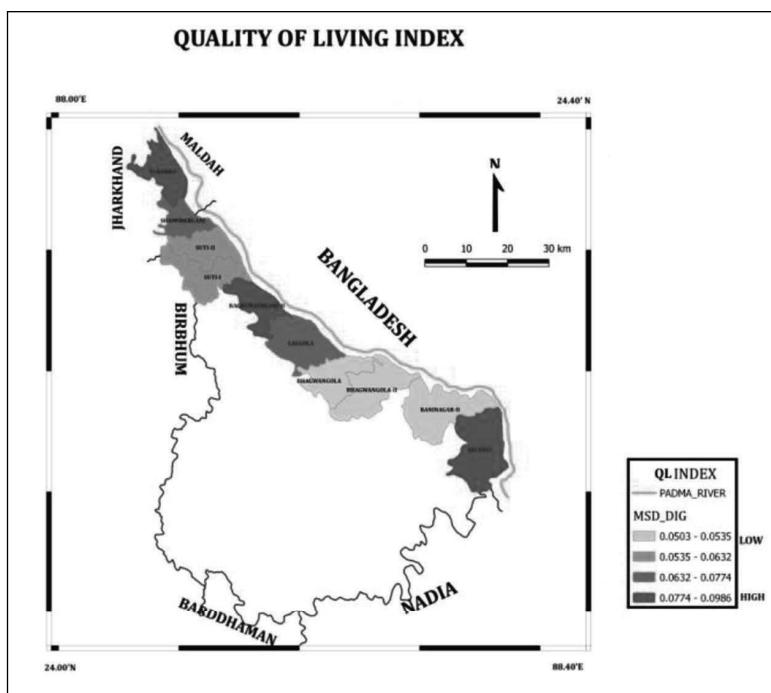
Figure 6. Spatial Distribution of Blocks Based on Composite Score (CS).

Source: Authors created using Q-GIS software version 3.14. Composite score values of selected 10 blocks.

and the other three blocks quality of living very poor namely Bhagawangola-I (CS .0503), Bhagawangola-II (CS .0503) and Raninagar-II (CS .0518). Table 6 provides the Maximum, minimum and average values of all selected indicators of this article.

There are three backward blocks concerning the Composite Index. These blocks are Bhagawangola-I (CS .05), Bhagawangola-II (CS .05) and Raninagar-II

(CS .051) near the Indo-Bangladesh border. The main causes of the backwardness of these blocks are as follows:

1. The Absence of adequate secondary economic activities and agricultural development.
2. Riverbank erosion and the flood of Padma River are problems in this region every year.

On the contrary, Jalangi (CS .098), Farakka (CS .079) and Raghunathganj-II (CS .092) blocks carry comparatively a high quality of living conditions concerning the Composite Index. The main reasons why these blocks carry comparatively a high quality of living conditions are as follows:

1. Those blocks are located adjoin to each other in the Jangipur subdivision. Besides agriculture activities, the development of the *Bidi* industry (70%) and household industry synchronises the economic base of people here.
2. The nearest Dhuliyan and Jangipur municipality acts as a growth pole for the all-round development of these blocks.

Moreover, the SL people in the other blocks such as Samserganj (CS .06), Lalgola (CS .053), Suti-I (CS .06) and Suti-II are comparatively medium to low levels because

1. an existing municipal town in these blocks cannot ensure adequate growth potential for the theme,
2. low level of agricultural development and
3. proper developmental planning is necessary to attain developed social conditions here.

Conclusion

This study attempted to measure spatial variation in the quality of living of different blocks of this study region, applying the composite score value based on some selected indicators. The blocks are ranked based on the level of living conditions of the people. The level of living conditions is assessed separately for the HCI, FCI, PCI, and HI. The blocks are categorised into four classes based on a composite score to measure the living conditions across the blocks. As per the result, it is recorded that several blocks like Bhagawangola-I, Bhagawangola-II, Raninagar-II, Suti-I and Suti-II are deteriorated from providing a better way of living compared to so-called remote blocks. Jalangi, Raghunathganj-II, Farakka, Samseganj, and Lalgola blocks make the selected indicators' consistent performance and attach them to comparatively very high to medium ways of living.

The quality of living and development of a particular region depends not only on a single criterion but also on the interplay of several socio-economic factors that determine that region's development level. In addition, the state and central government level policy intervention can affect the interplay of socio-economic factors. They need to assess their policies to detect the factors behind such unequal

development at the regional level. Often the agencies fail to bring the desired economic development favouring the have-nots utilising the hard-taxed money due to the lack of understanding of the development state. The state and central governments should need special care to implement proper development to enhance people's living quality in the study area.

Declaration of Conflicting Interests

Funding

References

Biswas, B., & Caliendo, F. (2002). A multivariate analysis of the human development index. *Indian Economic Journal*, *49*, 96–100. 27. https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1243&context=eri

Costanza, R., Fisher, B., Ali, S., Beer, C., Bond, L., Boumans, R., Danigelis, N. L., Dickinson, J., Elliott, C., Farley, J., Gayer, D. E., Glenn, L. M., Hudspeth, T., Mahoney, D., McCahill, L., McIntosh, B., Reed, B., Rizvi, S. A. T., Rizzo, D. M., & Snapp, R. (2007). Quality of life: An approach integrating opportunities, human needs, and subjective well-being. *Ecological Economics*, *61*(2–3), 267–276. https://www.researchgate.net/publication/222122719Quality_of_life_An_approach_integrating_opportunities_human_needs_and_subjective_well-being. https://doi.org/10.1016/j.ecolecon.2006.02.023

Das, A., Das, M., & Barman, H. (2019a). Access to basic amenities and services to urban households in West Bengal: Does its location and size of settlements matter? *GeoJournal*, 1–6. https://doi.org/10.1007/s10708-019-1010

Das, A., Das, M., & Houqe, R. (2019b). Evaluating the quality of living (QOL) of the households in the Dandakaranya region, India: A well-being approach. Spatial information research. *Geological Journal*. https://doi.org/10.1007/s41324-019-00286-w.

Das, M., Das, A., and Mandal, A. (2020). Assessing the level of living conditions in the Bundelkhand region of Central India: A household level analysis. *Geological Journal*. https://link.Springer.com/article/10.1007%2Fs10708-020-10220-5.

Dasgupta, P., & Weale, M. (1992). On measuring the quality of life. *World Development*, *20*(1), (119–131). https://doi.org/10.1016/0305-750X(92)90141-H. Elsevier. https://www.researchgate.net/publication/222122719Qualityof_life_An_approach_integratingopportunities_human_needs_and_subjective_well-being, 20(1).

Diener, E. (1995). A valued-based index for measuring the national quality of life. *Social Indicators Research*, *36*(2), 107–127. https://link.springer.com/article/10.1007/BF01079721. https://doi.org/10.1007/BF01079721

Forbes. (2013). Quality of life: everyone wants it, but what is it?". Retrieved March 11, 2020, from https://www.forbes.com/sites/iese/2013/09/04/quality-of-life-everyone-wants-it-but-what-isit/?sh=6f71840c635d

Greyling, T., & Tregenna, F. (2017). Construction and analysis of a composite Quality of Life Index for a Region of South Africa. *Social Indicators Research*, *131*(3), 887–930.

https://link.springer.com/article/10.1007/s11205-016-1294-5. https://doi.org/10.1007/s11205-016-1294-5

Haq, H. (2009). *Measuring human wellbeing in Pakistan: Objective versus subjective indicators* [MPRA paper], 38968, University Library of Munich. https://mpra.ub.uni-muenchen.de/38968/.

Haq, R., Ahmed, A., & Shafique, S. (2010). Variations the quality of life within Punjab: Evidence from MICS, 2007–2008. *Pakistan Development Review*, *49*(4), 863–879. https://www.jstor.org/stable/41428694

Haq, R., & Zia, U. (2008). Dimensions of well-being and millennium development goals. *Pakistan Development Review*, *47*(4II), 851–876. https://www.jstor.org/stable/41261259. https://doi.org/10.30541/v47i4IIpp.851-876

Haque, I. (2016). Infrastructure development and access to basic amenities in class-I cities of West Bengal, India: Insights from census data. *Journal of Infrastructure Development*, *8*(1), 36–84. https://www.centreforpublicimpact.org/case-study/indonesias-trans-java-toll-road-infrastructural-development-project-20112019/?gclid=Cj0KCQjwk4yGBhDQARIsACGfAetDiu. https://doi.org/10.1177/0974930616640089

Ketchen, D. J., & Shook, C. L. (1996). The application of cluster analysis in strategic management research: An analysis and critique. *Strategic Management Journal*, *17*(6), 441–458. https://onlinelibrary.wiley.com/doi/abs/10.1002/%28SICI%291097-0266%28199606%2917%3A6%3C441%3A%3AAID-SMJ819%3E3.0.CO%3B2-G. https://doi.org/10.1002/(SICI)1097-0266(199606)17:6<441::AID-SMJ819>s3.0.CO;2-G

Kingdon, G. G., & Knight, J. (2006). Subjective well-being poverty vs. income poverty and capabilities poverty? *Journal of Development Studies*, *42*(7), 1199–1224. https://link.springer.com/article/10.1023/A:1021951302937. https://doi.org/10.1080/00220380600884167

Koh, J. M. (2018). *Green infrastructure financing: Institutional investors, PPPs, and bankable projects*. Palgrave.com. GP/book/9783319717692. Palgrave Macmillan. ISBN 978-3-319-71769-2. https://www.

Krishnan, V. (2015). https://link.springer.com/article/10.1007/s11205-014-0591-0. Development of a multidimensional living condition index (LCI). *Social Indicators Research*, *120*(2), 455–481. https://doi.org/10.1007/s11205-014-0591-0

Krishnakumar, J., & Nagar, A. L. (2008). On exact statistical properties of multidimensional indices based on principal components, factor analysis, MIMIC, and structural equation models. *Social Indicators Research*, *86*(3), 481–496. https://link.springer.com/article/10.1007/s11205-007-9181-8. https://doi.org/10.1007/s11205-007-9181-8

Kundu, A., Pradhan, B. K., & Subramanian, A. (2002). Dichotomy or continuum: Analysis of the impact of urban centers on their periphery. *Economic and Political Weekly*, 5039–5046. https://www.jstor.org/stable/4412965, 3.7(50).

Lai, D. (2003). Principal component analysis of human development indicators of China. *Social Indicators Research*, *61*(3), 319–330. https://link.springer.com/article/10.1023/A:1021951302937. https://doi.org/10.1023/A:1021951302937

Li, L., Young, D., Wei, H., Zhang, Y., Zheng, Y., & Xiao, S. (2010). The relationship between objective life status and subjective life satisfaction with the quality of life. *Behavioral Medicine*, *23*(4), 149–159. https://www.tandfonline.com/doi/abs/10.1080/08964289809596371

Martinez, J. (2019). https://link.springer.com/article/10.1007/s11482-018-9617-0. Mapping dynamic indicators of quality of life: A case in Rosario, Argentina. *Applied Research in Quality of Life*, *14*(3), 777–798. https://doi.org/10.1007/s11482-018-9617-0

Mazziotta, M., & Pareto, A. (2016). Methods for constructing composite indices: One for all or all for one? *Rivista Italiana di Economia Demografa e Statistica*, *LXVII*(2), 67–80. https://doi.https://doi.org/10.1016/j.trac.2016.07.002

MEA. (2005). *Ecosystems and human well-being: Synthesis*. Island, Washington, DC. https://www.millenniumassessment.org/documents/document.356.aspx.pdf.

Miller, J. G., & Roth, A. V. (1994). A taxonomy of manufacturing strategies. *Management Science*, *40*(3), 285–304. https://pubsonline.informs.org/doi/abs/10.1287/mnsc.40.3.285. https://doi.org/10.1287/mnsc.40.3.285

Ministry of Panchayati Raj, Government of India. (2009). A note on the Backward Regions Grant Funds Programme. *National Institute of Rural Development, November 2018*. https:http://archive.org/web/20120405033402/http://www.http://nird.org.in/brgf/doc/brgfBackgroundNote.pdf

Osberg, L., & Sharpe, A. (2000). *International comparisons of trends in economic well-being*. Paper presented at the American Economic Association, New York annual meeting. https://prevedere.com/economic-scenario-planning-whitepaper/?gclid=Cj0KCQjwk4yGBhDQARIsACGfAesQMni2_lBb2tVZLvI_X32Cn-Qaco-fScc8rbrqKtrn0dB4ykWXXXEaAu

Pal, A. K., & Kumar, U. C. (2005). Quality of life (QoL) concept for the evaluation of societal development of rural community in west Bangal, India. *Asia-Pacific Journal of Rural Development*, *15*(2), 83–93. https://sci-hub.se/https://jou.rnals.sagepub.com/doi/pdf/10.1177/1018529120050205. https://doi.org/10.1177/1018529120050205

Prakongsai, P. (2006). An application of the asset index for measuring household living standards in Thailand. *SSRN Electronic Journal*, *11*(4), 20–26. https://www.research-gate.net/. https://doi.org/10.2139/ssrn.1080909

Quackenbush, J. (2002). Microarray data normalization and transformation. *Nature Genetics*, *32*(4), 496–501. https://www.knime.com/why-knime-for-life-

Rahman, K., Khan, A., Muhammad, N. M., Jo, J., & Choi, K. H. (2012). Fine-resolution patterning of copper nanoparticles through electrohydrodynamic jet printing. *Journal of Micromechanics and Microengineering*, *22*(6), 65–112. https://scholar.google.com/citations?User=GRfgXksAAAAJ&hl=th. https://doi.org/10.1088/0960-1317/22/6/065012

Ruzevicius, J. (2007). Quality of life and its components measurement. *Engineering Economics*, *2*, 43–48. https://www.researchgate.net/publication/26496151Quality_of_Life_and_its_Components'_Measurement

Saisana, M., & Tarantola, S. (2002). *State-of-the-art report on current methodologies and practices for composite indicator development*, Ispra, Italy: European Commission, Joint Research Centre, Institute for the Protection and the Security of the Citizen, Technological and Economic Risk Management Unit.214. https://www.eea.europa.eu/data-and-maps/indicators/economic-water-productivity-of-irrigated/state-of-the-art-report

Sam, K., & Chakma, D. N. (2016). An inter-block level analysis of regional disparity in the youngest Alipurduar District of West Bengal. *Space and Culture, India*, *3*(3). https://10,10.20896/saci.v3i3.159, 10–20. https://doi.org/10.20896/saci.v3i3.159

Sarriera, J., & Bedin, L. (2017). A multidimensional Approach to Well–Being, Springer, *16*(3), 22–26. https://psycnet.apa.org/record/2017-24428-001

Sen, A. (1985). Well being, agency and freedom: The Dewey lectures. *Journal of Philosophy*, 82(4), 169-221.

Slottje, D. J. (1991). Measuring the quality of life across countries. *Review of Economics and Statistics*, *73*(4), 684–693. https://ideas.repec.org/a/tpr/restat/v73y1991i4p684-93.html. https://doi.org/10.2307/2109407

Stanton, E. (2007). The Human Development Index: A History, *Political Economy Research Institute*. https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1101&context=peri_workingpapers. University of Massachusetts – Amherst, 127.

Ura, K., Alkire, S., Zangmo, T., & Wangdi, K. (2012). *A short guide to a gross national happiness index*. Retrieved March 3, 2014. http://www.grossnationalhappiness.com/wpcontent/uploads/2012/04/Short-GNH-Index-edited.pdf

Vijaya, N., & Krishnan, G. S. S. (2014). Characterization of semi-open subcomplexes in abstract cellular complex. In *Computational Intelligence, Cyber Security and Computational Models* (pp. 275–283). Springer. https://www.semanticscholar.org/paper/Characterization-of-Semi-open-Subcomplexes-in-Vijaya-Krishnan/f144acfec3bd3eb70c2576a92f1bbe33da8e0a50

Does Regulation Matter? Assessing the Long-run Impact of Regulation on the Cost Efficiency of the Microfinance Institutions in Bangladesh

**Taiabur Rahman[1], Md. Abdul Khaleque[1]
and Md. Arifuzzaman[2]**

Abstract

Bangladesh started regulating microfinance in 2006 by establishing the Microcredit Regulatory Authority, which granted licenses to 746 microfinance institutions (MFIs) and supervised them through prudential and non-prudential regulations. Economic regulation is relatively inexpensive. It affects performance which is mostly reflected in the costs and revenues of the MFIs. This paper investigates the relationship between cost efficiency and regulation using data from 534 MFIs. Cost efficiency was measured using the stochastic frontier model and the ordinary least-squares method to find the inefficiency determinants. It was observed that microcredit regulation reduced the cost-inefficiency of the MFIs significantly in Bangladesh.

Keywords

Microfinance, Microcredit Regulatory Authority, stochastic frontier model, cost-efficiency, regulation, Bangladesh

Introduction

The microfinance program, against all odds, is one of the most successful programs in Bangladesh, which has contributed substantially to reducing rural

[1]Department of Development Studies, Faculty of Social Sciences, University of Dhaka, Dhaka, Bangladesh
[2]MFI's Audit and Offsite Supervision Microcredit Regulatory Authority (MRA), Dhaka, Bangladesh

Corresponding author:
Taiabur Rahman, Department of Development Studies, 5th Floor, Faculty of Social Sciences Building, University of Dhaka, Dhaka 1000, Bangladesh.
E-mail: taiaburrahman.dvs@du.ac.bd

poverty and increasing the income of the poor by providing them access to financial services (Khandker, 2005). Many implementing organisations are involved in this sector which varies extensively in size, the amount of loan outstanding, number of members/borrowers, outreach, years of operation, etc. The major players in this sector are Grameen Bank (GB), Bangladesh Rural Advancement Committee (BRAC), Association for Social Advancement (ASA), Thengamara Mohila Sabuj Sangha (TMSS), the state-owned banks, and other financial institutions of Bangladesh. As of June 2018, microfinance institutions (MFIs) cover some 31.22 million members and disburse BDT[1] 1201.91 billion in the economy of Bangladesh with a total loan outstanding of around BDT673.90 billion. The amount of savings by members is BDT262.96 billion (Microcredit Regulatory Authority [MRA], 2020). The sector has accelerated the country's overall economic development by reviving rural Bangladesh's farm and off-farm activities. Although the sector had initially provided microloans starting from BDT1,000, various loan products have been operationalised over time.[2]

The MFIs grew rapidly in Bangladesh and increased their outreach within a limited time with a view to widening the access to financial services to the poor at a low-interest rate compared to the village moneylenders. In his study, Sinha (2011) analysed the performance of Bangladesh's 10 largest MFIs. Three were very large: GB, BRAC, and ASA. Sinha found that the number of active borrowers and their portfolio size has increased steadily over time and that their contribution to financial inclusion was substantial. The average loan balance has increased in real terms. The MFIs have also diversified to include micro-insurance services.

Before regulation, it was common around the globe that the pricing in microfinance was mostly opaque, and MFIs were selling products almost without truth-in-lending legislation. Albeit some motivated MFIs tried to mask their prices, but the downward spiral trapped nearly all MFIs into a complicated pricing scheme in this sector (Waterfield, 2008). In August 2006, the MRA formally started its operations to ensure good governance and transparent financial systems of MFIs and to build up an inclusive financial market for the country's economic development. It had circulated applications for MRA licenses and received 4241 applications from different nongovernmental organization (NGO)-MFIs,[3] of which 1000 were very small NGO-MFIs with less than 1000 borrowers or BDT40 lakh in outstanding loans. Till June 2018, the MRA had granted licenses to 803 NGOs while cancelling the licenses of 97 NGOs. As of June 2014, 3454 applications have been rejected.

Generally, regulation refers to a rule or order issued by a government's executive authority or regulatory agency with the force of law. The regulations indicate a set of enforceable rules that aim to restrict or direct the economic behaviour of market participants (Chavez & Gonzalez-Vega, 1994). The primary argument for regulation originates from the asymmetric distribution of information between borrowers and investors. The objectives of the financial regulators are usually to maintain confidence in the financial market system, contribute to the protection, enhancement, and stability of the financial system, and secure the appropriate degree of protection for the consumers.

Before 2010, the NGO-MFIs charged different fees for new members and borrowers. The MRA has fixed a ceiling price of BDT25 for admission fees,

passbook fees, and loan application fees per borrower. In some cases, the MRA restricted the MFIs' income from the borrowers. It hampered their revenue and reduced their surpluses. These rules and regulations were big challenges for NGO-MFIs to survive in this sector. Additionally, the MRA also came up with a uniform system to repay the first loan instalment. It is worth mentioning that the MRA circular requires the NGO-MFIs to collect their first instalment from the borrowers on the 15th day of the disbursement of microcredit loans. Before the circular issued by the MRA regarding the grace period,[4] the NGO-MFIs used to collect the first instalment within 7 days of disbursement. The Authority of Microcredit set up 46 weekly instalments per year. One of the rules stated that if any borrower had paid his/her microcredit loan within 35 or less than 46 instalments, then s/he will be entitled to the rebate[5] from the remaining instalments. Every Microcredit Organisation must declare the applicable interest rate on deposits in advance and not pay interest at a lesser rate under any circumstances. The MRA requires NGO-MFIs to pay interest at the announced rate[6] on the compulsory savings of the borrowers. The most important circular issued by MRA stated that they had set up the ceiling price of service charge at 27% using the declining balance method. The service charge practiced in the microcredit sector continues to be 27% (following the declining balance method).

In 2010, the MRA imposed a score of rules on the NGO-MFIs. The most important of these rules compelled the NGO-MFIs to form a 10% reserve on the cumulative surplus and a 15% savings reserve for liquidity. According to Rule 20(1) and 20(3) of MRA, every Microcredit Organisation will create a reserve fund using 10% of its total income surplus, which will be maintained in a bank account. Every Microcredit Organisation must maintain a 15% liquidity fund of its entire compulsory, voluntary, and term deposit, or whatever name is assigned to the deposit funds, in the savings account of a scheduled bank of the branch offices. MRA rule 27(2) indicates that, in general, the total deposit balance of any microcredit organisation will not exceed 80% of the principal loan outstanding at any given time.

NGO-MFIs could only collect term deposits from their members or clients after fulfilling the terms and conditions of the MRA, such as requiring organisations to have a minimum of 10 years of experience with the operational profitability for the last 5 years, a loan recovery rate of 95% for accumulated loans and 90% for current loans in the past 10 years, liquidity of deposits as specified in section 34(1), and total term deposits no more than 25% of the total capital of the organisation. For voluntary deposits, the microcredit organisation may collect voluntary deposits from the clients under the following terms and conditions: (a) the organisation must have at least 5 years of experience conducting microcredit operations; (b) it should have documentary evidence of running the operation profitably for the last 3 years; (c) accumulated loan recovery rate must be at least 95%, and current loan recovery rate must be at least 90% during the past 5 years; (d) it should maintain liquidity of deposits as specified in section 34(1); and (e) the total voluntary deposits cannot be more than 25% of the total capital[7] of the organisation. Before 2010 or the pre-regulation stage, the NGO-MFIs generated a huge surplus. However, their income was reduced after the MRA imposition of

rules and regulations. The rules and regulations hurt their revenue. Therefore, to survive in this sector and generate profit or even satisficing profit, the organisations were forced to rethink their cost structure and be cost-efficient. Against this backdrop, the paper aims to assess the cost efficiency of NGO-MFIs conforming to the rules and regulations of the MRA.

The MRA's rules and regulations discussed above have directly impacted the cost and efficiency of MFIs. Fixing a 27% declining balance method interest rate on disbursement loans hurt revenue (it will reduce revenue). On the contrary, a 6% interest rate on the client's savings raised the costs of the NGO-MFIs. However, the mobilisation of the client's savings also reduced the dependency of consumers on borrowed funds like those from the Palli Karma-Sahayak Foundation (PKSF),[8] commercial banks, Bangladesh Bank, and other financial institutions. Moreover, the microcredit rules and regulations improved the acceptance of the licensed NGO-MFIs relative to the non-licensed NGO-MFIs. Commercial banks have shown interest in providing loan facilities to licensed NGO-MFIs that will help the NGO-MFIs expand. While complying with all the rules and regulations of the MRA, the most important thing for the firms to survive in this sector was to find a way to be cost-efficient. Therefore, the focus of this research is to find out whether the NGO-MFIs have become cost-efficient or not during the post-regulation period.

With the implementation of the rules and regulations, the NGO-MFIs experienced a fall in revenue because of capped interest rates, the increased interest rate on members' savings, and costs due to binding regulations. The MRA had outlined that 40% of the service charges be allocated for salaries which f the NGO-MFIs to be cost-efficient by reducing operating costs through enhancing staff productivity. Within the new regulatory environment, the NGOs/MFIs set strategies to cope with regulatory shocks and to rearrange their operation management. In this change process, skilled staff may reduce operational costs and carry out their responsibilities properly. Regulation helps to combat corruption. Al-Azzam (2016) stated that corruption positively affects the interest rate of unregulated MFIs, and such effects are negligible among regulated MFIs. The effects of regulations are diverse. The study of Khalily et al. (2014) showed a negative relationship between regulation and cost efficiency, but their data has some limitations because of the short duration of regulated years. This paper aims to understand the dynamics of the changes in the relationship between regulation and cost efficiency using relatively large panel data. It aims to see the pattern and direction of the changes in cost efficiency over time. In particular, it aims to know, 'What is the direction of changes of cost efficiency of NGO-MFIs to the years of regulation?' Does the pattern of the effect of various factors of cost efficiency of NGO-MFIs change in the modified scenario?

Literature Review and Application of Model

Regulation, the producer's output, and the consumer's consumption level are well-connected. Regulations are warranted to secure the interests of the clients as

well as those of the service providers. Regulations that affect the economic decisions of the agents are relatively inexpensive. It affects the firm's input–output choice, revenue, and costs. The literature has widely discussed the relationship between efficiency and regulation (Asaftei, & Kumbhakar, 2008; Erbetta & Cave, 2007; Filippini & Maggi, 1993; Filippini et al., 2004). Data drawn from water distribution utility (Aubert & Reynaud, 2005), electricity distribution utilities (Farsi & Filippini, 2004), water and sewerage industry (Ashton, 2000), railway (Cantos & Maudos, 2001), and banking sector (Chortareas et al., 2012) have been used to assess the relationship between regulation and cost.

In Bangladesh, the cost per borrower is one of the lowest worldwide, operational efficiency is high, and the yield has been stable in recent years, well below the interest cap of 27% (under the declining balance method) set by the MRA. A pure price cap is optimal when the interests of producers and consumers have equal weight to the regulator's objective (Cowan, 2002).

Khalily et al. (2014) assessed the impact of MRA regulation on the cost efficiency of the MFIs using the data of 182 institutions covering the period from the pre-regulation year (year preceding the year of licensing) to 2011. They had panel data of 96 MFIs licensed in either 2007 or 2008 and unbalanced panel data of 182 MFIs. The paper showed that the regulations had contributed to reducing cost-inefficiency by 2.1% each year they were applied. PKSF partner organisations (POs) were more efficient than the non-POs as a partnership with PKSF decreased the cost-inefficiency by another 1% annually. The direct impact of regulation was measured through the changing behaviours of the MFIs, while the indirect impact was measured through an increase in staff productivity. This paper showed that the total effect of regulation was 2.5%, of which the direct effect was 2.1% (Khalily et al., 2014).

In consideration of the policy and regulatory environment for microfinance in Asia, Paul B. McGuire identified eleven criteria for `good practice' in policy and regulations, covering the policies of governments and donor agencies to support microfinance; the regulation of non-bank MFIs; and the regulation of banks (McGuire, 1999). It graded the performance of nine countries in Asia, including the Philippines and Bangladesh. Cracknell, D identified that most of the microfinance industry was regulated under either the Grameen Ordinance or the Co-operatives Act. His paper also showed that the repayment rates in certain districts had declined because the people wanted to manage their finances by saving up instead of taking loans. Most of the initiatives on regulation so far have been undertaken by donors. The fundamental issue was related to the protection of depositors' savings. On the contrary, the MFIs would work like a legal firm that allows them to mobilise savings (Cracknell, 2000).

Jackson & Islam concluded that 'appropriate regulation may give investor confidence and produce sustainability. Regulation of loan appraisal may assist in reducing monitoring and transaction costs, and extend the number of loans to the truly poor, thus achieving both bottom-line targets' (Jackson & Islam, 2005). Badruddoza (2013) analysed the performances of the licensed NGO-MFIs and provided guidelines for correcting identified problems. 'MRA has undertaken; mainly (1) to enhance the social benefits in the microfinance sector, (2) to bring discipline and homogeneity among practices, and (3) to increase the transparency

and accountability to preserve the interest of clients, workers, and donors'. MRA's regulation seeks to maximise the utilisation of resources towards profitability and thereby increase cost-efficiency (Badruddoza, 2013). Mia (2017) showed that Bangladesh had made remarkable socio-economic and economic development progress. However, the regulatory framework was still rather weak, with the NGO-MFIs being concentrated on well-off areas such as Dhaka and Chittagong.

Khalily et al. (2014) assessed the impact of MRA regulation in the very early period of regulation, and the study used a short period of pre- and post-regulation years. Nearly a decade has already passed since their study. No new study was conducted to examine the general pattern of the impact of regulations, particularly in the long run. This study, hence, aimed to fill the gap in understanding the long-run relationship between regulation and cost efficiency.

Conceptual Framework and Methodology

This study followed the conceptual framework Scott (2017) developed based on various views and theories in the literature. The framework uses three major theories: transaction cost theory, principal-agent theory, and allocative efficiency theory, linked with regulations/policies/enforcement and outcomes (availability, quality, and cost of services).

The system theories as depicted in Figure 1state the interdependency of various components of natural or human-made systems as the system has some boundaries, is influenced by contexts, and has structure, function, and role. Changing one component of the system may affect other components, thereby changing the behaviour of the agents. The transaction cost theory states that the extra cost for a transaction influences the market outcome. In the Principal-Agent setting of the organisations, the external effect affects the choices and decisions of the
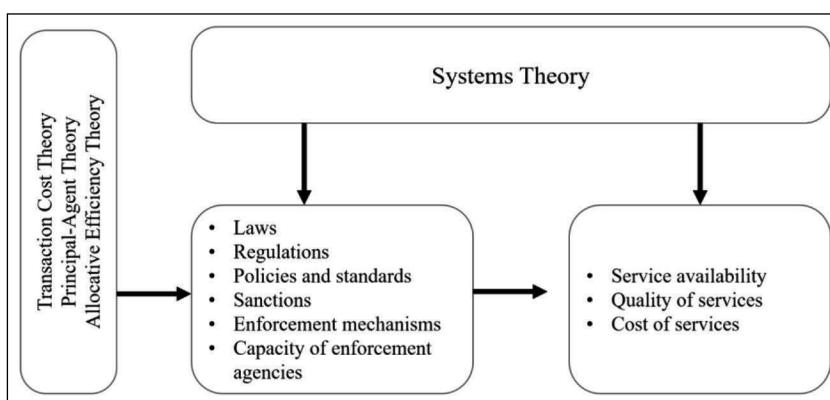

Figure 1. Conceptual Framework.

Source: Adapted from Scott (2017).

organisations. A general relationship between the regulation and efficiency of NGO-MFIs is presented below.

Figure 2 shows how the regulatory environment affects the market, the market share, cost-revenue structure, choices, and decisions of NGO-MFIs, which is translated into efficiency.

Materials and Methods

The research framework clarifies the paper's implicit theory. The stochastic frontier model (SFM) has been used to conceptualise research problems in the paper, similar to Khalily et al. (2014). The purpose and the pattern of the research dataset used are similar to them. In this regard, it is deduced that the SFM will be the best option to highlight research limitations and interpret research data.

This research seeks to test a hypothesis regarding the impact of regulation on cost efficiency using quantitative data. The SFM and ordinary least-squares (OLS) method have been used to assess the impact of regulation. The study is based on secondary data. Secondary data sources include institutional or organisational records, government sources of records like the BBS (Bangladesh Bureau of Statistics), and other official sources. The MRA has an 'MFI Audit and offsite supervision' department. According to the MRA's rules (2010). 'The Microcredit Organisations will prepare the annual financial statements and send it to the Authority within 90 days of the end of each financial year'. In this regard, the MFI Audit and offsite supervision department collected the annual financial statements of the NGO-MFIs[9] and analysed them to generate its reports. Additionally, the department has been archiving the annual financial statements of the NGO-MFIs since 2008. The MRA has approved using data from 2008 to 2018 to conduct this research. Based on the nature of the data utilised in this paper, it can be considered as quantitative research.

All quantitative approaches aim to generalise findings to the population. This paper used cross-sectional information from 321 NGO-MFIs for the pre-regulation period and 534 NGO-MFIs for the regulation period. Since the MRA started issuing licenses between 2006 and 2007, the pre-regulation year was chosen as 2008. The balanced panel data was constructed based on the information from 264 NGO-MFIs. From 2008 to 2018, some NGO-MFIs' licenses have been
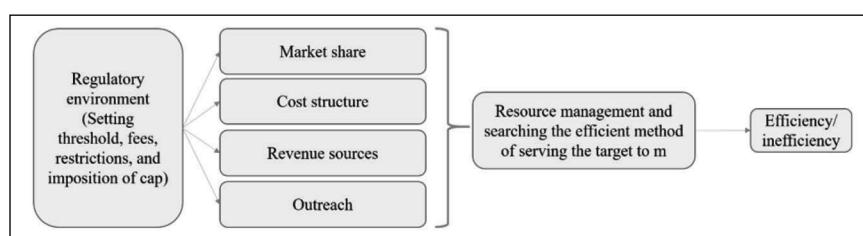

Figure 2. Theoretical Relationship Between Regulation and Efficiency.

cancelled due to poor performance or failure to comply with the MRA's rules and regulations.

Econometric Modelling

To analyse economic efficiency, most of the authors used the SFM (Battese & Coelli, 1995; Bhattacharyya et al., 1995; Jondrow et al., 1982; Orea et al., 2018; Paul & Shankar, 2018). This model is also used to assess the cost-efficiency of MFIs (Abdulai & Tewari, 2016; Gebremichael & Gessesse, 2016; Kendo, 2017; Sravani & Rao, 2017; Surender, 2018). To analyse our data, we have used the SFM to generate the inefficiency scores. Moreover, a time-invariant inefficiency model has been applied to get inefficiency-related data from the pre-regulation to the regulation period. As a result, the overall inefficiency from 2008 to 2018 can be observed. Another statistical model named 'Frontier Normal/Half Normal Model' has been used to generate inefficiency scores for every year to compare the regulation years to the pre-regulation year. To attain the inefficiency scores for all the observations, both the SFM cCross) and the frontier normal/ exponential model (statistics) were utilised in tandem. After the inefficiency scores had been generated, a simple regression model was run to assess which components were positively or negatively correlated with the inefficiency scores.

Conceptually, efficiency shows the quantitative relationship between the quantity of output, the inputs' cost, and the outputs' value. The attainment of a maximum level of output with a minimum level of input or attaining a certain level of output with minimum cost results in efficiency, output efficiency, or cost-efficiency for the firm. Two models are popularly used to measure efficiency or inefficiency: (1) stochastic frontier analysis (SFA, parametric approach) and (2) data envelopment analysis (DEA, non-parametric approach). Several papers have compared the parametric and non-parametric approaches to efficiency analysis. Jacobs discussed the pros and cons of SFA and DEA, he stated: 'Non-statistical approaches such as DEA have the disadvantage of assuming no statistical noise, but have the advantage of being non-parametric and requiring few assumptions about the underlying technology. On the contrary, SFA models have the attraction for statistical noise but have the disadvantage of requiring strong assumptions as to the form of the frontier (Jacobs, 2001).

Methodologically, the SFA has an advantage over nonparametric approaches (Masood & Ahmad, 2008). For example, nonparametric methods presume that the inefficiency is captured in the variations of the attributes of MFIs leaving the measurement errors, omitted variables, and exogenous shocks in the measurement. On the contrary, parametric estimation gives a chance to test the result. Moreover, the quantitative restrictions while estimating the model are feasible in the SFA approach.

Specification of the Cost Frontier

To examine the long-term cost efficiency of the MFIs in Bangladesh, we use the SFA model in the form as specified by Battese and Coelli:

$$InCOST_{it} = c\left(x_{it}; \beta\right) + \omega_{it} + e_{it} \tag{1}$$

where $COST_{it}$ is the total operating cost of ith MFI (i = 1, 2, ..., N) and $c\left(x_{it}; \beta\right)$ is the cost frontier. X_{it} is the $(1 \times k)$ vector of the logarithm of input prices and product quantities of MFI i. β is the $(k \times 1)$ vector of the unknown parameters that are to be estimated. ω_i is a random variable, and e_i is a non-negative random variable that shows the technical inefficiency in cost.

Generally, an MFI offers two types of service: saving[10] and lending. The MFIs pay interest on the savings while charging interest on loans to the members. To control the input cost, we included three variables as input prices: wages (w), the interest rate on institutional borrowing (IRIB) (r_b), and the interest rate on members' savings (r_s). Here, the cost must equal the expenses incurred to employ the inputs (some combination of labour and capital with w, r_b and r_s) to produce a certain amount of output (y). If the cost exceeds the expenses, ω and e will be greater than zero, indicating that some unobserved factors contribute to cost more than they do for an average Bangladeshi MFI. From these unobserved factors $(\omega + e)$, we define that ω as the part that can be eliminated if the MFI is efficient. On the contrary, e is the part that is truly unobserved and idiosyncratic to that institution. Technically, the total operating cost is the sum of the expenses on employees and capital. Several factors might contribute to the cost-inefficiency of a particular MFI. In our case, the total operating cost excludes all depreciation and provisions. Here, the annual salary per employee (ASPE) is the ratio of salary plus other allowances to the number of staff, the interest rate on member's savings (IRMS) is the ratio of total interest payment on members' savings to the total amount of members' savings, and the interest rate on IRIB is the ratio of total interest payment on IRIB to total IRIB.

$$lnCOST_{it} = a_0 + \beta_1 lnASPE_{it} + \beta_2 lnIRMS_{it} + \beta_3 lnIRIB_{it} + u_{it} + v_{it} \tag{2}$$

The Lee and Schmidt (1993) and the Cornwell et al. (1990) models can be estimated using the following syntax:

$$
\begin{aligned}
lnCOST_{it} = &\, a_0 + \beta_1 lnASPE_{it} + \beta_2 lnIRMS_{it} + \beta_3 lnIRIB_{it} + \beta_4 \left(lnASPE_{it}\right)^2 \\
&+ \beta_5 \left(lnIRMS_{it}\right)^2 + \beta_6 \left(lnIRIB_{it}\right)^2 + \beta_7 \left(lnASPE_{it} \times lnIRMS_{it}\right) \\
&+ \beta_8 \left(lnIRMS_{it} \times lnIRIB_{it}\right) + \beta_9 \left(lnIRIB_{it} \times lnASPE_{it}\right) + u_{it} + v_{it}
\end{aligned} \tag{3}
$$

The dependent variable is the log of operating cost (lnCOST), and the independent variables are borrowing cost, savings cost, and salary cost.

Specifications of the Stochastic Cost-Inefficiency Models

As discussed earlier, we obtain the unobserved factors $(\omega_{it} + e_{it})$ once we run the cost SFM. Then, we regress the predicted term e on various factors that can contribute to the inefficiency of MFI. Thus, we will be able to predict the inefficiency scores. The inefficiency score is zero if the MFI is efficient and positive otherwise. The stochastic inefficiency term is defined as:

$$\left(\text{Inefficiency Model}\right) e_{it} = z_{it}\alpha + \varepsilon_{it} \tag{4}$$

The set of factors that can affect the inefficiency of an MFI is the status of regulation due to off-site and on-site monitoring, regular auditing to maintain accountability in the documentation, transparency in governance, the number of borrowers per staff to capture the capacity effect, the status of grants/subsidies,[11] some financial characteristics like savings-outstanding ratio and investment to asset ratio, and borrower-member ratio. Conceptually, an increase in the productivity of employees and the number of borrowers per member of staff will improve cost efficiency. At the same time, subsidies/grants showing expense preference behaviour will result in lower efficiency of the MFIs.

Rural poor people benefit the most from microcredit loans. These people usually need more training for further investment. A larger loan size results in greater amounts overdue and raises the value of loan loss provision (LLP). So, we expect a positive relationship between the average loan size and inefficiency. We used the savings-to-loan outstanding ratio (SAVLOR) to explain a part of cost-inefficiency. Cost-inefficiency may decrease with the increase in the members' savings because the savings can be used to finance microcredit loans and make repayment less expensive. Therefore, we can expect a negative correlation between the savings-to-loan outstanding ratio and inefficiency. On the contrary, cost efficiency may decrease due to an increase in the investment-to-asset ratio (INVASSR) because of the existing restrictions on commercial investments. The main objective of a microcredit program is to provide credit facilities, and the most efficient organisations heavily focus on this objective.

Therefore, we expect the correlation between the borrower-to-member ratio and inefficiency to be negative.

So, the equation for inefficiency is as follows:

$$u_{it} = \gamma_0 + \gamma_1 YREG_{it} + \gamma_2 BPS_{it} + \gamma_3 G_{it} + \gamma_4 ALS_{it} + \\ \gamma_5 SAVOUT_{it} + \gamma_6\ INVASS_{it} + \gamma_7 BRM_{it} + \varepsilon_{it} \tag{6}$$

where YREG is Year Under Regulation, BPS is Borrowers per Staff (BPS), ALS is Average Loan Size, SAVOUT is Savings to Outstanding ratio, INVASS is Investment to Asset Ratio, and BRM is Borrower to Member ratio.

Table 1. Some Stylised Facts Regarding the Microfinance Sector of Bangladesh (Monetary Figures Are in Millions).

Characteristics	2008	2012	2013	2014	2015	2016	2017	2018
Members (millions)	23.81	22.80	22.91	23.55	25.43	27.67	29.79	30.75
Borrowers (millions)	18.87	18.18	18.09	18.90	20.64	22.97	25.38	26.36
Staffs (millions)	0.11	0.11	0.11	0.11	0.12	0.13	0.14	0.15
Borrowers per staff	159.77	164.30	164.32	168.03	175.98	179.47	179.65	179.70
Outstanding loan	95,645	209,432	239,269	277,114	357,263	461,934	594,511	670,742
Members' savings	37,008	73,716	88,452	110,820	136,841	172,127	221,336	260,940
Total assets	117,644	257,601	294,301	340,851	439,434	568,179	731,250	825,012
Operating cost	24,651	53,357	43,943	50,463	59,951	74,652	90,494	105,256
Institutional borrowings	2,008	63,809	76,870	93,853	110,099	126,232	193,054	275,056
MFIs receiving direct income subsidy (%)	12.04	6.51	6.44	5.89	5.42	4.26	3.58	4.89
Operating cost per BDT100 loans outstanding	25.77	25.48	18.37	18.21	16.78	16.16	15.22	15.69
Outstanding loan per staff	0.91	1.89	2.17	2.46	3.05	3.61	4.21	4.57
Average size of loan outstanding (BDT)	5067	11520	13227	14663	17312	20113	23427	25442
Investment for cumulative surplus	643.78	1846.54	2691.56	3686.55	5080.68	11813	16358	20391
Investment for savings	1187	3321.61	5387.41	7729.78	10155	15711	26308	36205
Cumulative surplus	27,832	68,637	78,109	100,173	125,354	154,643	191,393	212,256

Source: MRA (2020).

Results and Findings

Descriptive Findings

The cost-efficiency analysis was conducted on 321 NGO-MFIs for the 2008 (pre-regulation) period and 534 NGO-MFIs from 2012 to 2018 (post-regulation) (see Table 1). The NGO-MFIs started to apply for licenses in 2007, and by 2008, most of the large NGO-MFIs were under licensing. For this paper, the year 2008 was regarded to be the pre-regulation year, while 2012 to 2018 were regarded as the regulation years. In 2008, one staff had provided services to around 159.77 clients, whereas in 2018, one staff provided service to around 179.70 clients. This suggests that the productivity of the staff has increased over time. The operating costs have also increased by 16% from 2008 to 2018, while the operating cost per BDT100 of outstanding loans has decreased from BDT25.77 to BDT15.69 during the same period. The subsidies, grants, and donations NGO-MFIs received before licensing declined under the MRA regulations. In 2018, each staff provided a credit facility amounting to BDT4.57 million BDT relative to the BDT0.91 million they had provided in 2008. Before the imposition of regulations, microcredit borrowers could only receive a loan of around BDT5,000; however, recently, borrowers can borrow around BDT25,000, which is a good sign.

Under the Microcredit Regulatory Authority Act, 2010 13(3), all NGO-MFIs must ensure that at least 70% of their clients are borrowers. In 2012, it was 80%; in 2018, the percentage had improved. The ratio of borrowers and members has gradually increased, indicating that the NGO-MFIs are doing better under the regulation of the MRA. The operating cost per BDT100 loan outstanding decreased from BDT24.54 in 2012 to BDT19.46 in 2018 over the years of regulation which is a positive sign for the NGO-MFIs. Since the amount of outstanding loans provided by each staff increased from BDT1.89 million in 2012 to BDT4.57 million in 2018, it suggests that the staff became better skilled under the regulation of the MRA. The borrowers had access to an average of BDT11,520 microcredit loans in 2012, which increased to around BDT25,442 in 2018. This suggests that the microcredit sector has started providing larger amounts of loans as the demands of the borrowers' households increased. According to MRA regulations, 2010, 20 (1), every microcredit organisation will create a reserve fund using 10% of its total income surplus. The cumulative surplus investment percentage was 2.69% during the initial regulation stage. Consequently, after 7 years of regulation, the percentage of investment for cumulative surplus rose to 9.61%, close to 10%.

According to the Microcredit Regulatory Authority Act, 2010 34 (1), every microcredit organisation must maintain a 15% liquidity fund of its entire compulsory, voluntary, and term deposit, or whatever name assigned to the deposit funds, in the savings account of a scheduled bank of the branch offices. To fulfil this rule, all organisations maintained a liquidity fund. Within 7 years of regulation, the percentage increased to 13. 87% in 2018, which is a good sign for this sector.

Econometric Results

Firstly, we ran the 'translog' cost function model and generated the unobserved terms (U) and (V). Once the terms were estimated, the inefficiency model was run

Table 2. Stochastic Frontier Model (Dependent Variable Log of Operating Cost).

Explanatory Variables	All Sample			Pre-regulation		
	Coefficient.	Standard Error	P > |z|	Coefficient.	Standard Error	P > |z|
Log (savings rate)	-2.18	0.86	.01	3.57	2.07	.08
Log (borrowing's rate)	3.80	0.98	.00	-0.71	1.80	.69
Log (salary)	-2.69	0.51	.00	-2.87	1.62	.07
Squared log (savings rate)	-2.69	0.04	.03	-0.12	0.06	.04
Squared log (borrowing's rate)	0.02	0.02	.33	0.08	0.04	.03
Squared log (salary)	0.19	0.02	.00	0.13	0.07	.07
Log (savings rate) × log (Borrowing's rate)	0.05	0.05	.41	-0.02	0.07	.74
Log (savings rate) × log (salary)	0.15	0.06	.04	-0.46	0.20	.02
Log (borrowing's rate) × log (Salary)	-0.31	0.08	.00	0.14	0.17	.40
Constant	22.96	4.39	.00	30.04	10.92	.01
Sigma_v	2.58			1.67	0.07	
Sigma_u	0.31			0.03	1.42	
Observations	3759			321		

Note: All explanatory variables except 'log (savings rate)', 'squared log (savings rate)', 'squared log (borrowing's rate)', 'log (savings rate) × log (borrowing's rate)' and 'log (savings rate) × log (salary)' are statistically significant. The number of observations is 4059 and the number of MFIs is 534. 321 NGO-MFIs were selected for the pre-regulation stage and 534 NGO-MFIs were selected for the regulation stage. The operating cost is the dependent variable and the savings interest rate, borrowing interest rate and the salary per staff are the independent variables.

Table 3. Estimated Inefficiency Scores From 2008 to 2018.

Year	Inefficiency Score	Reduction of Inefficiency Compared to the Pre-regulation Year 2008 (%)	Average Reduction of Inefficiency (%)
2008	2.78	–	15.10
2012	2.06	25.89	
2013	2.52	9.35	
2014	2.49	10.43	
2015	2.35	15.46	
2016	2.61	6.12	
2017	2.39	14.02	
2018	2.10	24.46	

Note: Statistical calculations for each year are attached to appendices.

Table 4. Stochastic Frontier Model (Dependent Variable Log of Operating Cost: Balanced Panel Data).

	All Sample		
Explanatory Variables	Coefficient.	Standard Error	$P > |z|$
Log (savings rate)	−2.65	1.20	.03
Log (borrowing's rate)	1.83	1.20	.12
Log (salary)	−3.46	0.67	.00
Squared log (savings rate)	−0.10	0.05	.02
Squared log (borrowing's rate)	−0.02	0.03	.42
Squared log (salary)	0.23	0.02	.00
Log (savings rate) × log (borrowing's rate)	0.05	0.06	.39
Log (savings rate) × log (salary)	−0.17	0.09	.06
Log (borrowing's rate) × log (salary)	−0.20	0.10	.04
Constant	22.25	5.78	.00
Sigma_v	0.51	0.09	.00
Sigma_u	1.55	0.04	.00
Observations		2112	

Note: Statistical calculations for each year are attached to appendices.

to determine which segment of the unobserved terms comprised the MFI's inefficiencies. The stochastic cost frontier model was estimated beforehand to estimate the cost-inefficiency score.

The results of Table 2 are presented in log-log form, and the model specification has little scope for interpreting the regression coefficient. The partial effects can be understood using differential calculus. It explains the effect of the changes on operating costs due to the change in the respective variable.

Table 5. Determinants of Cost-inefficiency.

Inefficiency Scores	Coef.	Standard Error
Year under regulation	−0.040***	0.005
Number of borrowers per staff (BPS)	−0.011***	0.003
Grants (G)	0.038***	0.005
Average loan size (ALS)	0.063***	0.003
Saving to outstanding ratio (SavOut)	−0.003***	0.0008
Investment to asset ratio (InvtAsst)	0.002***	0.0009
Borrower to member ratio (BrrMem)	0.009***	0.004
Constants	0.130***	0.037
Number of observation	2112	
R^2	0.207	
Adjusted R^2	0.204	

Note: * refers significant at 10% level, ** refers significant at 5% level, and *** refers significant at 1% level.
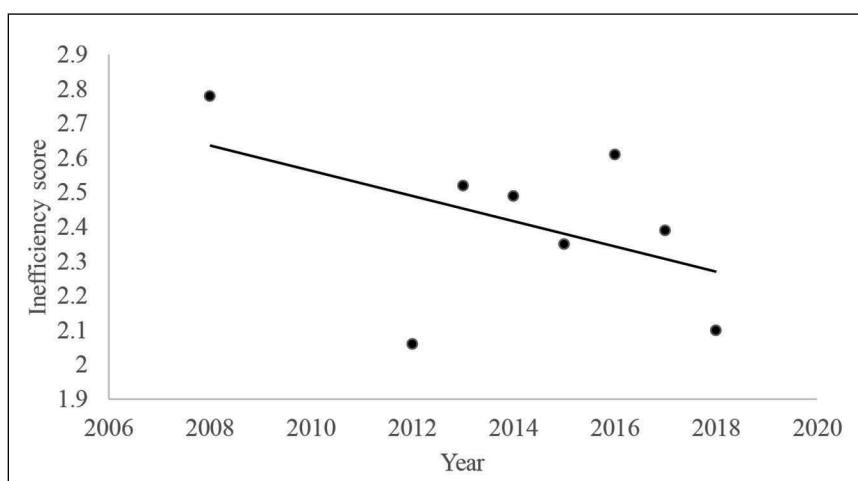

Figure 3. Trend of Inefficiency Score.

From the pre-regulation to the regulation stage, the standard errors (see Table 4 and table 5) for two components- random (V) and inefficiency (U) are 2.58 and 0.308, respectively. During the pre-regulation stage for 2008, the standard errors for two components- random (V) and inefficiency (U) are 1.674 and 0.0278, respectively. Here, the inefficiency score for 2008 is compared with the scores from 2012 and 2018. Firstly, inefficiency scores for the years between 2012 and 2018 were found. For 2008 (pre-regulation period), the inefficiency score was 2.78. It is evident from Table 3 and Figure 3 that for the regulation periods of 2012, 2013, 2014, 2015, 2016, 2017, and 2018, the inefficiency scores were 2.06,

2.52, 2.49, 2.35, 2.61, 2.39, and 2.10, respectively. Compared to the inefficiency score from 2008, the inefficiency scores from 2012 to 2018 fell by 25.89%, 9.35%, 10.34%, 15.46%, 6.12%, 14.02%, and 24.46%, respectively. Overall, a significant reduction in the inefficiency scores from the years 2012 to 2018 relative to the 2008 score was observed.

The higher inefficiency score at the pre-regulation stage relative to the later stages suggests that the NGO-MFIs were less efficient at this stage. During the years under regulation, the inefficiency scores started to go down, which indicates that the NGO-MFIs became more efficient. The NGO-MFIs were the most efficient during 2012 and 2018 compared to other years. In 2012, the percentage of reduction of the inefficiency score was 25.89% compared to the base year (the pre-regulation year is 2008). Similarly, the percentage reduction of the inefficiency scores relative to the base year (2008) for 2013 to 2018 was 9.35%, 10.43%, 15.46%, 6.12%, 14.02%, and 24.46%, respectively. The average reduction in the inefficiency score from 2012 to 2018 compared to the pre-regulation year is 15.10%.

The inefficiency model (as specified in equation 6) tries to determine which segments of the unobserved terms result from the MFI's inefficiencies.

All the independent variables are statistically significant as the *p*-values are close to zero. It suggests that they significantly contribute to the variation in the inefficiency scores. A statistically significant negative correlation exists between the 'YREG' and the inefficiency score (IS). It indicates that an additional year of regulation reduces the inefficiency score by 4.0% while holding other variables in the model constant. The result shows that the years under regulation improved the cost-efficiency of MFIs.

A statistically significant negative correlation exists between the BPS and inefficiency score (IS). Moreover, increasing staff productivity or the number of borrowers per staff reduces the inefficiency score by 1.1% while holding the other variables in the model constant. This suggests that the microcredit programs are run properly under the close supervision of the staff. If the number of borrowers is increased per member staff, then it is difficult to monitor the borrowers adequately. It could hamper the realisation of the loans disbursed. One of the executive directors opined that the increasing number of borrowers per staff is a good sign for bigger NGO-MFIs like BRAC, ASA, and TMSS. The director reasoned that since the bigger NGO-MFIs had a huge number of branches all over Bangladesh, they could benefit from the increasing BPS, unlike the medium and small NGO-MFIs, which only had a handful of branches. The staff from small or medium-sized MFIs had to travel as far as 10 km from their branch office to collect the dues from the group of members. Additionally, during collection day, it was common for 2-3 borrowers to be absent from the group. Consequently, it took a lot of work for the staff to revisit the group for the second time. Furthermore, the variable 'number of borrowers per staff' (BPS) indicates the capacity of MFI employees to handle the borrowers. An increase in the productivity of employees implies an improvement in cost efficiency. Thus, the employees from large MFIs are more efficient than those from small and medium MFIs.

Additionally, there is a positive correlation between the grants and the inefficiency score (IS). This suggests that the level of inefficiency is higher among the grant recipients by 3.8% while holding the other variables in the model constant. With direct income grants/subsidies, the subsidised MFIs tend to exhibit expense preference behaviour. Therefore, subsidised MFIs are likely to be more inefficient. Edwards (1977) showed that an expense preference theoretical framework better explains the behaviour of regulated firms than a profit-maximisation framework. Khalily and Imam (2001) advocated for a regulatory framework for the microfinance industry of Bangladesh as they found that the subsidised MFIs have more expense preference behaviour and are relatively less efficient.

A statistically significant positive correlation exists between the average loan size (ALS) and the inefficiency score (IS). It suggests that if the average loan size increases by one unit, the inefficiency score tends to increase by 6.3% while holding the other variables in the model constant. Rural and poor people mainly benefit from microcredit loans. These people usually need more training for further investment and be equipped to make money from that investment. An increase in the average loan size of the borrowers contributes to inefficiency. Large loans usually result in a greater overdue amount and raise the loan loss provision (LLP). Borrowers usually need more experience to handle investments, and large loans make them more likely to default. One of the credit coordinators from the microcredit sector suggested that large loans weren't utilised properly by the microcredit borrowers and that they could not pay those loans on time. Moreover, these types of loans have no social mortgage because individuals, not groups, take these loans.

The results show that a marginal increment in the value of 'SavOut' reduces the inefficiency score by 0.3% while holding the other variables in the model constant. The microcredit sector has struggled with fund collection. Commercial funds from banks and other financial institutions are very expensive for running operations. In this regard, the savings funds are less expensive. As a result, NGO-MFIs are more likely to utilise savings funds. They collect savings in categories like compulsory, term, and voluntary. The NGO-MFIs with higher savings are considered more prudent as the savings funds are less expensive than those collected from commercial institutions.

Moreover, a marginal increase in the investment-to-asset ratio will likely increase the inefficiency score by 0.016% while holding the effects of the other variables in the model constant. Investment refers to the utilisation of funds in projects other than microcredit programs. These projects are usually run for commercial purposes. The microcredit regulations encourage greater investment in microcredit programs than in other commercial ventures.

A marginal increase in the borrower-member ratio also increases the inefficiency score by 0.092% while holding other variables in the model constant. Under the Microcredit Regulatory Authority Rules, 2010 13(3), all NGO-MFIs must ensure that at least 70% of their clients are borrowers. The main objective of a microcredit program is to provide credit facilities to the poor so that they can generate more income while covering their monthly expenses and potentially escape poverty. The most efficient organisations mainly focus on this objective.

For example, BRAC and ASA maintain a borrower-to-member ratio (BrrMem) of 87% and 91%, respectively. However, a positive correlation exists between 'BrrMem' and the inefficiency score. One expert opined that 'large organisations can maintain this ratio easily, but the small and medium organisation cannot do so properly. They try to maintain the ratio by providing a small amount of credit, which is not helpful. The main objective of a microcredit program should be to involve poor people in income-generating activities. To do so, a large amount of credit is required. However, small and medium organisations cannot meet the poor people's requirements or fulfil the microcredit program's objective. So, the MRA must focus more on the credit shortages than the ratios themselves'. The R-squared value is 20.73%, which indicates that the model is described by 20.73% of the independent variables. The R-squared values (20.73%) and the Adjusted R-squared value (20.47%) are very close.

Conclusion

Based on the commission study 'The Regulatory Aspects of Microfinance Institutions (MFIs) and linking it with the Formal Financial Sector,' the Bangladesh government passed the 'Microcredit Regulatory Authority Act 2006' in 2006. The MRA started providing licenses in 2007 and granted licenses to more than 700 institutions by June 2018. In this study, we assessed the impact of MRA regulations on the cost-efficiency of the MFIs using the data from 321 and 534 organisations during the pre-regulation and regulation periods, respectively.

Before 2010, the NGO-MFIs had charged varying amounts of admission fees, passbook fees, loan application fees, and insurance fees. The MRA started to enforce new rules and regulations as soon as it was established. The descriptive statistics showed that the ratio between the borrowers and members had increased gradually. In 2018, one staff was handling more than 179 borrowers whereas, in 2012, the number was 164, which indicates that the staff's productivity had increased. The operating cost per BDT100 loan outstanding was BDT25.77 in 2008, which fell to BDT19.46 in 2018, which indicates that the NGO-MFIs are becoming more cost-efficient. Each staff member had provided credit facilities of around BDT1.89 million on average in 2012, which rose to BDT4.57 million in 2018 under the regulation of the MRA. The borrowers had access to an average of BDT11,520 microcredit loans in 2012, which increased to around BDT25,442 in 2018. The cumulative surplus investment percentage was 2.69% during the initial regulation stage. After 7 years of regulation, the percentage of investment for cumulative surplus rose to 9.61%. According to the Microcredit Regulatory Authority Act, 2010, 34 (1), every microcredit organisation must maintain a 15% liquidity fund to protect the clients' savings. Within 7 years of regulation, the average percentage of the liquidity fund increased to 13.87% in 2018, which is a good sign for this sector.

The inefficiency score for the pre-regulation stage (2008) was 2.78. On the contrary, during the regulation stage, the inefficiency scores tended to decline; for 2018, it was 2.10. The average percentage reduction in the inefficiency score for the regulation period relative to the 2008 value was 15.10%, and the greatest

reduction was in 2012 and the second highest in 2018. Long-term regulations ameliorated the cost-efficiency of the MFIs: for each additional year of regulation, the inefficiency score falls by 4% while holding other factors in the model constant. Additionally, the regulation-induced and capacity-indicating 'borrowers per staff' (BPS) variable shows that improving the number of borrowers per staff improves cost efficiency. The NGO-MFIs with higher savings are considered more prudent as savings funds are less expensive than those collected from commercial institutions. Improvements in the investment-to-asset ratio can increase inefficiency as there are greater restrictions for commercial investments than for investments in microcredit programs. MRA regulations require that at least 70% of the MFI's clients are borrowers. However, this may bring about inefficiency. The paper concludes that microcredit regulation has impacted the cost-efficiency of MFIs in Bangladesh. Although the pattern of the level of inefficiency score varies over years, it shows a general negative trend. Therefore, we may recommend implementing binding regulation strategies to enhance the efficiency and transparency in the microfinance sector of Bangladesh.

Declaration of Conflicting Interests

Funding

Notes

1. 1 USD = 85.6 on average.
2. According to the Microcredit Regulatory Authority 'Credit services of this sector can be categorised into six broad groups: (a) general microcredit for small-scale self-employment based activities, (b) microenterprise loans, (c) loans for ultra-poor, (d) agricultural loans, (e) seasonal loans and (f) loans for disaster management. Loan amounts up to BDT50,000 are generally considered as microcredit; loans above this amount are considered as microenterprise loans.'
3. NGO-MFIs refer to all the NGOs in Bangladesh that got licenses from the Microcredit Regulatory Authority (MRA) to operate microcredit programs.
4. The grace period refers to the gap between loan disbursement and the first instalment realisation. Borrowers will pay first the instalment of the microcredit loan on or after 15 days after getting the loan.
5. Rebate policy: borrowers usually pay 46 instalments of the principal amount along with the service charge of their loan but if they pay it in less than 46 instalments then the service charge of remaining instalments does not have to be paid or only the principal amount of the remaining instalments will have to be paid.
6. Announced saving Interest rate: NGO-MFIs have to announce the rate of interest on the deposits made by the borrowers. Generally, for the compulsory savings, borrowers get 6% interest on their deposited amount.

7. Total capital refers to the sum up of cumulative surplus, 10% reserve fund, donation of the general committee and 1% of Good loan from Loan Loss Provision (LLP) of the particular NGO-MFI.
8. PKSF. It denotes Palli Karma-Sahayak Foundation (PKSF), an apex development organisation, which was established by the Government of Bangladesh (GoB) in May 1990, for sustainable poverty reduction through employment generation.
9. The annual financial statements comprise balance sheets, income statements, cash flows, receipts and payments, notes and the managerial reports of the NGO-MFIs.
10. Savings refers to the deposit money of the members. According to the MRA's rules, the MFIs cannot collect savings of more than 80% of the loan outstanding. They should instead be mostly financed by IRIB.
11. Grants/subsidies refer to the direct reward from the donors. With direct income subsidy, the subsidised MFIs might exhibit expense preference behaviour.

References

Abdulai, A., & Tewari, D. D. (2016). Efficiency of microfinance institutions in sub-Saharan Africa: A stochastic frontier approach. *Ghana Journal of Development Studies*, *13*(2), 117–139. https://doi.org/10.4314/gjds.v13i2.7

Al-Azzam, M. D. (2016). Corruption and microcredit interest rates: Does regulation help? *Bulletin of Economic Research*, *68*(S1), 182–202. https://doi.org/10.1111/boer.12080

Asaftei, G., & Kumbhakar, S. C. (2008). Regulation and efficiency in transition: The case of Romanian banks. *Journal of Regulatory Economics*, *33*(3), 253–282.

Ashton, J. K. (2000). Cost efficiency in the UK water and sewerage industry. *Applied Economics Letters*, *7*(7), 455–458.

Aubert, C., & Reynaud, A. (2005). The impact of regulation on cost efficiency: An empirical analysis of Wisconsin water utilities. *Journal of Productivity Analysis*, *23*(3), 383–409.

Badruddoza, S. (2013). *Rules of Microcredit Regulatory Authority in Bangladesh: A synopsis*. Institute of Microfinance (InM).

Battese, G. E., & Coelli, T. J. (1995). A Model for Technical Inefficiency effects a Stochastic Frontier Function for Panel Data. *Empirical Economics*, *20*(2), 325–332. https://doi.org/10.1007/BF01205442

Bhattacharyya, A., Harris, T. R., Narayanan, R., & Raffiee, K. (1995). Specification and estimation of the effect of ownership on the economic efficiency of the water utilities. *Regional Science and Urban Economics*, *25*(6), 759–784. https://doi.org/10.1016/0166-0462(95)02107-8

Cantos, P., & Maudos, J. (2001). Regulation and efficiency: The case of European railways. *Transportation Research Part A*, *35*(5), 459–472. https://doi.org/10.1016/S0965-8564(00)00007-0

Chavez, R., & Gonzalez-Vega, C. (1994). Principles of regulation and prudential supervision and their relevance for the microenterprise finance organisation. InM. Otero & E. Rhyne (Eds.), *New World of Microenterprise Finance*. West Hartford, CT: The Kumarian Press.

Chortareas, G. E., Girardone, C., & Ventouri, A. (2012). Bank supervision, regulation, and efficiency: Evidence from the European Union. *Journal of Financial Stability*, *8*(4), 292–302.

Cornwell, C., Schmidt, P., & Sickles, R. C. (1990). Production frontiers with cross-sectional and time-series variation in efficiency levels. *Journal of Econometrics*, *46*(1-2), 185–200.

Cowan, S. (2002). Price-cap regulation. *Swedish Economic Policy Review*, *9*(2), 167–188.

Cracknell, D. (2000). Microfinance Regulation in Bangladesh-a long path to progress. *Small Enterprise Development*, *11*(4), 42–51. https://doi.org/10.3362/0957-1329.2000.042

Edwards, F. R. (1977). Managerial objectives in regulated industries: expense preference behavior in banking. *Journal of Political Economy*, *85*(1), 147–62.

Erbetta, F., & Cave, M. (2007). Regulation and efficiency incentives: Evidence from the England and Wales water and sewerage industry. *Review of Network Economics*, *6*(4). https://doi.org/10.2202/1446-9022.1128

Farsi, M., & Filippini, M. (2004). Regulation and measuring cost-efficiency with panel data models: Application to electricity distribution utilities. *Review of Industrial Organization*, *25*(1), 1–19. https://doi.org/10.1023/B:REIO.0000040474.83556.54

Filippini, M., Hrovatin, N., & Zorič, J. (2004). Efficiency and regulation of the Slovenian electricity distribution companies. *Energy Policy*, *32*(3), 335–344. https://doi.org/10.1016/S0301-4215(02)00295-1

Filippini, M., & Maggi, R. (1993). Efficiency and regulation in the case of the Swiss private railways. *Journal of Regulatory Economics*, *5*(2), 199–216. https://doi.org/10.1007/BF01065366

Gebremichael, B. Z., & Gessesse, H. T. (2016). Technical efficiency of microfinance institutions (MFIs). *International Journal of Development Issues*, *15*(3), 224–239. https://doi.org/10.1108/IJDI-04-2016-0026

Jackson, K. E., & Islam, T. (2005). Regulation of microfinance NGOs: General reflections and the case of Bangladesh. *International Journal of Rural Management*, *1*(1), 45–57. https://doi.org/10.1177/097306800400100103

Jacobs, R. (2001) *Alternative methods to examine hospital efficiency: data envelopment analysis and stochastic frontier analysis*. Centre for Health Economics (CHE) (Discussion Paper No. 177). Heslington: University of York.

Jondrow, J., Lovell, C. K., Materov, I. S., & Schmidt, P. (1982). On the estimation of technical inefficiency in the stochastic frontier production function model. *Journal of Econometrics*, *19*(2–3), 233–238.

Kendo, S. (2017). Do decision variables improve microfinance efficiency? A stochastic frontier analysis for African countries. *Strategic Change*, *26*(2), 159–174.

Khalily, M. B., Khaleque, M. A., & Badruddoza, S. (2014). Impact of regulation on the cost efficiency of microfinance institutions in Bangladesh. In Khalily B. (Ed.), *Microfinance institutions* (pp. 139–161). Palgrave Macmillan.

Khalily, B., & Imam, M. O. (2001). Behaviour of microfinance institutions and the case for regulation and supervision. In I. Sharif & G. Wood (Eds.), *Challenges for Second Generation Microfinance – Regulation, Supervision and Resource Mobilisation*. Dhaka : The University Press Limited.

Khandker, S. R. (2005). Microfinance and poverty: Evidence using panel data from Bangladesh. *World Bank Economic Review*, *19*(2), 263–286.

Lee, R., & Schmidt-Marwede, U. (1993). Interurban competition? Financial centres and the geography of financial production. *International Journal of Urban and Regional Research*, *17*(4), 492–515.

Masood, T. & Ahmad, M. I. (2008). *Technical efficiency of microfinance institutions in India- a stochastic frontier approach*. (MPRA Paper No. 25454). Accessed at http://mpra.ub.uni-muenchen.de/25454/MPRA Paper No. 25454.

McGuire, P. B. (1999). Policy and regulation for sustainable microfinance: Country experiences in Asia. *Journal of International Development: The Journal of the Development Studies Association*, *11*(5), 717–729.

Mia, M. A. (2017). An overview of the microfinance sector in Bangladesh. *East Asian Journal of Business Management*, *7*(2), 31–38. https://doi.org/10.13106/eajbm.2017. vol7.no2.31

MRA (Microcredit Regulatory Authority). (2020). *NGO-MFIs in Bangladesh, June 2020: A Statistical Publication of Microcredit Regulatory Authority*. Dhaka: MRA.

Orea, L., Álvarez, I. C., & Jamasb, T. (2018). A spatial stochastic frontier model with omitted variables: Electricity distribution in Norway. *Energy Journal*, *39*(3). 93–116.

Paul, S., & Shankar, S. (2018). On estimating efficiency effects in a stochastic frontier model. *European Journal of Operational Research*, *271*(2), 769–774. https://doi. org/10.1016/j.ejor.2018.05.052

Scott, G. K. (2017). *Implications of public financial management regulatory framework on service delivery: Reflections of Ghana's district assemblies. Journal of Public Policy*, *4*(2), 1–17.

Sinha, S. (2011). *Bangladesh microfinance review*. BRAC Development Institute.

Sravani, M., & Rao, D. S. (2017). Performance of microfinance institutions an evaluative study on the efficiency of selected MFIS in India using stochastic frontier analysis. *ZENITH International Journal of Business Economics and Management Research*, *7*(11), 66–77.

Surender, M. (2018). Case study: Measurement of technical efficiency of Indian microfinance Institutions. *Advances in Management*, *11*(1), 12–19.

Waterfield, C. (2008). Why we need transparent pricing in microfinance. Retrieved July 15, 2009, from http://www.mftransparency.org/

Investigating the Role of Urban–Rural Economies in the Development of Rural Settlements: Fresh Evidence from Iran

Mir Najaf Mousavi[1], Nazim Ali[2], Simki Kumari[2], Ismail Safar Alizadeh[3] and Waseem Ahmed[4]

Abstract

Urban–rural relations are recognised as one of the essential factors in the occurrence of social, economic and cultural changes in urban and rural areas. However, most planning and development theories emphasise the duality of the city and village. Numerous correspondences in rural towns can lead to the development or underdevelopment of rural or urban areas. Therefore, this study investigates the role of rural-urban economies in developing rural settlements in the Balajer, QarahSaqal, Sarrjez and Dehshams of the Nalous district of Iran. The study is based on primary data sources as well as secondary data sources. Moreover, the method of data collection combines documentary and field survey methods. The data have been collected from 240 households. The secondary sources are studies, journals, business magazines and published literature. In this work, the descriptive-analytical relationships have been examined. The study's statistical population includes all rural households in the sampled villages. For data analysis, Cronbach's test, one-sample t-test, Pearson correlation and linear regression model. The t-test result was 2.54, which assessed the poor relationship between the city and the village. Also, in the Pearson correlation test, the flow of urban investment in rural economic activities has a higher correlation. In the regression test, communication flow has significantly impacted communication by providing financial resources.

Keywords

Rural development, urban–rural economies, rural settlements, Iran

[1]Department of Geography, Urmia University, Urmia, West Azerbaijan, Iran
[2]Department of Geography, Zakia Afaque Islamia College, Siwan, Bihar, India
[3]Department of Geography, Payame Noor University of Tehran, Tehran, Iran
[4]Glocal University, Saharanpur, Uttar Pradesh, India

Corresponding author:
Nazim Ali, Department of Geography, Zakia Afaque Islamia College, Siwan, Bihar 841226, India.
E-mail: nazimamu.geography@gmail.com

Introduction

Human settlements' characteristics are their evolution and dynamism (Des Roches et al., 2020). This dynamism in space takes place over time through exchanges, transformations and transitions that always manifest themselves as the movement of population, the flow of goods, energy, information and capital (Salazar & González, 2021) and the inter-relationships between villages and cities and their structural and functional integration (Jat et al., 2008). One of the influential factors in how a regular network is formed is the relationship and interactions between urban and rural areas (Xia et al., 2020). Therefore, analysing urban–rural relations is of exceptional theoretical and functional importance (Chen et al., 2020). According to the traditional view, cities have control effects on the village rather than a breeding role (Zavratnik et al., 2020).

As wealth is concentrated not only in the hands of the capitalist class but also in certain places with high added value, cities are the geographically broadest concentration of capital (Beauregard et al., 2018). Inter-relationships and connections between cities and rural areas significantly influence social and cultural change (Hou et al., 2020). Despite this fact, most development theories and practices emphasise the duality of population and activities in urban and rural areas (Zhou et al., 2018). The relationship between cities and surrounding villages is significant in reciprocity because the essential rural products intended for export are mainly exported through cities (Wu & Haasis, 2018). At the same time, cities provide imperative financial resources, services and information for villages and deal with importing industrial goods and some agricultural inputs (Butsch & Heinkel, 2020). Thus, cities link rural areas and the global market (Li et al., 2019). These interdependent relationships can form the basis of a positive interaction cycle (Krayenhoff et al., 2018). Studies show that urban–rural relations in different regions can also be effective by affecting household assets (Maxwell, 2006, Yu et al., 2014, Mumtaz & Smith, 2018, Wang et al., 2020).

One of the strategies that Hillhurst proposes considering the importance of spatial development in eliminating intra-regional, inter-regional and sectoral dichotomies, is the scattered expansion strategy (Madanipour et al., 2021, Syhlonyk, 2016; Rock et al., 2016). According to this theory, in the early stages of development, the centre is particularly interested in those structures that maintain the relationship between the steps of the centre and its surroundings and enable the implementation and executive control of decisions. In this regard, the three categories of flows that create such structures are of particular importance: a) formation of cadres (responsible for implementing significant decisions), b) formation of controlling institutions and organisations, c) establishment of transportation networks, transportation and communications to control the flow of goods and services; The integration process that begins in this way leads to an increase in the exchange of goods between the centre and the surrounding subsystems. But increasing exchanges tend to favour the centre because its technology has made it possible (McCormack et al., 2014). Today, with extensive socioeconomic and technological developments, including transportation and

communication routes, urban–rural economic relations have become much broader and more diverse (Clayton et al., 2005).

Financial communication is done through production relationships, consumption methods, income and commodity flow (Nuttall, 2008, Jarzębowski, 2020, Zhou et al., 2020). In such a way, the conditions in rural and urban settlements are strongly affected by the low quality of these relationships (Jamshed et al., 2020, Chen et al., 2018). Today, urban–rural interactions can be divided into two categories: spatial interactions, including the flow of people, goods, and information and sectoral interactions, including industry and services (Tacoli, 1998). Notably, villages and their social systems are much more diverse, complex and general than in centuries past (Kennedy et al., 2001). Processes such as modernism and its planning goals accelerate and disrupt this type of communication (Sheppard et al., 2013). The history of urban–rural relations in Iran has an ancient history (Golboni et al., 2018, Khorrami et al., 2017). The drastic changes in Iran's social and economic situation in recent decades have completely changed the economic relations between urban and rural areas (Fanni, 2006; Alijani et al., 2020). Until now, although cities had clear sovereignty in the regions, it is not undeniable that there was a kind of trade-based balance between the city and the countryside that ensured the life of different areas (Langroodi et al., 2014).

These two settlements require trade based on the surplus production of rural agricultural products and the provision of services and goods (Masoom et al., 2015). By adopting a new economic and capitalist approach influenced by the Western development model in the 19th century, the ruling system of the region and the existing border between urban and rural areas in Iran have gradually changed (Shahi & Tabrizi, 2020). Following this change in approach and with the transformation of oil as one of Iran's sources of income and reducing cities' dependence on the production surplus of rural society, the form and nature of economic relations have changed (Moeedfar, 2008). Thus, the organic relationship between the city and the village in the previous stages has been broken due to the city's independence from the rural economic surplus. The spatial reflection of this trend is manifested in the marginalisation of the agricultural sector and villages and the migration of a part of the rural labour force to the city (Hesamyan, 2007).

Therefore, the present study investigates the effects of urban–rural economic relations on the social and economic situation of rural settlements in Oshnavieh City of West Azerbaijan province. The central question of the present study is to what extent the economic relations between urban and rural areas have affected the economic and social situation of the rural areas studied. Therefore, in this paper, it would be interesting to succinct the rural-urban dichotomy to understand the rural areas' socio-economic transformation.

This paper is divided into six sections. Following the introduction, the second section provides a theoretical framework. The third section gives a brief on the study area. The fourth section details the data sources and methodology adopted. Results are discussed in the fifth section, and the sixth section defines the causal effect relationship and then concludes.

Theoretical Framework

Space economics is the spatial pattern of the activities that make up an economy (Seif al-Dini, 2011). Space economics is the processing of economic activities emphasising spatial efficiency. Thus, it can be said that space economics explains the spatial characteristics of economic activities and the relationship between them (Afrakhteh, 2012).

According to many thinkers, contemporary culture is increasingly influenced by the economics of space and space logic, and the excitement of our time is primarily related to the form of activities in space (Friedland & Boden, 2020). The flow of activities in space plays an essential role in explaining why phenomena evolve and create a special space organisation. Therefore, providing an adequate understanding of social relationships and processes depends on the forms of spatial activity (Crisan et al., 2021). Explaining the function of space is affected by three issues space, time and economic and social mechanisms (Langroodi, 2015). According to Peter Haggett, settlements are interconnected like a network because spatial flows between villages and cities create a network system resulting from residential interactions (Guan & Rowe, 2020). The shape of the network and the pattern of spatial flows are based on the movement of money, goods and people based on the six principles of movement, ducts, nodes, hierarchy, levels and distribution (Khaniki, 2014). These elements are network formation factors that significantly shape spatial flows in the area and cause spatial differences according to the characteristics and type of residential networks (Sahneh et al., 2017).

According to Isard, the theory of space economics deals with the spatial arrangement of economic activities concerning the geographical distribution of data and inputs as well as cost and price changes (Afrakhteh, 2001). In this theory, the interaction of people, goods, money, capital, information and waste is essential. In a homogeneous regional network, the distribution of wealth and ecological and economic resources occurs appropriately between different settlements and generations (Xue, 2014).

Urban–rural relations include physical-spatial, socio-economic and legal-political links (Saidi, & Mikaniki, 2009). Today, the increasing interaction between rural and urban areas has reduced the importance of differentiation between urban and rural areas (Fadaei et al., 2021). The villagers are accustomed to the urban lifestyle and travel between the village and the city. In some countries, industries are moving to rural areas and agriculture is becoming an important sector in urban areas for economic and environmental reasons (Yu et al., 2019). Urban and rural areas and, consequently, their economies are increasingly intertwined. Thus, economic relations and flows between urban and rural areas have led to many changes in rural and urban areas (Gao et al., 2020). In this regard, the interactions between village and city can be divided into two levels and examined: (a) Spatial interactions (such as flows of people, goods, money, information and waste); and (b) sectoral interactions of rural activities that take place in urban areas, such as urban agriculture with activities that are often classified as urban but take place in rural areas, such as industry and services.

The existence of rich wealth and economic resources in areas causes each region a specific economic context, and the performance of that region is also affected by the same economic context. In other words, the weaker the region in terms of economic resources and wealth, the spatial and sectoral relations between them are less prosperous, and the result of the interaction is weaker (Rezvani, 2002), as a result of economic urban–rural ties, capital and goods moves between them Cecilia Tuckley describes four types of correlations and connections: the flow of people, goods, waste and communications. Human flow includes patterns of migration that are mainly from rural to urban and sometimes from metropolitan areas to small towns and villages (Dobsen, 2007). The flow of goods also refers to market transactions that form the primary link between town and village. The flow of waste from urban to rural areas is a global phenomenon. Power generation and machinery are a few examples of the long list of waste streams that have turned many rural regions into bins for municipal waste. And communications refer to urban work done in rural areas, such as non-agricultural products and services and pastoral jobs done in urban areas, such as agriculture in urban areas (Haghighatian, 2013).

One of the crucial factors in the emergence and necessity of urban–rural communication is the over-production of agricultural products and livestock, which causes economic movement and flow between urban and rural areas, making the city's administrative, service and political functions inevitable (Liu, 2021). Rural-urban relations in the field of the regional economy, on the one hand, include the flow of agricultural products and other products from rural to urban markets and, on the other hand, pave the way for the flow of industrial goods from urban centres to rural settlements (Jamshed et al., 2021).

In this regard, information flow between rural and urban areas, knowledge of market mechanisms ranging from price fluctuations to consumer tastes and job opportunities for potential immigrants (Lubienski et al., 2022). Economically, there are three types of consumption, production and financial relations between rural and urban areas. Consumer relations are summarised by demand for final goods. These relationships exist everywhere. Production relations are the same, considering the past and present links for producing various goods and services between urban and rural areas. Financial ties are formed in different ways in urban–rural relations; for example, the payment of rent by villagers to landlords living in cities or the savings of villagers in banks and other urban institutions (Taqiloo & Abdullahi, 2013). There are different approaches to the relationship between city and village, one of which is the district-oriented view. This view, far from the common urban and rural prejudices, has believed in elements such as linking industry, agriculture, village and city and urban development. Regardless of the interrelationship, everyone finds it unattainable (Taherkhani et al., 2009).

Also, geographical study and theorising about city and village relationships are important in various economic and geographical schools (Mechaniky, 2011). From the nineteenth century in the school of 'historical materialism' and in the 20th century in the school of 'capital economics' and the geographical perspectives based on them, fundamental theories about the relationship between the village and its application in regional planning Central location, beneficial effects have

been published (Rafiei et al., 2021). According to these patterns, the city and the village are not only related to each other but also interdependent. According to these principles, complementary functions between settlements (including urban and rural) are necessary to establish a flow, so there are no fundamental differences between urban and rural. Still, they are two poles as a whole and in relationships (Sarafi & Taghizadeh, 2008).

Research Methodology

Research Design

A quantitative analysis based on a cross-sectional survey was performed to investigate the role of urban–rural economic relations on the development of rural settlements in Iran (Figure 1).
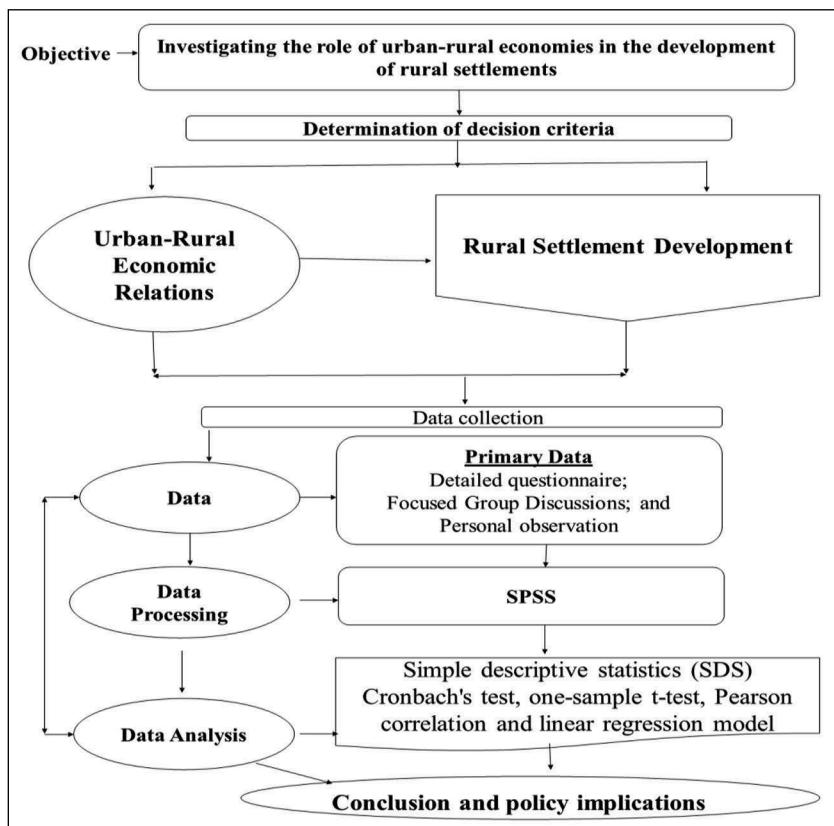

Figure 1. Flow Chart of Research Framework.

Data Collection

Primary and secondary data were collected for the present research work. A well-structured questionnaire is used to obtain primary data. The secondary sources are studies, journals, business magazines and published literature. The Statistical Package for the Social Sciences (SPSS) software, one-sample t-test, Pearson correlation and regression of variables were used to analyse the questionnaire data. The validity of the research has been confirmed using previous research and interviews with experts. The reliability of the research tool was also calculated through Cronbach's alpha 0.818, which indicates the appropriate reliability of the research tool. Seven variables have been used to examine the effects of economic relations. The statistical population studied here is the total population living in the village of Nalous district. At first, the sample size of 240 households was determined by the Cochran sampling method (Table 1). In the second stage, the share of each village according to the population ratio of each village to the whole community in terms of the number of households was determined (Table 2). A questionnaire was completed among the villagers.

The Study Area

Oshnavieh City is a mountainous and plain region located in the south of West Azerbaijan province and is the closest city to the centre of West Azerbaijan province (73 km). This city, with an area of 1187 square kilometres, is about 3.1% of the area (Figure 2). It occupies 2% of the population of West Azerbaijan
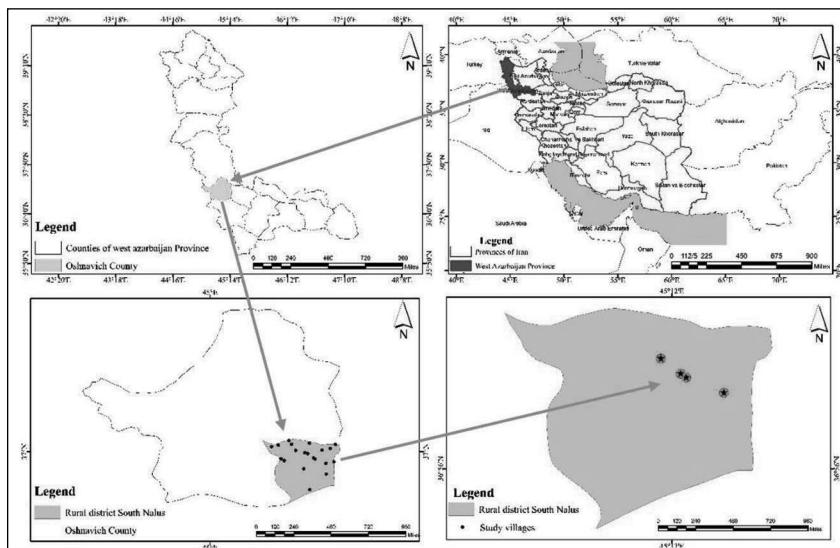

Figure 2. Location of the Study Area.

province. The city is located between 44 degrees and 45 minutes to 45 degrees and 17 minutes east longitude and 36 degrees and 53 minutes to 37 degrees and 17 minutes north latitude in terms of geographical coordinates and is 1520 metres above sea level. This city is connected to Naghadeh city from the east, Urmia city from the north and Piranshahr city from the south. It borders Turkey and Iraq. Oshnavieh city has two parts: central and Nalous) and four villages of northern Oshnavieh and Dasht-e-Bill in the central part and southern Oshnavieh and Haq in Nalous.

Table 1. The Total Number of Households and Sampled Households.

Sample Villages	Total Number of HH	Sampled HH
Balajer	119	60
QarahSaqal	38	19
Sarrjez	97	49
Dehshams	225	112
	479	240

Source: Statistics Center of Iran, 2021.

Note: HH: Household.

Table 2. The Extent of the Economic Relationship Between City and Village Regarding Residents and its Constructive Criteria.

Aspects	Mean	Std.	Sig.	
The degree of the economic relationship between the city and the village	2.54	0.456	0.00	
Communication flow-through financing	2.90	0.85	0.00	
Communication flow related to product marketing and sales	2.24	0.64	0.00	
The flow of rural investment in the economic activities of the city	2.84	0.72	0.00	Theoretical Average = 3
The flow of urban investment in the economic activities of the city	2.38	0.76	0.00	
Money exchange flow	2.34	0.739	0.00	
The flow of information, ideas and economic thoughts	2.10	0.593	0.00	
Migration rate	2.11	0.655	0.00	

Source: Calculation is based on primary data.

Result and Discussions

Analysis of the Urban–Rural Relationship

The study uses an experimental model comprising 21 indicators that were scaled in seven aspects. Then a one-sample t-test was formulated, which was used for the analysis. Therefore, the average economic relationship between the urban and rural areas was measured to be 2.54 on a scaling method, with a theoretical average of 3 (due to the use of five spectral questions). A village person's investment in the economy and communication flow has a dwindling pattern which is mediated by finance. Still, the other remaining aspects have a lower score than the overall average. Respectively, factors like the flow of ideas and economic thoughts and the rate of migration score 2.10 and 2.11. In the same way, the flow of money exchange, the flow of urban investment in the city's economic activities and the flow of communication, related to marketing and sales of products were placed in the lower ranks compared to the total average.

Economic Relationship Between City and Village According to its Constructive Criteria

The study encompasses a one-sample t-test to obtain the status of the urban–rural economic relationship in its various criteria (Table 3). In a comprehensive examination of the independent variables related to the theoretical average, the investments of Oshnavieh urban residents were highest in the rural agricultural activities with an average of 4.11 score. Meanwhile, the criteria of rural expenditure in urban industries have an average of 3.9, the amount of rural investments in urban services with an average score of 3.85, and the amount of urban investment in rural livestock and rural land and housing has 3.19 and 3.05 scores, respectively. Moreover, the income generated through the agriculture sector, individual consumption patterns and the diversity of rural products rate of rural migration are slightly higher than the average. Variables related to summer crops, cereals, horticulture and dairy, the buying and selling of handicraft materials, the amount of generated income and the expenses by the villagers from Oshnavieh city, the rate of consultation of villagers with urban dwellers regarding economic activities and the rate of migration of villagers to the city for economic reasons have received the lowest score.

The correlation techniques have been applied between the influencing factors and the economic relationship between urban and rural areas. According to the information obtained from the results of the Pearson test through SPSS software, Table 5 shows that, among the aspects of the research model, the investment flow in rural economic activities with a score of 0.800 and a significance level of 0.000 (the closer the number obtained from the correlation ratio 0 to 1, the stronger the correlation rate and the significance level to 0. The closer it is, the more significant it will be). Accordingly, this aspect has the highest correlation with the economic

Table 3. The Status of the Economic Relationship Between the City and the Village According to its Constructive Criteria.

Items	Mean	Std.	Sig.	Situation
The rate of use of financial income	3.53	1.03	0.00	High
The number of sales of its products (summer crops) in the city	2.26	1.11	0.00	Low
The number of sales of its products	1.92	0.981	0.00	Low
The number of sales of its products (garden) in the city	1.74	0.824	0.00	Low
Sales of your dairy products in the city	2.00	1.05	0.00	Low
Sales of your handicrafts in the city	3.30	1.17	0.00	High
The amount of your investment in the urban industries sector	3.58	1.01	0.00	High
How much you spend on urban industries	3.90	0.859	0.00	High
The amount of your investment in the municipal services sector	3.85	0.968	0.00	High
The amount of investment of Oshnavieh urban dwellers in rural agricultural activities	4.11	0.815	0.00	High
The amount of investment of Oshnavieh	1.84	0.818	0.00	Low
The amount of purchases of Oshnavieh city dwellers from handicrafts in the village	1.65	1.14	0.00	Low
The amount of investment of Oshnavieh urban dwellers in the livestock sector of the village	3.19	1.02	0.00	High
The amount of investment of urbanites in land and housing	3.05	1.10	0.00	High
The amount of financial income from the city	1.62	1.13	0.00	Low
The amount of money spent in the urban environment	1.59	0.801	0.00	Low
The effect of citizens' consumption patterns on the production and variety of rural products	2.57	0.780	0.00	Medium
The extent of consultation with urban dwellers regarding economic activities	2.15	1.07	0.00	Low
The rate of rural migration to the city for economic reasons	1.51	0.810	0.00	Low
The rate of migration of citizens to the village for economic reasons (tourism as a garden house)	2.71	1.10	0.00	Medium
Income from agriculture	2.99	0.859	0.00	Medium

Source: Calculation is based on primary data.

Table 4. Results of Pearson Correlation Statistical Method Between Urban and Rural Economic Factors.

Items	Pearson Correlation	Sig. (2-tailed)
Migration rate (mainly of economic origin)	0.439	0.000
Flow of information, ideas and economic thoughts	0.389	0.000
Money exchange flow	0.784	0.000
The flow of urban investment in the village	0.800	0.000
The flow of rural investment in the city	0.632	0.000
Communication flow related to product marketing and sales	0.712	0.000
Communication flow-through financing	0.714	0.000

Source: Calculation is based on primary data.

Table 5. Results of a Statistical Method of Regression of Variables.

Items	β-value	t-value	Sig.	Partial Correlation	Collinearity Statistics Tolerance	R^2 Value
Communication flow-through financing	0.465	9.575	0.000	0.708	0.833	$R^2 = 896$
Communication flow related to product marketing and sales	0.374	5.638	0.000	0.509	0.665	
The flow of villages' investment in the economic activities of the city	0.383	7.000	0.000	0.592	0.856	
Urban investment in rural economic activities	0.306	5.419	0.000	0.512	0.730	
Money exchange flow	0.280	1.562	0.000	0.162	0.120	
The flow of information, ideas and economic thoughts	0.340	6.547	0.000	0.566	0.996	
Migration rate (mainly of economic origin)	0.315	5.781	0.000	0.518	0.973	

Source: Calculation is based on primary data.

relations of urban and rural areas, the element of money exchange flow, with a correlation coefficient of 0.784. There is a correlation between the studied aspects and the research topic, communication flow-through financing, marketing and sales of products, with a correlation rate of 0.714 and 0.712, respectively, and a 0

significance level with a relatively strong correlation with the flow (Table 4). Economic aspects of urban and rural areas: rural investment flow in urban economic activities with a correlation coefficient of 0.632. In median correlation, the elements of information flow, ideas and economic thoughts, the migration rate (mainly of economic origin), with 0.389 and 0.439, respectively and a weak correlation with the primary research variable.

Rural Economic Development with Urban and Rural Exchange Flows

Also, according to the output of multivariate regression statistical analysis, it was found that the adjusted coefficient of determination for the variables included in the research model is equal to (R square = 0.896), which indicates that 89% of the variance and changes in rural economic development by The variables in the equation and the rest of these changes (10%) are derived from the dependent variables related to the cause of the effect of external factors and variables, which is known as the square of the error quantity 2e. In this study, communication flow variables through financing (0.465). Communication flow related to product marketing and sales (0.374). The flow of villagers' investment in the city's economic activities (0.383). Money exchange flow (0.280), the flow of information, ideas and economic thoughts (0.340). The migration rate, that is, mainly of economic origin (0.315), was identified as a factor affecting the economic development of rural areas. rural investment (0.306), money exchange (0.280), information flow (0.340), immigration rate (0.315) and financing (0.465) were obtained.

In general, based on the results obtained from linear regression, based on the level of significance and the standard beta coefficient of communication flow-through financing, the highest economic relationship between urban and rural areas, then the aspect of rural investment in urban economic activities. It has the largest share of the economic relationship between the city and the village, flows related to the retrieval and sale of products as well as the flow of information, the flow of urban investment in rural economic activities, economic ideas and thoughts in the next categories of economic communication Urban and rural areas are located. The migration rate has the least relationship with the economic relations of urban and rural areas in the study area. And the aspect of money exchange flow is rejected due to the significant level higher than the value of 05. This hypothesis of Ka's role in the flow of economic relationships is rejected.

Conclusion and Recommendations

Studies show that today cities and villages cannot be considered separately, as considerable actions are taken in relation to each other. It has always been proven that in order to study and plan for the impact of the city on the village and the village on the city, it is necessary to emphasise the points that establishing a

relationship between the city and the village, leads to the development of each of them. What is noteworthy in this regard is the importance of cities as centres of services and markets for agricultural products because, in these conditions, cities communicate with their sphere of influence through the transfer of agricultural surplus, unsustainable movement of human resources and labour and supply of consumer goods that may be useful and positive or, conversely, lead to the regression of rural areas.

In this case, its effects can be seen as increasing or decreasing the price of land and housing, land fragmentation, changes in land plots and deviation from agricultural jobs to service work. Meanwhile, the economic relations between the city and the village, as one of the essential current relations between these two settlements, have always played an influential role in the social and economic areas. The results of the present study showed that the financial relationship between urban and rural areas did not affect the economic and social dimensions of the villagers in the study area; among the aspects related to the study is the flow of rural investment in urban economic activities. Respondents believed that Oshnavieh urban residents' investment in rural agricultural activities was the most relevant among the variables affecting the studied factors.

The rate of rural migration to the city for economic reasons was the least appropriate. The correlation between the studied aspects of the economic relations in the region showed that the flow of urban investment in the city's financial activities had the highest correlation, and the flow of information, ideas and economic thoughts had the lowest correlation. It needs more variety. The results obtained differ from those of Sahneh et al. (2017). They stated that the relationship between the city and village in the Azarshahr region is effective in rural development. The research of Masoom et al. (2015), the result of Abbasi research that showed poor communication and more money flow to urban areas, which weakens the rural economy, is similar to the fact that most of the villagers living in the study area in the first part of the economy, namely agriculture. The main economic flows between the studied villages and the city of Oshnavieh are related to agricultural, horticultural and livestock activities.

Declaration of Conflicting Interests

Funding

References

Afrakhteh, H. (2001). Urban-rural relations, social and humanities. *Shiraz University*. *16*(20), 73–49.

Afrakhteh, H. (2012). Space economics and rural development (Case: Shaft Area). *Space Economics and Rural Development*, *1*(1), 39–54.

Alijani, Z., Hosseinali, F., & Biswas, A. (2020). Spatio-temporal evolution of agricultural land use change drivers: A case study from Chalous region, Iran. *Journal of Environmental Management*, *262*, 110326. https://doi.org/10.1016/j.jenvman.2020.110326

Beauregard, R. A. (2018). Cities in the urban age. In *Cities in the urban age*. University of Chicago Press.

Butsch, C., & Heinkel, S. B. (2020). Periurban transformations in the global south and their impact on water-based livelihoods. *Water*, *12*(2), 458. https://doi.org/10.3390/w12020458

Chen, K., Long, H., Liao, L., Tu, S., & Li, T. (2020). Land use transitions and urban-rural integrated development: Theoretical framework and China's evidence. *Land Use Policy*, *92*, 104465. https://doi.org/10.1016/j.landusepol.2020.104465

Clayton, B. D, Dent, D., & Dubois, O. (2005). *Rural planning in developing countries*. Earthscan Publication Ltd.

Crişan, E. L., Salanşă, I. I., Beleiu, I. N., Bordean, O. N., & Bunduchi, R. (2021). A systematic literature review on accelerators. *The Journal of Technology Transfer*, *46*(1), 62–89. https://doi.org/10.1007/s10961-019-09754-9

Des Roches, S., Brans, K. I., Lambert, M. R., Rivkin, L. R., Savage, A. M., Schell, C. J., Correa, C, Meester, L.D., Diamond, S.E., Grimm, N.B., Harris, N.C., Govaert, L., Hendry, A.P., Johnson, M.T.J., Munshi-South, J., Palkovacs, E.P., Szulkin, M., Urban, M.C., Verrelli, B.C., & Alberti, M. (2021). Socio-eco-evolutionary dynamics in cities. *Evolutionary Applications*, *14*(1), 248–267. https://doi.org/10.1111/eva.13065

Chen, C., LeGates, R., Zhao, M., & Fang, C. (2018). The changing rural-urban divide in China's megacities. *Cities*, *81*, 81–90. https://doi.org/10.1016/j.cities.2018.03.017

Fadaei, M., Rahmani, B., & Tavakolinia, J. (2021). Study of economic and social relations of Farsan City and its periphery villages. *Peripheral Urban Spaces Development*, *2*(2), 157–178. https://dx.doi.org/10.22067/JRRP.V10I4.2105.1012

Fanni, Z. (2006). Cities and urbanization in Iran after the Islamic revolution. *Cities*, *23*(6), 407–411. https://doi.org/10.1016/j.cities.2006.08.003

Friedland, R., & Boden, D. (2020). ONE. Now here: An introduction to space, time and modernity. In R. Friedland & D. Boden (Eds.), *NowHere : Space, time and modernity* (pp 1–60). University of California Press. https://doi.org/10.1525/9780520342095-002

Gao, Y., Shahab, S., & Ahmadpoor, N. (2020). Morphology of urban villages in China: A case study of Dayuan village in Guangzhou. *Urban Science*, *4*(2), 23. https://doi.org/10.3390/urbansci4020023

Golboni, F., Nadrian, H., Najafi, S., Shirzadi, S., & Mahmoodi, H. (2018). Urban–rural differences in health literacy and its determinants in Iran: A community-based study. *Australian Journal of Rural Health*, *26*(2), 98–105. https://doi.org/10.1111/ajr.12378

Guan, C., & Rowe, P. G. (2020). Multi-criteria locational analysis for retail development in small towns. In W. Wu, & Y. Wang (Eds.), *The geography of mobility, wellbeing and development in China* (1st ed, pp. 156–171). Routledge.

Haghighatian, M., & Omidi, M. (2013). Social relations in the city and the village (Case study: Semirom city). *Urban Sociological Studies*, *3*(7), 54–76.

Hesamyan, F., (2007). *Urbanization in Iran (urbanization in transition)* (5th ed). Agah (In Persian).

Hou, L., Wu, F., & Xie, X. (2020). The spatial characteristics and relationships between landscape pattern and ecosystem service value along an urban-rural gradient in Xi'an City, China. *Ecological Indicators*, *108*, 105720. https://doi.org/10.1016/j.ecolind.2019.105720

Jamshed, A., Birkmann, J., Feldmeyer, D., & Rana, I. A. (2020). A conceptual framework to understand the dynamics of rural–urban linkages for rural flood vulnerability. *Sustainability*, *12*(7), 2894. https://doi.org/10.3390/su12072894

Jamshed, A., Birkmann, J., McMillan, J. M., Rana, I. A., Feldmeyer, D., & Sauter, H. (2021). How do rural-urban linkages change after an extreme flood event? Empirical evidence from rural communities in Pakistan. *Science of the Total Environment*, *750*, 141462. https://doi.org/10.1016/j.scitotenv.2020.141462

Jarzębowski, S., Bourlakis, M., & Bezat-Jarzębowska, A. (2020). Short food supply chains (SFSC) as local and sustainable systems. *Sustainability*, *12*(11), 4715. https://doi.org/10.3390/su12114715

Jat, M. K., Garg, P. K., & Khare, D. (2008). Monitoring and modelling of urban sprawl using remote sensing and GIS techniques. *International Journal of Applied Earth Observation and Geoinformation*, *10*(1), 26–43. https://doi.org/10.1016/j.jag.2007.04.002

Kennedy, J. J., Thomas, J. W., & Glueck, P. (2001). Evolving forestry and rural development beliefs at midpoint and close of the 20th century. *Forest Policy and Economics*, *3*(1–2), 81–95.

Khaniki, H. (2014). Globalization and communications, theoretical backgrounds and perspectives. *Strategic Studies of Public Policy*, *4*(13), 6–33.

Khorrami, Z., Yarahmadi, S., Etemad, K., Khodakarim, S., Kameli, M. E., & Hazaveh, A. R. M. (2017). Urban-rural differences in the prevalence of self-reported diabetes and its risk factors: The WHO STEPS Iranian noncommunicable disease risk factor surveillance in 2011. *Iranian Journal of Medical Sciences*, *42*(5), 481–487.

Krayenhoff, E. S., Moustaoui, M., Broadbent, A. M., Gupta, V., & Georgescu, M. (2018). Diurnal interaction between urban expansion, climate change and adaptation in US cities. *Nature Climate Change*, *8*(12), 1097–1103. https://doi.org/10.1038/s41558-018-0320-9

Langroodi, S. H.M., Khosravimehr, H., & Toorani, A. (2015). The impact of urban-rural economic relation upon social economic status of rural settlements Case: Chehelcha district, Minoodasht. *Space Economy & Rural Development*, *3*(10), 19–42.

Li, Y., Westlund, H., & Liu, Y. (2019). Why some rural areas decline while some others not: An overview of rural evolution in the world. *Journal of Rural Studies*, *68*, 135–143. https://doi.org/10.1016/j.jrurstud.2019.03.003

Liu, Y. (2021) Research progress and practical enlightenment of urban–rural transformation. In *Urban-Rural Transformation Geography*. Sustainable Development Goals Series. Springer. https://link.springer.com/book/10.1007/978-981-16-4835-9

Lubienski, C., Perry, L. B., Kim, J., & Canbolat, Y. (2022). Market models and segregation: Examining mechanisms of student sorting. *Comparative Education*, *58*(1), 16–36. https://doi.org/10.1080/03050068.2021.201304

Madanipour, A., Shucksmith, M., & Brooks, E. (2022). The concept of spatial justice and the European Union's territorial cohesion. *European Planning Studies*, *30*(5), 807–824. https://doi.org/10.1080/09654313.2021.1928040

Masoom, M. Q., Cheraghi, M., & Rizvani, M. (2015). The effects of urban-rural economic relations on the security of rural households, Case: Zanjan city. *Quarterly Journal of Space Economics and Rural Development*, *4*(14), 69–85. http://dx.doi.org/10.18869/acadpub.serd.4.14.69

Maxwell, S. (1996). Food security: A post-modern perspective. *Food policy*, *21*(2), 155–170. https://doi.org/10.1016/0306-9192(95)00074-7

McCormack, G. R., Rock, M., Swanson, K., Burton, L., & Massolo, A. (2014). Physical activity patterns in urban neighbourhood parks: Insights from a multiple case study. *BMC Public Health*, *14*(1), 1–13. https://doi.org/10.1186/1471-2458-14-962

Mechaniky, J. (2011). Urban-rural social relations and demographic instability of rural Settlements. *Quarterly Journal of Khorasan Socio-Cultural Studies*, *3*(19).

Moeedfar, S., & Akbari., S. (2008). Relations between the village and the town and its effects on development. Journal of Geography, *Geographical Society of Iran*, *6*(17–18), 106–123. (In Persian)

Mumtaz, M. Z., & Smith, Z. A. (2021). The behavior of household finance on demographic characteristics in Pakistan. *Economic Research-Ekonomska Istraživanja*, *34*(1), 1409–1427. https://doi.org/10.1080/1331677X.2020.1825107

Nuttall, S., & Mbembe, J. A. (Eds.). (2008). *Johannesburg: the elusive metropolis*. Duke University Press.

Rafiei, M., Khatibi, S. M. R., & Davoodpour, Z. (2021). The explanation of the peri-urban concept and the factors affecting its creation and development. *The Monthly Scientific Journal of Bagh-e Nazar*, *17*(92), 33–56. https://doi.org/10.22034/bagh.2020.194075.4215

Rezvani, M. R. (2002). Analysis of patterns of urban-rural relations in rural areas around Tehran. *Geographical Research*, *43*, 81–94.

Rock, M. J., Degeling, C., Graham, T. M., Toohey, A. M., Rault, D., & McCormack, G. R. (2016). Public engagement and community participation in governing urban parks: A case study in changing and implementing a policy addressing off-leash dogs. *Critical Public Health*, *26*(5), 588–601. https://doi.org/10.1080/09581596.2016.1177635

Sahneh, B., Sadin, H., Neshat, A. S., & Talkhabi, H. R. (2017). The effects of city-village relations on economic and social developments in Azadshahr villages. *Space Economics and Rural Development*, *6*(21): 138–121.

Saidi, A., & Mikaniki, J. (2009). Transformation of urban and rural areas, with emphasis on economic activity. *Journal of Geography*, *Geographical Society of Iran*, *6*(17–18), 27–44. (In Persian).

Salazar, G., & González, P. (2021). New mobility paradigm and indigenous construction of places: Physical and symbolic mobility of Aymara groups in the urbanization process, Chile. *Sustainability*, *13*(8), 4382. https://doi.org/10.3390/su13084382

Sarrafi, M., & Taghizadeh, F. (2008). Regional network strategy: A framework for regional development in the country. *Earth Sciences Research*, *1*(1), 89–71.

Seif al-Dini, F (2011). *Specialized language of urban and regional planning*. Ayizh Publications.

Shahi, A., & Tabrizi, A. (2020). Iran's 2019–2020 demonstrations: the changing dynamics of political protests in Iran. *Asian Affairs*, *51*(1), 1–41. https://doi.org/10.1080/03068374.2020.1712889

Sheludkov, A., Kamp, J., & Müller, D. (2021). Decreasing labor intensity in agriculture and the accessibility of major cities shape the rural population decline in post socialist Russia. *Eurasian Geography and Economics*, *62*(4), 481–506. https://doi.org/10.1080/15387216.2020.1822751

Sheppard, E., Leitner, H., & Maringanti, A. (2013). Provincializing global urbanism: A manifesto. *Urban Geography*, *34*(7), 893–900.

Syhlonyk, A. (2016). *Communicating Change: Public Engagement, Intensification, and Urban Redevelopment* [Master's thesis]. University of Waterloo.

Tacoli, C. (1998). Rural-urban interactions: A guide to the literature. *Environment and Urbanization*, *10*(1), 147–166.

Taherkhani, Mehdi. R., Eftekhari, Abdoreza., & Taghvaee, Ali Akbar. (2009). Analysis on Effects of urban centers on peripheral settlements in Iran the case study of Qazvin Province. *International Journal of Humanities (The Journal of Humanities)*, *16*(2), 129–146. https://sid.ir/paper/78288/en

Taqiloo, A,A., & Abdullahi, A. (2013). Agricultural development with emphasis on urban-rural relations (Case study: West Azerbaijan province). *Space Economics and Rural Development*, *1*, 50–29.

Wang, Y., Li, Y., Huang, Y., Yi, C., & Ren, J. (2020). Housing wealth inequality in China: An urban-rural comparison. *Cities*, *96*, 102428. https://doi.org/10.1016/j.cities.2019.102428

Wu, J., & Haasis, H. D. (2018). The freight village as a pathway to sustainable agricultural products logistics in China. *Journal of Cleaner Production*, *196*, 1227–1238. https://doi.org/10.1016/j.jclepro.2018.06.077

Xia, C., Zhang, A., & Yeh, A. G. (2022). The varying relationships between multidimensional urban form and urban vitality in Chinese megacities: Insights from a comparative analysis. *Annals of the American Association of Geographers*, *112*(1), 141–166. https://doi.org/10.1080/24694452.2021.1919502

Xue, J. (2014). Is eco-village/urban village the future of a degrowth society? An urban planner's perspective. *Ecological Economics*, *105*, 130–138. https://doi.org/10.1016/j.ecolecon.2014.06.003

Yu, T. W.A., Wu, Y., Zheng, B., Zhang, X., & Shen, L. (2014). Identifying risk factors of urban-rural conflict in urbanization: A case of China. *Habitat International*, *44*, 177–185. https://doi.org/10.1016/j.habitatint.2014.06.007

Yu, L., Xie, B., & Chan, E. H. (2019). Exploring impacts of the built environment on transit travel: Distance, time and mode choice, for urban villages in Shenzhen, China. *Transportation Research Part E: Logistics and Transportation Review*, *132*, 57–71. https://doi.org/10.1016/j.tre.2019.11.004

Zavratnik, V., Podjed, D., Trilar, J., Hlebec, N., Kos, A., & Stojmenova Duh, E. (2020). Sustainable and community-centred development of smart cities and villages. *Sustainability*, *12*(10), 3961. https://doi.org/10.3390/su12103961

Zhou, D., Bonafoni, S., Zhang, L., & Wang, R. (2018). Remote sensing of the urban heat island effect in a highly populated urban agglomeration area in East China. *Science of the Total Environment*, *628*, 415–429. https://doi.org/10.1016/j.scitotenv.2018.02.074

Zhou, Y., Li, X., & Liu, Y. (2020). Rural land system reforms in China: History, issues, measures and prospects. *Land Use Policy*, *91*, 104330. https://doi.org/10.1016/j.landusepol.2019.104330

An Empirical Study on Rural Non-farm Employment in Developing and Urbanised Regions of Maharashtra, India

Shuchi Benara Misra[1]

Abstract

Maharashtra accounts for a meagre share of employment in the rural non-farm sector compared to the other states. There is a high degree of disparity in the socio-economic development, level of urbanisation and social infrastructure in Maharashtra, due to which there are differences in the factors affecting participation in rural non-farm employment (RNFE) across the different regions in the state. An empirical study of Kadam Wak Wasti village in the Pune district in Maharashtra reveals that rural men dominate RNFE while rural women are engaged in the farm sector. The service sector accounts for the majority of RNFE in the village. The casual nature of non-farm employment dominated the sector. The educated and skilled individuals in the village were engaged in RNFE, while most of the landless and uneducated individuals were confined to the farm sector. Agricultural labour was considered the last resort due to low wages and a lack of required skills. Thus, urbanisation and proximity to an urban area positively impact the growth of RNFE, affirming that the growth of RNFE in the developing and urbanised regions of the state is due to pull or growth-induced factors.

Keywords

Development, regional, employment, rural, non-farm sector

Symbiosis School of Economics, Symbiosis International University (Deemed University), Pune, Maharashtra, India

Corresponding author:
Shuchi Benara Misra, Symbiosis School of Economics, Symbiosis International University (Deemed University), Pune, Maharashtra 411004, India.
E-mail: shuchi.misra@gmail.com

Introduction

In the context of the structural transformation of the Indian economy and the generation of additional employment opportunities for the growing rural population, the rural non-farm sector (RNFS) has emerged as a viable option. Factors like gender, age, level of education, asset ownership, household size, social group and location play an important role in determining access to various non-farm employment activities. Several all-India and state-level studies have been conducted to identify whether the diversification towards rural non-farm employment (RNFE) is distress or demand-induced. These studies have also examined the role of regional disparities in urbanisation, availability of rural infrastructure, etc., affecting access to various RNFE opportunities (Coppard, 2001; Singh, 2006). Literature (Shukla, 1991, 1992; Unni, 1991, 1996; Singh, 1994; Mukherjee & Zhang, 2005) suggests that the growth of agriculture stimulates the growth and development of RNFS. Haggblade et al. (2010) put forth that the composition and growth of RNFE differ in zones with growing agricultural productivity and those with stagnant rural settings. They revealed that prospects of RNFE growth are brightest in well-connected rural regions in developing countries with rapidly growing agricultural and national economies. On the contrary, the prospects are least favourable in the backward regions of developing countries. Jha (2006) argued that the growth of 'income-infusing activities' like agriculture, manufacturing and tourism leads to growth-induced diversification, and the dearth of these activities leads to distress-driven diversification.

Maharashtra is one of the lowest-ranking states in India in the level of employment in RNFS, where RNFE increased from 20.6 per cent in 1993–94 to 29 per cent in 2018–19, followed by a decline to 25 per cent in 2019–20, which is below all India level of 38.5 per cent in 2019–20. The state has a high degree of disparity in the socio-economic development and level of urbanisation; hence, regional variations have been observed in the growth of RNFE in the state. The growth of RNFE is skewed toward the districts of the better-developed Inland Western and coastal regions compared to the districts of the lesser-developed regions like Eastern, Inland Eastern and Inland Central. Both pull and push factors affect this pattern of RNFE growth in different regions. Pull factors are responsible for the growth of RNFE in better-developed regions of the state.

Considering the above facts, the present study attempts to bring out some regional variations in the growth of RNFE within the state and endeavours to evaluate the RNFE scenario in the developing and urbanised regions of the state, based on a primary survey of Kadam Wak Wasti village in Pune district in Maharashtra conducted in October–December 2019.

Data and Methodology

Based on the findings from National Sample Survey Office data, the Pune district was selected in the Inland Western region since it accounted for the maximum number of rural non-farm workers in the entire period under study, even though

this has shown a decreasing trend. However, Solapur district ranks second, and in 2009–10 it accounted for the same percentage of workers in RNFS in the state as Pune. Proximity to industrial areas indicates development and access to diverse employment opportunities. It increases the number of job opportunities available to rural workers and allows them to opt for employment outside agriculture without shifting their base to urban areas. Therefore, within the Pune district, those villages on the Pune-Solapur highway were selected that had proximity to industrial areas. Therefore, Kadam Wak Wasti was selected for this study due to its nearness to the Hadapsar industrial area and Fursungi.

Data and the desired information regarding the household, demographic characteristics of the working members, education levels, employment status, etc., were collected from 150 households using a questionnaire. A focus group discussion was held with the Gram Sevak/the Village Development Officer and other members of the Gram Panchayat of Kadam Wak Wasti to get the desired information about the village economy, available infrastructural facilities, income-generating activities, the role of NGOs and Gram-Panchayat, etc. Literature (Wandschneider, 2003; Ranjan, 2009) shows that land ownership patterns impact access to employment in RNFS; therefore, a stratified random sample based on land ownership for 150 households was considered for this study. The Gram Sevak gave data on land ownership patterns in the village from the records of the Gram Panchayat. The study was carried out from October to December 2019.

Results and Discussions

The village Kadam Wak Wasti comes under Haveli block and is located on the Pune-Solapur highway, eight km from the Pune Municipal Corporation boundary. According to Census 2011, the village population has more than doubled in the last 10 years. This increase in the village population is mainly due to migration from the villages of Osmanabad, Latur, Ahmednagar and other less-developed districts of the state. The village mainly gets canal water for irrigation from the Khadakwasla dam and the Mula-Mutha River. The village produces commercial crops like sugarcane and vegetables; flowers like aster, jasmine, rose, mogra; groundnut and soya bean; and fruits like pomegranate, guava and banana. Dairy farming, especially poultry, is also practised. The village's proximity to Pune city, Hadapsar industrial estate, Fursungi and other local manufacturing industries is advantageous (Source: Records of Gram Sewak).

The basic data mentioned below were collected to understand the general infrastructure situation of the village in terms of facilities like roads, schools, hospitals, markets, power, etc., and the population distribution.

Infrastructure and Livelihood Assets

The village is about eight km. East of Pune city and is well connected by Pune-Solapur highway, NH-9, to Pune city and its neighbouring districts. Nearness to

the National Highway provides bus connectivity to this village. The village also has rail connectivity, and the railway station at Loni Kalbhor (within one km.) connects the village to various other towns and cities of the state.

The village has four primary government schools, two middle, two upper primary schools and one higher secondary school that are privately run. All these schools are within one km. of the village and provide English and Marathi medium education. MIT Institute of Design is within two km of the village. It should be noted that the village has a sound availability of general education. Gram Panchayat is actively involved in providing vocational training to the villagers. There are three maternity nursing homes and three private hospitals in and around the village. At the same time, one Primary Health Sub-Center must be fully operational in the village due to the need for proper infrastructure.

The village has bank branches of Union Bank of India, Bank of India, Bank of Maharashtra, Bank of Maharashtra Gramin and Pune District Central Co-operative Bank for farmers. A group discussion with the villagers found that they need help availing credit from formal banking institutions as they cannot satisfy the official criterion to avail of loan facilities; the need for more information about various loan-related schemes and complicated procedures also demotivates them. Lack of regular jobs and inability to provide a guarantor are the main constraints in availing of formal credit. However, with the introduction of Self-help groups (SHG), several women are now availing of credit at a low-interest rate as and when required. Gram Panchayat also played a crucial role in facilitating credit to rural women through a scheme where a loan of up to five lacks was provided at zero per cent interest rate if the women took up vocational training in sewing or beauty parlour course or any other course mutually decided by the women and gram panchayat. The village is well electrified through Maharashtra State Electricity Board and has almost 24 hours power supply. Water for irrigation and other domestic use is very well available.

Agriculture and Allied Activities

Agriculture plays an important role in the village economy. The village mainly cultivates sugarcane, vegetables and flowers like aster, jasmine, rose, mogra; ground nuts, soya bean; and fruits like pomegranate, guava and banana. Due to the proper availability of irrigational facilities, cultivation of commercial crops is preferred over traditional crops as the former fetch higher returns. Sugarcane is the main commercial crop of this village, and proximity to Yashwant Sahakari Sakhar Karkhana is an advantage. Dairy farming, especially poultry, is also practised in the village, and there are buffalo and cattle sheds. Dairy is a profitable option and has lucrative prospects in the future. Milk and other by-products are sold on small-scale within the village and in the nearby markets.

Most of the households were landowners, especially marginal and small landowners. About 93 households in the village were identified as landless (Census, 2011, from the records of Gram Panchayat). From the survey, it was observed that the ones who owned land preferred cultivation. However, marginal

and small landowners preferred to lease their land to bigger landowners and took up non-farm jobs. Households mainly did self-employment in agriculture with medium and large lands and agricultural labour was mainly taken up by landless households and individuals without any education, especially women.

The survey results revealed that from 150 households, 380 men and women were employed as UPSS workers in the 15–59 age group. From this, 166 individuals (44 per cent) were engaged in the farm sector, that is, agriculture and allied activities, and 214 individuals (56 per cent) were engaged in the non-farm sector (Table 1). A gender-wise distribution of workers within these sectors (Table 2) reveals that male workers dominate the non-farm sector. In contrast, most female workers were engaged in the farm sector.

Within the farm sector, 47 were self-employed in agriculture, five were in dairy farming, 11 women as self-employed in the household enterprise, and the remaining 114 individuals were agricultural labourers on other's farms. The dominance of women as agricultural labourers was evident as 65 out of 114 were women labourers. The wages in the farm sector were as low as Rs.180–230 per day, and this option was taken up totally out of economic compulsion.

Rural Non-farm Activities

Agriculture dominated village employment till the last decade. However, with the development of the area in and around Pune city, various non-farm activities, especially employment in the construction sector, had seen a boom in the last seven-eight years. The main non-farm activities in which the people from this village were involved were casual labour on construction sites, wage labour in local industries, porters at the Loni Kalbhor railway station, and transport. The villagers preferred employment in the non-farm sector due to better daily market wages (Rs. 300–350 per day) compared to the farm sector (Rs.180–230 per day, as reported by the respondents). People from this village preferred to work outside

Table 1. Results of the Primary Survey UPSS Workers in 15–59 years//Oct–Dec 2019.

Number of Households	Total No. of Individuals				
	Male	Female	Total	Farm	Non-farm
150	251	129	380	166(44%)	214 (56%)

Source: Compiled from primary data.

Table 2. Gender-wise Distribution of UPSS Workers in 15-59 years//Oct–Dec 2019.

Sector	Male	Female
Farm	90	76
Non-Farm	161	53
Total	251	129

Source: Compiled from primary data.

National Rural Employment Guarantee Act due to the lower per-day wages offered in the scheme compared to other non-farm employment options, while it involved much physical effort.

Interestingly, the migrant population mainly took up non-farm employment; however, the local people preferred cultivating their farms. It was found that most of these migrants were small farm owners in their native villages, mainly Osmanabad, Latur, Bid, Ahmednagar, etc., and had leased them out for cultivation. However, they preferred to shift to Kadam Wak Wasti due to better employment opportunities in the non-farm sector and better education for their children.

Primary data revealed that the non-farm sector dominated rural employment in this village. Of the 214 respondents employed in this sector, 43 were self-employed, 40 were salaried, and the maximum chunk of workers, that is, 131, were employed as casual wage labour (Table 3).

Self-employment was mainly dominated by men who owned grocery shops (eight), tea stalls (six), vegetables and fruit vendors (eight), repair works (five), masonry (four) and pan shops (three). Women were mainly engaged in tailoring (four), ran their beauty parlour (three) and grocery shops, and engaged in selling vegetables and other agricultural produce (two). Salaried jobs mainly included drivers (nine), clerks (seven), office boys (11), and housekeeping staff in housing societies in Hadapsar (seven men + six women). Casual wage workers were engaged as porters at the railway station to lift cement and other heavy goods from the goods train (23), construction site (49 men + 25 women), and various local factories (21 men + 13 women).

Construction: The construction sector has seen a boom in recent years in and around the Hadapsar area and Fursungi leading to the requirement of many casual wage labourers.

Local manufacturing industries - Cement factory, Porwal Foods, Sarda oil mill, Yashwant Sahakari Sakhar Karkhana in Theur, Plant shampoo and soap mill, Rajendra Petro Chemicals, and Vishay Electronics, formerly Phillips, absorbed several villagers as wage labourers. The better-educated individuals were employed as clerks and office boys in these factories.

Services: Some village men were employed as drivers and housekeeping staff in the nearby housing societies and were salaried employees.

Business: The villagers largely relate to grocery and vending shops as village business activities.

Table 3. Employment Status of the Respondents//Oct-Dec 2019.

Employment Status of Workers	Farm			Non–Farm		
	Male	Female	Total	Male	Female	Total
Self-employed	41	11	52	34	9	43
Regular/Salaried	-	-	-	34	6	40
Casual wage labour	49	65	114	93	38	131
Total	90	76	166	161	53	214

Source: Compiled from primary data.

Women from below-poverty households sold items like vegetables, stationery, and cooking items such as mustard oil, mustard, dry chilli, etc. The better-skilled women were involved in tailoring and as beauticians. An alternate activity identified by the villagers is the running of small 'hotels' (which means selling cooked foods). There are two, but villagers rarely use them: they are close to the highway and used by passengers and travellers.

Local governance and role of SHGs - The village comes under Kadam Wak Wasti Gram Panchayat, which has its office on Pune-Solapur Road. The panchayat plays a very important role in the village. It looks after the housing conditions of the villagers and facilitates credit to them at easy terms and conditions. The panchayat has proactively provided credit to rural women at a zero per cent interest rate under the condition that they had to undergo a vocational training program. This task taken up by the panchayat indicates their active participation in the skill development of women of this village.

Encouraging Factors for RNFE

Cultivation was remunerative, however marginal, and small landowners took up non-farm jobs due to better opportunities and higher wages in the non-farm sector. Proximity to the Pune city, its thriving market base, and road and rail connectivity were the major advantages for RNFE growth in the village. Some non-farm activities (especially the hotels, betel and grocery shops) are strategically located to avail maximum benefit from the bus stop and passing traffic. So, they are functional not only on weekdays but also on weekends. Again, proper road connectivity enables the villagers' good access to urban markets to get raw materials and accessories for the enterprise. Rail connectivity enables the villagers to travel to Lonavala, Daund and Baramati for work.

Proximity to a thriving market base promotes various economic activities, whether agricultural or non-farm. The village is about eight km from Pune city. The villagers find a wider marketing network to sell village-level goods. Interaction with other traders and urban consumers automatically gives them good exposure resulting in widening their marketing and entrepreneurship knowledge.

Increase in peoples' demand: With the modern sector reaching out to the villagers and making its way into the village economy, the needs and activities of people have diversified, thus increasing their demands. The active role of Gram Panchayat in facilitating skill development and providing credit facilities, especially to women.

Constraints for RNFE

Discussions with villagers unveiled the limitations of the need for more development of non-farm activities in the village. Accessing bank loans with a

low-interest rate relative to other informal loan facilities and poor saving capacity is a hurdle to starting new income-generating activities. This hampers financing for their children's higher education.

Education is one of the most important factors required for improvement and increasing involvement in Non-farm activities (NFA). There are primary, secondary, and higher secondary schools in the village. However, the quality of education imparted is the biggest concern. Institutions for technical and higher education are available in Pune city; however, the high cost of this education is a major constraint. Low-skilled non-farm jobs are easily available, but a lack of higher education is a barrier to getting better-paying, high-skilled, and regular non-farm jobs.

There was a need for more information about the skills required for various non-farm jobs available. If the villagers are more informed about the type of labour demanded, acquiring such skills and getting better employment would be easier.

Conclusion

The village appeared to be highly influenced by the urbanisation of the nearby areas. Access to infrastructure facilities and better road and rail connectivity are the main reasons for this village's high percentage of RNFE. These findings are supported by the literature (Unni, 1991; Papola, 1992; Eapen, 1994; Gordon & Craig, 2001; Singh, 2006; Haggblade et al., 2010) that urbanisation and proximity to an urban area has a positive impact on the growth of RNFE and concludes that growth of RNFE in the developed and urbanised regions of the state is due to pull factors. However, with the PMC extending its limit up to the villages of Hadapsar and Fursungi, Kadam Wak Wasti village is bound to experience growth of rural NFAs due to its proximity to Pune city.

The study has helped bring out relevant issues; some specific areas need to be noticed due to the limited sample size of this ongoing study. Nonetheless, the study does address relevant features of employment in RNFS. Currently, employment in RNFS would help increase employment opportunities within rural areas and stop the out-migration of rural people to urban areas in search of better livelihoods.

References

Census (2011) Official Website. (n.d). http://censusindia.gov.in/

Coppard, D. (2001). *The rural non-farm economy in India: A review of the literature*. NRI Report No. 2662. http://projects.nri.org/rnfe/pub/papers/2662.pdf

Eapen, M. (1994). Rural non-agricultural employment in Kerala: Some emerging trends. *Economic and Political Weekly*, *29*(21), 1285–1296.

Gordon, A., & Criag, C. (2001). Rural non-farm activities and poverty alleviation in sub-Saharan Africa. *NRI Policy Series 14*. http://www.nri.org/search/34%20gordon-a

Haggblade, S., Hazell, P., & Reardon, T. (2010). The rural non-farm economy: Prospects for growth and poverty reduction. *World Development*, *38*(10), 1429–1441. http://www.sciencedirect.com/science/article/pii/S0305750X10000963

Jha, B. (2006). *Rural non-farm employment in India: Macro-trends, micro-evidences and policy options*. (Working Paper No. 267). Institute of Economic Growth website http://iegindia.org/workpap/wp267.pdf

Mukherjee, A., & Zhang, X. (2005). *Rural non-farm development in China and India: The role of policies and institutions*. (DSGD Discussion Paper No. 24). IFPRI website http://www.ifpri.org/publication/rural-non-farm-development-china-and-india

Papola, T.S. (1992). Rural non-farm employment: An assessment of recent trends. *The Indian Journal of Labour Economics*, *35*(3), 238–245.

Ranjan, S. (2009). Growth of rural non-farm employment in Uttar Pradesh: Reflections from recent data. *Economic and Political Weekly*, *44*(4), 63–70.

Shukla, V. (1991). Rural non-farm activity: A regional model and its empirical application to Maharashtra. *Economic and Political Weekly*, *26*(45), 2587–2595.

Shukla, V. (1992). Rural non-farm employment in India: Issues and policy. *Economic and Political Weekly*, *27*(28), 1477–1488.

Singh, A.K. (1994). Changes in the structure of rural workforce in Uttar Pradesh. In Visaria, P., & Basant, R. (Eds.), *Non-Agricultural Employment in India: Trends and Prospects*. Sage Publications.

Singh, S.P. (2006). Rural non-farm employment in Uttar Pradesh: Determinants, dimensions and regional pattern. *The Indian Journal of Labour Economics*, *49*(4), 871–890.

Unni, J. (1991). Regional variations in rural non-agricultural employment: An exploratory analysis. *Economic and Political Weekly*, *26*(3), 109–122.

Wandschneider, T. (2003). *Determinants of access to rural non-farm employment: Evidences from Africa, South Asia and transition economies*. NRI Report No. 2758. http://projects.nri.org/rnfe/pub/papers/2758.pdf

Marine Fishing Community in South India and Impacts of Technological Transformation

Dalibandhu Pukkalla[1] and K. R. Rama Mohan[2]

Abstract

Over the past two decades, India's marine fisheries sector has experienced significant changes. Adopting various technological interventions has brought substantial changes to the everyday social life of fishing communities, affecting their economic and social well-being. This article provides an ethnographic analysis of how modernized fishing practices have impacted the industry and people's lives. It is also observed how, partly as a result changing marine ecological conditions introduced further coping mechanisms and adaptive livelihood practices in this fishing community, including gender-based changes. This article articulated recent technological innovations which have led to economic and livelihood distress in small-scale fisheries. There should be a balanced and smooth way of shifting towards these modern technologies, not at the cost of their invaluable knowledge systems and practices, which must be included.

Keywords

Economy of fishing, food security, livelihoods, marine ecology, mechanisation of fishing

Introduction

Marine fishing has long been a significant industry in India, supporting and sustaining large marine fishing communities and substantial local populations that depend on such fishing activities more indirectly. Fish and fish products have

[1]Anthropological Survey of India, Southern Regional Centre, Mysore, Karnataka, India
[2]Department of Anthropology, Sikkim University, Gangtok, Sikkim, India

Corresponding author:
Dalibandhu Pukkalla, Anthropological Survey of India, Southern Regional Centre, Mysuru, Karnataka 570006, India.
E-mail: anthrodali@uohyd.ac.in

contributed to food security and national income growth in India. Fish exports significantly contribute to India's rising national income, providing a considerable share (Ramaiah & Rajanikanth, 2013; Handbook on Fisheries Statistics, 2018). However, marine fishing is considered a risky and potentially dangerous activity and occupational engagement, especially when compared with land-based occupational activities, including river-based fishing. Despite their economic importance to the national economy, people in the marine fishing communities are generally considered socially excluded, partly due to their inferior social status in the social fabric of Indian society. Unfortunately, most fishing communities in India lag in the socioeconomic developmental process compared with other marginalised groups. Particularly against economic liberalisation in the past three decades, examining how such fishing communities have adapted to India's rapid economic development and social transformation is pertinent. Given the marginalisation and vulnerability of these fishing communities, it is vital to understand the evolving conditions of their developmental processes along with their improved technological adoption.

This study draws connections between adopting new technologies in marine fishing, issues of marine ecology and socio-cultural changes in India's marine fishing communities. The study mainly investigates the impact of motorisation and mechanisation of marine fisheries on the fishermen and their role in the changing socio-economic development of fishing communities. It is observed that this modernisation process has, to some extent, resulted in the gradual erosion of fishermen's local knowledge practices, along with changing gender roles and modifications in the division of labour and shifts in the modes of fishing activities.

Marine fishing activity is based on collective endeavours and needs well-organised human and infrastructural resources for successful fishing expeditions. The motorisation of fishing activities has reduced the need for a large workforce and traditional fishing skills and knowledge during fishing expeditions. It has also led local fishermen to explore deep-sea fishing. As a result, local knowledge systems have been changing, including the operation of various mechanisms of boat handling, casting nets, hooks and lines for catching fish on a larger scale than before.

The fishermen earlier depended on acquired local knowledge, which was transmitted from their forefathers. In the pre-motorisation process, there was much transmission of cultural ethos transmitted orally during fishing expeditions and activities, which includes songs, myths, and stories of their local legends, passed on to their younger generation as part of the whole fishing activity since traditional fishing is a laborious occupational process spanning generations. Until recently, this type of intangible cultural transmission has been dwarfed due to the sophistication of occupational activities, which does not require more extended periods spent on and off the shores.

This study seeks to capture those tangible and intangible changes through ethnographic fieldwork conducted in 2017–19. The study presents a brief overview of existing literature and discusses the contexts and methods of the field study. The primary aspect of the study is composed of the number of essential case studies and the field data reflecting the various changes observed.

Literature Review

Some studies have provided details on the impact of new technologies in the fishing sector, which became an intervening factor in the changing social and cultural dynamics that affect marine livelihoods. The technological impact on fishing communities raised their socio-economic development somewhat, but not all changes have been positive. The connections between the dynamics of fishing livelihood, ecology, economy and technology of the fishing communities are covered in the literature (Dalibandhu & Rama Mohan, 2021; Guijarro et al., 2017; Hoeppe, 2007; Mathur, 2008; Madhanagopal & Pattanaik, 2019; Whitmarsh 1990; Ramanaiah, 2006; Schoembucher, 1988). The changing livelihood patterns and adoption of new technologies have also resulted in changing cultural characteristics that have enhanced these communities' social and economic well-being. Further, these changes are not only limited to socio-economic transformations. However, they are also affecting gender roles in marine fishing and related activities, such as the management of marine common property resources and the utilization and skills of fishing techniques (George, 2011; Gulati, 1984; Hapke, 1996, 2001; Prasada Rao & Kumar, 1984; Ramanaiah, 2006; Ramenzoni, 2017; Srivastava et al., 1986).

The fishermen interviewed for this study noted that after adopting modern technology for fishing, the changing patterns of fishing activities and fishing style also became a contributory factor for and intervened in the social and economic development processes. After adopting modern fishing activities, specific role performances also changed in the fishing community, and local people are aware of that. Hence, the technological transformations helped them to view their economic prosperity and social mobility in a partly critical light. Significantly, it also expressed that adopting motorisation or mechanisation of fishing and employing modern fishing methods led to overfishing. This reflects connections between the global dimensions and local conditions. The fishermen realise that these methods are becoming a threat to the marine ecological conditions, which also affect the livelihoods of their local marine fishing communities, which compete with larger operators further out in the sea. To compete with these commercialised large-sized fishing trawlers, the local fishing communities have started using outboard motors for their small-sized boats.

Thus, it is visible that in the process of globalisation, technological interventions in the fishing sector have affected the fishing economy in ways that partly increase the economic vulnerability of these fishing communities. This global technological transformation that also brought changes in the local fishing sector paved the way for reflection and considering new modes of adaptation in the social processes observed within this community. Here, the rising concerns over marine ecological niches and ecological adaptations offer significant scope to understand local perceptions about the community's livelihood after adopting motorisation and mechanisation of fishing (Kodanda Rao, 1991). Furthermore, it is notable for comprehending how, after the shift from traditional fishing to modern fishing with the help of motorboats, community members explored maritime modes of

production through the marine common property resources among the fishing communities (Schoembucher, 1988).

While some existing studies explored how these communities have embraced the mechanisation of fishing activities for and against their well-being, the present study investigates the social context of motorisation or mechanisation of fishing. This has an instrumental role in social and economic well-being (Kurien & Willmann, 1982; Hapke, 2001; Ota, 2006; Ramanaiah, 2006; George, 2011), and the focus of the present study is on the local patterns of adaptation in marine fishing community.

Context and Methods of the Study

Several studies on marine fishing communities have highlighted the broad socio-cultural dimensions and their relationship with livelihood patterns of Coastal Andhra Pradesh (Kodanda Rao, 1990; Nuckolls, 1996; Sridevi, 1989; Suryanarayana, 1977). The present study is based on the Jalari, a Telugu-speaking fishing caste in Peda Jalaripeta village in the Visakhapatnam district of Andhra Pradesh in India. This study is an ethnographic endeavour to conceptualise technology's implications in occupational activities and social life.

The data was collected regularly from 2017 to 2019 using in-depth interviews, case studies, and focus group discussions. The primary strategy adopted was to use case studies based on daily social conversations, excerpts from which are presented in this article. This explains how the adoption of modern technology brought changes that have impacted various ways of the social life of this fishing community. Focus group discussions were conducted to comprehend the utilisation of local knowledge practices during fishing expeditions by motorised boats. The research study is an ethnographic endeavour to elicit information on how local knowledge practices are still relevant to the current context of modern fishery livelihoods. In-depth interviews were conducted with community members to understand the role of technological adoption, especially clarifying to what extent motorisation of fishing was perceived to have impacted marine ecological conditions. To reiterate, the purpose of this research study was to unravel how these technological interventions are bringing significant changes in the livelihood dynamics of this community after the adoption of motorised fishing in the studied village.

Findings from Case Studies: Perceptions and Realities

Fishermen strongly believed that the motorisation and mechanisation of fishing had burdened the marine community's livelihoods. In earlier times, the fishermen used only a single variety of nets to catch various fish. After the rise of new technological innovations and an increasing industrialisation process in the fishing sector, boats with motor engines, suitable nets, hooks and lines, and

ready-made plastic fish toys are introduced into this sector for catching more fish. This drastically affected traditional fishing practices, which are on the brink of extinction. Furthermore, the fishermen believed that changes brought in traditional fishing practices and the mode of fishing activity after the engagement of modern fishing methods and technology. Using nylon nets and plastic items for fishing and leaking diesel particles from the shipping vessels into the seawater augment the disease/fatality of fish varieties and other valuable marine species.

Additionally, the accumulation of such toxic materials in the sea further affects living organisms' behaviour and reproduction systems. The informants stated that the present technology poses an immeasurable threat to marine ecology and the communities that depend exclusively on marine fishing livelihoods. In this changing scenario, it is believed that there is an urgent need for sustainable and eco-friendly technological innovations, which are essential to sustain healthy marine conservation to promote food security in the times to come. The study analyses to what extent this is practised, and the apprehensions about marine ecological damage which can hamper fishermen's occupational returns are discussed at length.

The field narratives from the informants revealed that motorisation and mechanisation had positive and negative consequences on marine fishing practices. Fishermen agreed about the positive aspects that have been noticed after adopting motorboats. These impacts include enhancing economic conditions, exploring deep-sea fishing and travelling long distances in the sea, and bringing higher catch with suitable nets for different fish varieties. The new technologies have also brought less dependency on weather conditions, reduced working hours, and led to innovative navigation skills. The increased catches have also increased outside wider social networks. However, the negative consequences include increased indebtedness to fishing communities because of the need for investment in expensive fishing equipment and the possibility of new occupational health risks. Increased frequent motor engine failures during extended fishing expeditions pose unique risks and may lead to occupational injuries, resulting in fishermen's deterioration of health. The slow and gradual erosion of local knowledge of the fishermen was also indicated as a negative consequence of these innovations in their traditional occupational process. Notwithstanding the financial gains with reduced time and physical efforts, fishermen expressed that traditional fishing is better than intensive motor-based mechanised boat fishing.

Case 1

Appanna (53) believes that *samudram nellu mandula panicesidi* [seawater works as medicine]. While taking a bath or a dip in the sea after fishing expeditions, seawater supports as an anti-germicide to prevent dermatitis problems for the fishermen. However, with an increased number of motor and mechanised boats and the accumulation of plastic materials or other debris, there is increased marine pollution, affecting seawater's medicinal properties. The polluted seawater is causing skin rashes/problems when cleaning boats or nets. The seawater that used

to cure dermatitis in the past now is not working to fix it; it also creates issues for those engaged in fishing activities. He also further narrated that fish was abundant in pre-mechanised times, and it was like *vari panta pandinatlu* [cultivation of rice in the agriculture field], as the fishermen put it. The fish were available at five fathoms in the sea. It is said that it is difficult to find fish even at sixty fathoms after the rise of motorised boats.

When they were young, they hardly travelled to the fishing ground called *gati rayi* to catch fish. However, today, at *gati rayi* also, it isn't easy to catch fish due to its non-availability. It is strongly believed and visible that the fish have either depleted or disappeared and has gone to the more bottomless sea, which is more than a hundred fathoms away. Fishing nets are introduced now, even to catch small fish varieties from the top to the bottom of the sea. This kind of net has drastically affected the growth of fish varieties and has depleted the fish stock fast from the ocean. After adopting motorised or mechanised boats, the working hours have been reduced compared with traditional boat fishing.

The Complex Matrix of Economy, Marine Resources and Social Life

Division of labour is apparent among the fishing communities. Fisherwomen used to engage in traditional fishing-related activities, such as the segregation of fish, fish processing and storage, and fish drying. Later, they used to sell fish in the market. However, today, fishermen prefer selling fish caught at the fishing harbour directly on motorboats. It has resulted in less engagement of women in fishing activities. This indicates that women are becoming disempowered due to less involvement in the post-fish catch process. Generally, the fish catch is now taken to the fishing harbour to sell the catch when it is more. If they get only a meagre catch, the fishermen bring the catch to the seashore, and their wives take it to the market to sell it. The motorisation or mechanisation of fishing indicates changes in the division of labour in the community.

After the adoption of motorboats, earnings have increased, but at the same time, the debt has also increased in buying new boats, suitable hooks and lines, and nets for fishing. They used to borrow money from private financiers, and when fishermen got good returns from fishing, they could clear their debts. Otherwise, it is an additional economic burden on their household management. Here, the institution of family and its sustenance has played a role in managing the household economy. The economic conditions of the family always support healthy relations among them. It is also reported that it affects individual well-being, directly or indirectly, in case of any economic fluctuations and deviations within a family. The families of fishermen expressed that with the meagre income returns from fishing; it is difficult to run household management. While the investment is slightly lower in the traditional boat fishing activity, the economic returns were satisfactory. After adopting motorised boats, the investment almost equals financial returns from fishing. It is said that there is virtually no possibility of savings among the fishing community members. Except, there is some comfort in navigating and ease in fishing.

The community's social and economic development depends entirely on the marine resources and availability in their local ecosystems. In developing these communities, they acquired knowledge that helped them manage their marine resources in the immediate environment. In the industrialisation and development process discourse, most of the occupational dynamics, including the fishing sector, have been drastically affected, leading to declining community resources. Researchers from different disciplines have also been working on the ways and means of protecting nature conservation, including marine conservation systems. Further, there is an urgent need to research the native practices of the community management of resources and their role in the nation-development process. It also needs to investigate how these native communities manage their marine resources without external intervention to protect resources for their sustainability. The post-liberalisation and industrialisation process severely affected the available resources in both inland and marine environments.

Case 2

Polamma (67) shared a change in fisherwomen's roles after adopting motorised fishing in the community. In earlier times, fisherwomen engaged in the fishing sector, particularly fish processing and storing fish, drying fish, separating flesh and bones, and selling fish in the market and community neighbourhoods. After adopting motorised boats, fishermen preferred to sell in the market directly at the fishing harbour. This new shift has declined fisherwomen's role in the fishing sector. Moreover, she also mentions that after the motorisation of fishing boats, kinship relations became weak, and the bondage of siblingship in the community was superficial. Brothers used to give a small piece of fish or the fish's head from his fish catch to the sister as a customary practice. This practice is rapidly declining with the introduction of motorised boats in the community.

Case 3

Ankayya (53) recounted that he had been engaged in fishing since he was a young boy. He has been continuously noticing several changes in the sea. He remembers that when he was a young adult, the sea was immaculate, and the availability of fish was abundant even at a shorter distance from the shore. The fishing type and methods have changed after introducing motorised boats in the village. On fishing expeditions, they used to get plastic bags in the sea and catch them in the nets. However, plastic in the ocean everywhere is causing much damage to marine ecology and a threat to marine species. Due to this reason, the fish have migrated to longer distances, and it is even difficult to identify their locations. Therefore, fishermen must travel longer distances on motorised boats to catch fish with nets, hooks and lines. He also noted that modern fishing methods have resulted in economic profits, but the consequence is increased sea fish decline. His overall

observation is that motorised boat fishing may not suit fishermen. It is detrimental to marine life and those whose livelihoods depend on it.

The Trajectory of Drifting Cultural Knowledge

Fishing is a collective effort and needs sufficient manpower for the success of fishing expeditions. This activity also depends on the accurate decision-making of the participating crew members. There is a precise division of labour among the fishers on the job. During traditional fishing activity, it is usually needed more manpower than a motor or mechanized boat. The fishermen revealed that while fishing activity (mending nets, repair of the boat and other fishing paraphernalia, preparing for the next day's fishing, discussing with other fishermen from other neighbouring villages about the weather conditions and decision making), few fishermen who know (on folk songs, ritual stories, past and present fishing experiences) used to share with his crew members on the boat and members of the community at the seashore. In fact, in earlier times, the community members were interested in learning from the elders' knowledge and transmitted it to them through several mechanisms on different occasions. This is how the repository of cultural knowledge has been sent, where fishing is part and parcel of it.

In the fishing sector, using motorboats or mechanized boats, readymade nets and hooks, Global Positioning System (GPS), and mobile phones, fishing made it relatively more manageable and accessible to perform fishing activities due to modern fishing equipment. Even with the contemporary technological support and benefits, this transformation has impacted the community members' social gatherings. In pre-technological times, the fishermen made their new nets, fishing threads, hooks, and lines at the seashore with much pleasure. However, this practice is now entirely dependent on readymade fishing equipment. During this process of making/polishing fishing equipment, and after the completion of work, the fishermen gather at one place and listen to their kin about several stories intrinsic to their cosmology. This type of cultural transmission has myriad functions, like it gives entertainment, reiterating their identity, and their deep sense of belongingness to the sea. It is felt that the transmission of cultural knowledge has been eroding due to technological intervention in their social and cultural systems.

Youth engagement in fishing activities has been declining due to various reasons such as uncertainty in fish catch, lesser price rate for fish catch and unprecedented weather conditions, etc. One of the senior fishermen who taught the ritual epics to the community members revealed that in the earlier times, all the age group members were keenly interested in learning ritual narrations, folksongs, moral stories, etc. Due to mobile phones and television access, the current generation is attracted to it and not interested in acquiring past oral cultural knowledge. He also noted that even the adoption of motorboats changed these aspects. For example, during traditional boat fishing, while travelling into the sea or catching fish, the senior fishermen sang songs and told stories on the boat. The crew members are also interested in learning and raising questions to strengthen

their knowledge. The present scenario is different from the past; the technologies like motor engines and GPS made it easy to do fishing among the community members.

During traditional fishing, the younger fishermen used to learn the skills from the senior fishermen, and the younger generation used to take their advice. Ever since, with modern fishing methods, the relationship between old and younger fishermen has been becoming diluent and thus created a vast knowledge gap and perceived hierarchies between them. The knowledgeable fishermen are always treated as unique in the community and respected by the other fishermen. Senior fishermen are believed to have expertise in traditional fishing methods and have lesser knowledge about modern fishing methods. Furthermore, they depended on the younger fishermen for motorboat handling and navigation skills during fishing expeditions. It is clearly understood that adopting modern fishing methods and introducing technology into fishing has impacted the traditional fishing practice.

Case 4

Raju (43) mentions that two decades ago, they used to see a pool/school of fish frequently at shorter distances in the sea, but now they do not find such a scenario earlier. He says that local environmental conditions, unsuitable fishing practices, wastage dumping into the sea, and modern fishing methods with fibre boats have destroyed marine environmental conditions and increased the decline of fish stocks near the coast. He opines that every district has roughly one thousand motor or mechanised fishing boats. If we can assess the adverse effects of these boats and the negative consequences, we can see how much pressure has been created on marine living species. This effect has directly impacted the fishermen's communities and their social well-being. He believes that as there are now insufficient economic returns from fishing, several of them had to opt for alternative livelihoods, such as wage labour and other unskilled jobs in the town, which make them more vulnerable and marginalised.

Conclusion

The impacts of motorisation and mechanisation of fishing activities have brought significant changes in the marine livelihood practices of this community. Fishing communities in North Coastal Andhra Pradesh have resisted social change for a long time despite their close association and geographical proximity to urban areas. This is visible as most of their social institutions are intact and did not yield to the urbanization process. Over the years, the rise of industrialization and modern fishing methods have charted a noticeable change, particularly in the fishing and mode of production among the fishing communities. The motorisation or mechanisation of fishing played a significant role in the swift changes in economic organization at the individual family to the group level of these

communities. However, with the use of motorisation or mechanisation of fishing activities, the fishing communities to sustain their livelihoods, the maritime mode of production, and marine common property resources have been further utilised.

Oblivion that it is reaping economic benefits with the newer technological armoury, the fishermen are now starting to take stock of the situation. There are a few concerns about their future due to a more significant decline in fish stocks. They are also worried about the consequences of this rudderless process on their traditional fishing. Finally, this article articulated recent technological innovations like motorisation of fishing, which have led to economic and livelihood distress in small-scale fisheries.

Declaration of Conflicting Interests

Funding

References

George, B. (2011). *Technological change and modernisation in the fishing sector: The question of sustainability*. [Doctoral thesis, Department of Applied Economic, Cochin University of Science and Technology].

Guijarro, B., Ordines, F., & Massutí, E. (2017). Improving the ecological efficiency of the bottom trawl fishery in the Western Mediterranean: It's about time! *Marine Policy*, *83*, 204–214. https://doi.org/10.1016/j.marpol.2017.06.007

Gulati, L. (1984). Technological Change and Women's Work Participation and Demographic Behaviour: A case study of three fishing villages. *Economic and Political Weekly*, *19*(49), 2089–2094.

Handbook on Fisheries Statistics 2018. (2019). Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying. Govt. of India, New Delhi. http://dof.gov.in/sites/default/filess/Handbook%20on%20FS%202018.pdf.

Hapke, H. M. (1996). *Fish mongers, markets, and mechanization: Gender and the economic transformation of an Indian fishery*. [Dissertation], Graduate School of Syracuse University.

Hapke, H. M. (2001). Gender, work, and household survival in South Indian fishing communities: A preliminary analysis. *The Professional Geographer*, *53*(3), 313–331. https://doi.org/10.1111/0033-0124.00287

Hoeppe, G. (2007). Conversations on the beach: Fishermen's knowledge, metaphor and environmental change in South India (1st ed). Berghahn Books. https://doi.org/10.2307/j.ctv287sjg4

Kodanda Rao, M. (1990). *Cultural and structural dimensions of family: A study of Jalari fishermen*. Concept Publishing Company.

Kodanda Rao, M. (1991). Ecological adaptation and maximisation of resources among the Jalari of Coastal Andhra Pradesh, South India. In R. Grønhaug, G. Haaland, G. Henriksen (Eds.), *The Ecology of Choice and Symbol: Essays in Honour of Fredrik Barth*. Alma Mater.

Kurien, J., & Willmann, R. (1982). *Economics of artisanal and mechanized fisheries in Kerala*. Programme for Community Organisation.

Madhanagopal, D., & Pattanaik, S. (2019). Exploring fishermen's local knowledge and perceptions in the face of climate change: The case of coastal Tamil Nadu, India. *Environ Dev Sustain*, *22*(4), 3461–3489. https://doi.org/10.1007/s10668-019-00354-z

Mathur, P.R.G. (2008). *Ecology, technology, and economy: continuity and change among the fisherfolk of Kerala*. Rawat Publications.

Nuckolls, C. (1996). *The cultural dialectics of knowledge and desire*. The University of Wisconsin Press.

Ota, Y. (2006). Socialisation of fishing knowledge: The emergence and transmission of new fishing technology and marine ecological knowledge in the Republic of Palau, Western Micronesia. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin, 20*, 24–32.

Prasada Rao, D.L, & Kumar, R. Y. (1984). Impact of mechanisation on a traditional economy: A case study of fishermen in Vishakhapatnam. *Man Life*, *10*(1&2), 31–42.

Ramaiah, T.G., & Rajanikanth, G. (2013). *Role of exclusive credit linkage programme for occupational dynamics among fisherwomen. A Study in Andhra Pradesh and Tamil Nadu States*. [Research Reports Series – 95], National Institute of Rural Development, Ministry of Rural Development, Government of India.

Ramanaiah, G. (2006). *Mechanization of fishing and its impact on socio- economic life of a fishing community in Andhra Pradesh*. [MPhil Dissertation, Unpublished]. Department of Anthropology, University of Hyderabad.

Ramenzoni, VC. (2017). Reconstructing the history and the effects of mechanization in a small-scale fishery of Flores, Eastern Indonesia (1917–2014). *Frontiers in Marine Science*, *4*, 65. https://doi.org/10.3389/fmars.2017.00065

Schoembucher, E. (1988). Equality and hierarchy in maritime adaptation: The importance of flexibility in the social organization of a South Indian fishing caste. *Ethnology*, *27*(3): 213–230.

Sridevi, C. (1989). The fisherwoman financier: A study of status-role nexus in a peasant community. *Economic and Political Weekly*, *24*(17):6–9.

Srivastava, U. K., Dharma Reddy, M., Subrahmanyam, B., & Gupta, VK. (1986). *Impact of mechanization on small fishermen: Analysis and village studies*. Concept Publishing Company.

Suryanarayana, M. (1977). *Marine fisherfolk of north-east coastal Andhra Pradesh*. Anthropological Survey of India, Government of India.

Whitmarsh, D. (1990). Technological change and marine fisheries development. *Marine Policy*, *14*(1), 15–22. https://doi.org/10.1016/0308-597X(90)90034-O

The Current Challenges of Sustainable Aquaculture in the Asia-Pacific Region and the Measures Recommended

Cherdsak Virapat[1]

Abstract

A key output from the GCA +20 has highlighted the principles and strategic pathways to maximise the contribution of sustainable aquaculture in achieving the Sustainable Development Goals and meeting the pledge of 'Leaving no one behind'. Network of Aquaculture Centres in Asia-Pacific (NACA) and the Centre on Integrated Rural Development for Asia and the Pacific, their country members and partners collaborate and cooperate with the Food and Agriculture Organization of the United Nations and other UN specialised agencies for building climate resilience in aquaculture and agriculture systems for supporting small-scale and subsistence farmers in Asia and the Pacific Region. Aquaculture growth can be sustained through mitigating the impacts of aquatic animal diseases, addressing the antimicrobial resistance in aquaculture, adapting and mitigating climate change, addressing food safety in the entire market chain from hatchery to consumer, identifying the capacity-building needs, and organising training courses and technology transfer for small scale fish farmers. The growing transboundary movement of aquatic animals calls for regional cooperation and collaboration among members to improve the conditions for sustainable aquaculture. NACA assists members in assuring the safety and quality of aquaculture products in member countries, which will likely assist small-scale farmers to adapt to the changing trade and safety environment. Cluster-based management approaches and forming farmer societies are promoted as practical mechanisms for implementing better management practices.

Keywords

Sustainable aquaculture, fish pathogens, antimicrobial resistance (AMR), climate change, capacity building, food security

[1]The Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP), Bangladesh

Corresponding author:
Cherdsak Virapat, The Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP), Chameli House, 17 Topkhana Road, Dhaka 1000, Bangladesh.
E-mail: cvirapat@cirdap.org

Introduction

'Aquaculture has great potential to positively contribute to human and planetary well-being when its products are aligned with the Sustainable Development Goals' (Troell et al., 2023). According to them, the various sectors of the aquaculture industry significantly contribute to achieving the Sustainable Development Goals (SDGs)/Agenda 2030, which can be increased in the future. Aquaculture is central to billions of people's food security, nutrition, and livelihoods, constituting a significant share of the global gross domestic product and economic activities. Aquaculture is a unique sector that encompasses all aquatic ecosystems (freshwater, brackish/estuarine, and marine) and is tightly interconnected with terrestrial ecosystems (Troell et al., 2023). Aquaculture provides more context-specific solutions for addressing opportunities and challenges for its future development.

Understanding the environmental, social, and economic characteristics of the multi-faceted nature of aquaculture is vital for its future role in the global context. Lack of understanding may adversely impact food security and nutrition, livelihood opportunities and employment, equity and gender equality, the environment, and climate change. Proper knowledge of it will help us explore the challenges of aquaculture in general and in the context of the Asia Pacific Region. We need to understand the main obstacles to the growth of aquaculture in the world that may limit our benefits from it in the future. Five key selected challenges that affect current aquaculture include pathogens, Antimicrobial Resistance (AMR), impacts of climate change, food safety and certification, and limited knowledge & technology transfer for small-scale fish farmers. The results will be varied depending on different countries.

The critical role of a diverse aquaculture sector in ensuring food security and poverty alleviation, as expected, is well recognised. We need sustained aquacultural production growth to fulfil the increasing global fish supply and demand gap. The growing transboundary movement of aquatic animals is a reality that creates the urgency of cooperation among the connected nations, requiring exchanging information and experiences and a shared vision and appreciation of achieving this sector's sustainable growth blending all the stakeholders' diverse and often conflicting interests. Recognising this urgency, the Food and Agriculture Organization of the United Nations (FAO), at the request of its members, organised the Global Conference on Aquaculture (GCA) Millennium +20 in collaboration with the Network of Aquaculture Centres in Asia-Pacific (NACA) and the Ministry of Agriculture and Rural Affairs of the People's Republic of China, held from 23 to 24 September 2021 in Shanghai, China. The GCA +20 is the fourth in a series of development-oriented conferences that have shaped global aquaculture: Kyoto (1976), Bangkok (2000), and Phuket (2010) (GCA +20). Under the theme 'Aquaculture for food and sustainable development', the GCA +20 aims to bring stakeholders from government, business, academia, and civil society together to identify the policy and technology innovations, investment opportunities, and fruitful areas of cooperation in aquaculture for food and sustainable development.

A key output from the GCA +20 – The Shanghai Consensus – has highlighted the principles and strategic pathways to maximise the contribution of sustainable

aquaculture in achieving the (SDGs) and meeting the pledge of 'Leaving no one behind'. NACA and the Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP), their country members and partners collaborate and cooperate with FAO and other UN specialised agencies for building climate resilience in aquaculture and agriculture systems for supporting 500 million small-scale and subsistence farmers in Asia and the Pacific Region.

The paper focused on the information the author obtained from his works at the CIRDAP and during his terms of service with the NACA and the Food and Agriculture Organization of the United Nations (FAO). In this paper, he summarises the key challenges and policies undertaken by some stakeholders of the Asia Pacific countries, along with some critical policy interventions there. The insights obtained from the materials of GCA +20 are also included in this paper when they are weighed and utilised for policy formulations and interventions there.

Key Challenges for Sustainable Aquaculture

To cover critical issues that impact aquaculture, the author consulted experts of CIRDAP, FAO, NACA, private sector, and academic institutions and identified the key challenges that affect aquaculture. Fish pathogens are considered the most significant issue affecting aquaculture production. Asia contributes over 90 percent of the world's aquaculture production, with intensification as a significant contributor to the fast growth of the aquaculture industry. Aquaculture intensification, however, has resulted in increased disease problems in cultured animals. The growing transboundary movement of aquatic animals related to seed supply and trade has further intensified the problem (Leano, 2017). Global water resource contamination by waterborne pathogens is a significant health concern worldwide.

Needless to mention that infectious diseases are by far the most significant limiting factor to expanding aquaculture production. Recent progress in aquaculture production parallels the growing number of disease incidences that harm global aquaculture production, profitability, and sustainability (Vanamala et al., 2022). Emerging infectious diseases have caused industry-wide production loss in many species and geographic zones worldwide in recent years. Antimicrobials are commonly used to prevent and control common aquatic animal diseases in aquaculture.

However, the indiscriminate and comprehensive overuse of unregulated antimicrobials without appropriate diagnostic examination contributes to the development of AMR strains of bacterial pathogens (Saengsitthisak et al., 2020). Although the control over the use of antimicrobials has been strengthened over the past decade mainly for trade-related purposes, they are still commonly used in aquaculture in the region. The control over the production and use of antimicrobials for aquaculture is far from adequate and effective in many Asian countries. However, some regulatory frameworks are already in place due to the sector's character. Un-prudent and poorly controlled use of antimicrobials in aquaculture

is likely to significantly contribute to AMR risk due to the feature of the aquaculture environment and how cultured animal diseases are handled.

AMR has been considered a devastating problem primarily in the human clinical domain and a recognised issue in domesticated animals and aquaculture. Therefore, it is critical to understand multidrug-resistant or antibiotic-resistant pathogens and their harboured antibiotic-resistant genes in aquatic environments. Thorough investigations of their dissemination, sources, and interactions are warranted, which underpin the strategy to curb their presence and spread. With the foreseen population growth and expected economic recovery and growth, it is anticipated that the demand for fish food will increase significantly in the coming decades. World's apparent fish consumption is projected to increase by 31 million tonnes in the next decade to reach 178 million tonnes in 2025 (FAO 2016). To meet the increasing demand for food fish globally, it is vital to maintain the sustainable growth of aquaculture in Asia. Aquaculture intensification will continue with the limited national resources, particularly water, land, and increasing user competition. Effective control of infectious diseases in cultured aquatic animals will be the key factor to productivity and efficiency in aquaculture.

Another key challenge is that the global climate is changing, and its impacts are associated with the accumulation of greenhouse gases in the atmosphere from human activities, changes in mean temperature, shifts in seasons, and increasing intensity of extreme weather events are already occurring. They are predicted to worsen in the future. The effects of climate change and rising temperatures have shown a dynamic shift in the aquatic niches' selection and pathogen growth as biofilms and other forms (Troell et al., 2023). Millions of people, particularly those in developing countries, face water and food shortages and more significant health risks. Therefore, it is critically important to address these climate change challenges, especially in many Asia-Pacific countries, which are highly vulnerable.

Food safety is a key concern for international trade in fish products. The constantly changing regulatory environment and safety requirements of importing countries pose a special challenge to small-scale aquaculture producers. Policy issues concerning aquaculture certification and activities in market access should also be addressed. Traceability, forced labour, human trafficking, food safety regulations, and trade and environment regulations. Limited knowledge of small-scale aquaculture producers on modern improved technology is another challenge. Education and training can improve knowledge and technology transfer, eventually mitigating all other challenges.

Initiatives and Actions at the Region

Actions to Contract Pathogens Affecting Aquaculture

The Aquatic Animal Health Programme of NACA assists its members in reducing the risks of aquatic animal disease impacting the livelihoods of farmers, national economies, trade, environment, and human health (NACA 2015) by (a) improving regional cooperation in aquatic animal health and welfare (b) developing and

implementing national strategies on aquatic animal health, (c) improving surveillance, reporting, and response to disease emergencies, (d) promoting harmonisation of diagnostic procedures and risk assessment, and (e) promoting better aquatic animal health management practices at the farm level widely.

According to a case study project titled 'Adaptive Learning in Sustainable Aquaculture Best Practices for Small-Scale Shrimp Farmers in Thailand (SSSF)' on Early Mortality Syndrome (EMS) or Acute Hepatopancreatic Necrosis Disease in Thailand, EMS is causing major losses in marine shrimp aquaculture in Thailand and several countries in Asia. The project was funded by the Walmart Foundation and The Sustainable Trade Initiative through the Sustainable Fisheries Partnership Foundation and implemented by the NACA and the Food School in collaboration with Thailand's Department of Fisheries and the International Ocean Institute in Thailand (IOI-Thailand) (Virapat et al., 2017).

The project aimed at promoting collaboration among small-scale marine shrimp farmers and groups of marine shrimp farmers in Thailand to improve their farm management practices and promote environment-friendly practices, disease prevention, stimulate their economies, and markets as well as a stakeholder participatory approach and the role of women in shrimp production and decision-making processes. The project targets to improve sustainable marine shrimp culture for about 500 SSSF in Thailand. A similar investigative project or case study is warranted in other parts of the Asia Pacific region.

Managing Antimicrobial Resistance

Considering the scale of use of antimicrobials in Asian aquaculture and the desire for sustainable growth of the sector, actions to address the AMR risk related to aquaculture are needed. Moreover, the lack of systematic and regular collection of high-quality information on AMR in livestock and aquaculture is one of the most critical gaps relevant to AMR mitigation in agriculture. Organising a regional consultation is an appropriate entry point to assess the use of antimicrobials in Asian aquaculture and its risks in contributing to AMR and to identify the desirable interventions to address the issue and long-term strategy to minimise AMR risk related to Asian aquaculture. This has been reflected in the actions taken by FAO and NACA. They undertook a regional assessment of antimicrobial use (AMU) and its risk in the development of AMR in aquaculture during 4–7 September 2018. They assessed the current status of AMU in aquaculture in selected countries in Asia as well as the regulation and governance of the use of antimicrobials. Significant issues, gaps, and constraints in minimising AMR risks related to aquaculture were identified in that assessment.

Regional consultation recommends strategies and actions for effectively addressing the AMR risk associated with aquaculture. Some recommendations are made for competent authorities to pay attention to the AMR issue, create an additional budget, and develop comprehensive and practical AMR control strategies. The critical step to minimising AMU and mitigating AMR is to prevent bacterial diseases in aquatic animals (good aquaculture practices). Effective

vaccines and other alternative treatments should be pursued, while measures to eliminate resistant bacteria or resistance genes in the aquaculture system should be developed if possible.

The critical message is that the abuse of antibiotics in aquaculture must be stopped. Drugs critical for human medicine, such as quinolones and cephalosporins, should be ruled out from the approved aquaculture antibiotics list. Strategies must be developed to contain and minimise the development of AMR by implementing the following measures: increased awareness, governance strengthening, GAPs (including biosecurity), AMU/AMR/antibiotics residues surveillance, research, and innovation, and One Health engagement. These measures can help prevent the development of AMR, antibiotic-resistant bacteria, and antibiotic-resistant genes (ARG) transmission.

Countering Climate Effect

As stated in the literature, aquaculture is an essential source of food, nutrition, income, and livelihood for hundreds of millions worldwide. The global climate is changing, and its impacts are associated with the accumulation of greenhouse gases in the atmosphere from human activities, changes in mean temperature, shifts in seasons, and increasing intensity of extreme weather events that are already occurring and are predicted to worsen in the future (Intergovernmental Panel on Climate Change, 2022). Millions of people, particularly those in developing countries, face water, and food shortages and more significant health risks. Therefore, it is critically important to address these climate change challenges, especially in many Asia-Pacific countries, which are highly vulnerable in various dimensions. But aquaculture production in low-latitude countries will likely be most negatively affected by direct climate changes (Barange et al., 2018), while effects in northern latitudes may be both positive and negative, creating challenges for existing farming to deliver on the SDGs but at the same time also creating opportunities for farms to be established in regions where farming conditions improve (Troell et al., 2023).

NACA, CIRDAP, and their partners are playing a vital role in implementing many activities for climate change mitigation and adaptation in fisheries, aquaculture, and agriculture, such as improving knowledge of climate change and related natural disasters and their impacts for policymakers, researchers, development practitioners, and other stakeholders and strengthening adaptive capacities to the impacts of climate change and related natural disasters in their member countries.

Most countries in Asia-Pacific have responded to climate change challenges by formulating climate change strategies and action plans and have policies for disaster management and rural development. Several institutions and funds have also been established to support policy implementation. Despite such initiatives and policy frameworks, they are still facing challenges to the effects of climate change, which need to be overcome for climate resilience and better livelihood. Many countries in the region need help to reduce risk and respond to the negative

effects of climate change. As a result, it hampers agricultural and aquaculture production and other rural livelihood alternatives. To overcome these challenges, four groups of strategic actions will be established as regional initiatives as follows:

- Group I. Increasing climate resilience of farmers, farming systems, and breeds available for farming.
- Group II. Increasing capacity to manage short- and long-term climate risks and reduce losses from weather-related disasters.
- Group III. Improving the sustainability of genetic diversity in broodstocks as a resource for long-term, continuous adaptation to climate change.
- Group IV. Finding the potential and developing the capacity of aquaculture in mitigating the impact of and sequestrating the release of greenhouse gas emissions.

NACA and CIRDAP, in collaboration with FAO and UN specialised agencies, their country members and partners will meet, discuss and develop active action programs for countries in Asia and the Pacific region. It is suggested that combined efforts should be made to set up a digital platform for regional climate change impact assessment, showing the possible effects of climate change on aquaculture and agriculture in different countries over the next 15 years (increasing temperature, change in rainfall patterns, storm intensity and frequency, increase CO_2 levels and sea level rise). This will be done jointly with the FAO family farming knowledge platform.

This would provide reliable and up-to-date database and decision-support systems for Governments, the private sector, industry, and farmers with information to make informed choices. Choices about how they should be adapting their aquaculture and agriculture development and production systems and related industries to climate change, defining adaptation strategies for the main environmental, disease, and genetic threats caused by climate change, to inform and guide local community organisations or cooperatives; communicating the results of the vulnerability assessment and adaptation planning and strategies at all levels; and implementing pilot projects on adaptation and providing capacity building required to manage farming systems better. NACA and CIRDAP, their country members and partners, will collaborate and cooperate with FAO and other UN specialised agencies to build climate resilience in aquaculture and agriculture systems for supporting 500 million small-scale and subsistence farmers in Asia and the Pacific Region (NACA & CIRDAP, 2021).

Food Safety and Certification

The program organised by NACA assists members in assuring the safety and quality of aquaculture products by adopting science-based better management practices. Policy issues concerning aquaculture certification and activities in market access should also be addressed. Traceability, forced labour, human trafficking, food safety regulations, and trade and environment regulations. The

NACA program focuses on assisting small-scale farmers to adapt to the changing trade and safety environment. Cluster-based management approaches and forming farmer societies are promoted as practical mechanisms for implementing better management practices (NACA 2015). Some key activities are as follows:

- Evaluation of commodity-specific better management practices for meeting domestic and international food safety standards
- Facilitating the establishment of national residue testing and monitoring programs and sharing of information amongst member countries
- Improving access to markets by small-scale farmers
- Improving market development for low-cost aquaculture commodities
- Address biosecurity and associated human health issues regarding the consumption of fish and processed products
- Development of farmer groups and cluster-based certification concepts and methodologies
- Distribution of food security from aquaculture widely to meet all consumers' needs

NACA is working to help address food safety through the entire market chain from hatchery to consumer.

Enhancing Capacity of Small-Scale Fish Farmers

Education and training can improve knowledge and technology transfer, eventually mitigating all other challenges. The Education and Training Programme of NACA (NACA 2015) assists capacity building among members through the exchange and sharing of knowledge and skills between members. Activities may include training courses, study visits, and personnel exchange. The program also supports regular training activities that may include several courses each year on various topics of regional priority in aquaculture development, such as:

1. Broodstock Management in Aquaculture
2. Aquaculture Business Management
3. Marine Finfish Seed Production
4. Aquaculture Governance and Planning
5. Management for Sustainable Aquaculture Development.

Key activities include the following:

- Identifying training needs for aquaculture development in NACA members
- Identifying and organising relevant expertise and capacities to meet the training needs
- Developing training modules and materials
- Facilitating routine education and training activities of NACA
- Facilitating and coordinating exchange programs among members and with other regions

Conclusion

A key output from the GCA +20 has highlighted the principles and strategic pathways to maximise the contribution of sustainable aquaculture in achieving the SDGs and meeting the pledge of 'Leaving no one behind'. NACA and the CIRDAP, their country members and partners collaborate and cooperate with FAO and other UN specialised agencies for building climate resilience in aquaculture and agriculture systems for supporting 500 million small-scale and subsistence farmers in Asia and the Pacific Region.

Aquaculture can be promoted and operated through the mitigation of impacts of aquatic animal diseases; management of chemical and antibiotic usage in aquaculture; adaptation and mitigation of climate change; address of food safety through the entire market chain from hatchery to consumer, and identification of capacity building needs and organisation of training courses and technology transfer to small-scale fish farmers. In addition, the growing transboundary movement of aquatic animals calls for regional cooperation and collaboration among members to improve the conditions for sustainable aquaculture for food security and safety in the coming years.

Education and training through their enhanced knowledge and technology transfer can eventually mitigate aquaculture challenges. The Education and Training Programme of NACA assists capacity building among members through the exchange and sharing of knowledge and skills between members. NACA assists members in assuring the safety and quality of aquaculture products in their countries, which will likely assist small-scale farmers to adapt to the changing trade and safety environment. Cluster-based management approaches and forming farmer societies are promoted as practical mechanisms for implementing better management practices.

Acknowledgment

Declaration of Conflicting Interests

Funding

References

Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K., Funge-Smith, S. & Poulain, F. (Eds.). (2018). Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options. *FAO Fisheries Technical Paper 627*. Rome, FAO. http://www.fao.org/3/i9705en/i9705en.pdf.

FAO. (2016). *The State of World Fisheries and Aquaculture 2016: Contributing to food security and nutrition for all*.

Intergovernmental Panel on Climate Change. (2022). Water. In *Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 551–712). Cambridge University Press. https://doi.org/10.1017/9781009325844.006

Leano, E. M. (2017). *Final report*. Organizing FAO regional consultation and related study on antimicrobial resistance (AMR) risk to aquaculture in Asia (Ref. LOA/RAP/2017/42).

NACA. (2015). *Work plan 2015+. Livelihoods and food security for rural communities*.

NACA, & CIRDAP. (2021). *Statement of support to the Shanghai Declaration*. Global Conference on Aquaculture Millennium +20, 24 September 2021, Shanghai, PR China.

Saengsitthisak, B., Chaisri, W., Punyapornwithaya, V., Mektrirat, R., Klayraung, S., Bernard, J.K. & Pikulkaew, S. (2020). Occurrence and antimicrobial susceptibility profiles of multidrug-resistant aeromonads isolated from freshwater ornamental fish in Chiang Mai province. *Pathogens*, *9*(11), 973. https://doi.org/10.3390/pathogens9110973

Troell, M., Costa-Pierce, B., Stead, S., Cottrell, R. S., Brugere, C., Farmery, A. K., Little, D. C., Strand, Å., Pullin, R., Soto, D., Beveridge, M., Salie, K., Dresdner, J., Moraes-Valenti, P., Blanchard, J., James, P., Yossa, R., Allison, E., Devaney, C., & Barg, U. (2023). Perspectives on aquaculture's contribution to the Sustainable Development Goals for improved human and planetary health. *Journal of the World Aquaculture Society*, *54*(2), 251–342. https://doi.org/10.1111/jwas.12946

Virapat, C., Tansutapanich, A., Boonchuwong, P., Chatjareyaves, S., Udomlarp, W., Rojanee, S., Surangpimol, S. A., Martnok, W., Muakthaisong, P., Anuratpanich, K., Virapat, P., Laoprasert, S., Poomthong, T., Koaeian, K., Wichaiwattana, C., Padejpai, K., Chankaew, K., Immink, A. & Morales, J. (2017). *Adaptive learning in sustainable aquaculture best bractices for small-scale shrimp farmers in Thailand (SSSF-Thailand)*. (A report prepared by the Network of Aquaculture Centres in Asia-Pacific and The Food School which is funded by the Walmart Foundation and The Sustainable Trade Initiative through the Sustainable Fisheries Partnership Foundation).

The 'Bloody Problem' of Women and Children in India

Vanishree Joseph[1] and N. V. Madhuri[2]

Abstract

This article explores the persistent challenge of anaemia in India, focusing on its impact on women and children. Anaemia, a 'silent killer', remains a major public health concern, with India harbouring nearly half of the world's anaemic women. In response, the government has implemented various programmes, but the prevalence of anaemia continues to rise, especially among women and children. The article discusses the Anaemia Control Programme's evolution, current strategies, and challenges in reducing anaemia prevalence. The article highlights the importance of nutritional outlook in tackling anaemia, emphasizing the need for food fortification, as evidenced by successful interventions. However, geographical, and socio-economic factors significantly influence anaemia prevalence, with tribal and marginalised communities facing higher risks due to inequitable gender norms, inadequate access to healthcare, and poor sanitation and hygiene practices. The study suggests a multi-faceted approach to combat anaemia, including targeted interventions for women and children, improved antenatal care services, and comprehensive awareness campaigns. Addressing anaemia requires synergistic efforts from healthcare providers, policymakers and communities to create a healthier and iron-sufficient India.

Keywords

Anaemia, women, children, India

Introduction

Anaemia is a 'silent killer' among women in India. Since the first round of the National Family Health Survey (NFHS-1) in 1993, increasing anaemia among women and children has received attention. The Indian subcontinent alone

[1]Centre for Gender Studies and Development, National Institute of Rural Development and Panchayati Raj, Hyderabad, Telangana, India
[2]National Institute of Rural Development and Panchayati Raj, Hyderabad, Telangana, India

Corresponding author:
Vanishree Joseph, Centre for Gender Studies and Development, National Institute of Rural Development and Panchayati Raj, Hyderabad, Telangana 500030, India.
E-mail: vanishreej.nird@gov.in

contains nearly half the world's anaemic women. In the WHO classification of countries by the significance of anaemia as a public health issue, India is listed as having a severe problem of anaemia in both pregnant women and non-pregnant women of reproductive age (WRA) (De Benoist et al., 2008). Most anaemic cases are due to inadequate nutrients like iron, folic acid, and vitamin B12. The 2020 adoption of anaemia reduction among WRA as an official target indicator for the second Sustainable Development Goal (SDG 2) now provides an opportunity for renewed commitment and attention to addressing this global public health challenge.

Anaemia Control Programme in India started in the 1970s as National Nutritional Anaemia Prophylaxis Programme (NNAPP) and evolved as 'Anaemia Mukht Bharat' in 2018. Reducing anaemia is one of the important objectives of the POSHAN Abhiyaan under the Ministry of Health and Family Welfare, launched in March 2018. Complying with the targets of POSHAN Abhiyaan and the National Nutrition Strategy set by NITI Aayog, the Anaemia Mukt Bharat strategy has been designed to reduce the prevalence of anaemia by 3% per year among children, adolescents, and WRA (15–49 years), between 2018 and 2022.

The fifth edition of the NFHS-5 covered 6.1 Lakh sample households nationwide. Those diagnosed with severe anaemia during testing were referred to local health facilities for immediate medication. At the national level, the findings of the NFHS-5 reveal that there has been an increase in the prevalence of anaemia among women and children compared to the previous NFHS-4 survey that was conducted in 2015–2016, about four years ago, which is a negative sign. The increase is the highest among children at 8.5 percentage points and is closer to the levels recorded in NFHS-3 from 2005 to 2006 when the prevalence was 70%. The increase in anaemia among pregnant women is by 1.8 percentage points, among all WRA is 3.9 percentage points, and among adolescent women by five percentage points.

Among children aged 6–59 months, anaemia is the most prevalent in Gujarat among the larger states, with nearly 80% of the children in the age group diagnosed with anaemia. Madhya Pradesh, Rajasthan, Punjab, Haryana, and Telangana are the major large states with a more than 70% prevalence among children. Kerala is the only state with a prevalence of less than 40%, though it has registered an increase of 3.7 percentage points compared to NFHS-4. The increase in the prevalence of anaemia is the greatest for Assam, where the prevalence has gone up from 35.7% in NFHS-4 to 68.4% in NFHS-5, an increase of 32.7 percentage points. Mizoram and Chhattisgarh recorded an increase of more than 25 percentage points each. The prevalence in four south Indian states except Telangana and six north-eastern states except Assam is below the national average as per NFHS-5. Only four states recorded a reduction in prevalence, though small in magnitude. These are Uttarakhand (by 1%), Haryana (1.3%), Jharkhand (2.4%) and Meghalaya (2.9%).

The purpose of this policy note is to describe the increased prevalence of anaemia in India and its differential dynamics across states and demographics. Another purpose is to explore the potential reasons behind such a dynamic given

the policy context of the government. Then make some policy recommendations to address the problem.

Women of Reproductive Age

Among women, iron deficiency prevalence is higher than in men due to menstrual iron losses and the increased iron demands of a growing foetus during pregnancy. Fatigue, restless leg syndrome, reduced working capacity, and pallor are some of the signs of iron deficiency anaemia. Maternal anaemia has been associated with an increased risk of maternal and foetal morbidity and mortality. Adverse pregnancy outcomes such as preterm birth, low birth weight (LBW), small for gestational age, delivery by caesarean section, and stillbirth have been reported to be linked with anaemia. There is significant iron supplementation, preferably by parenteral administration in the last trimester, to quickly correct the anaemia and prevent preterm deliveries. Studies show that with an increase in each g/dL of mean Haemoglobin (Hb) level, the risk of maternal mortality falls by 25%. Similarly, with every 1 mL of blood loss, there is a corresponding loss of 0.5 mg of iron; for women with low or depleted iron stores, 1000 mg or more of additional iron might be required to meet maternal and foetal iron needs (Brannon & Taylor, 2017).

Children

The infant's nutrient requirements below six months of age can be met by adequate breastfeeding of exclusive breast milk. Usually, the infant's iron stores at birth are sufficient to last until six months. For infants born pre-term, these stores may be smaller, and iron supplementation in medicinal drops (ferrous sulphate/infant vitamin drops) should be implemented at around two to three months of age to prevent iron deficiency anaemia. After six months of age, WHO suggests that infants should be fed semi-solid foods rich in iron and usually some meat products. In India, providing the infant with a thick porridge made from staples such as semolina, broken wheat, wheat flour, or millet is recommended. Other foods could include lentils, mashed fruits, or iron-fortified instant food mixes.

In India's most recent NFHS survey, only 4.9% of children aged 6–8 months met the minimum dietary diversity criterion. This survey also collected dietary information on iron-rich food intake based on a 24-hour recall period. Only about 18% of children aged 6–59 months consumed iron-rich foods on the previous day of the survey, while 20.7% of non-breastfed children in the 6–23 months age group consumed fortified baby foods. Consequently, only 8.7% of breastfeeding children (rural and urban) aged 6–23 months received a minimum acceptable diet.

In India, there is evidence of intergenerational anaemia. The state of Madhya Pradesh has strong associations between anaemia in mothers and their children, suggesting that intergenerational anaemia has long-term effects (Chandran & Kirby, 2021). Anaemia has cascading repercussions where infants born to anaemic

women are undernourished and often turn anaemic after a few months of birth. Without timely intervention, these children grow up anaemic and often marry early, giving birth to malnourished babies with fewer iron reserves who are anaemic within the first few months after delivery. Children born with LBW and those with stunted growth had a higher prevalence of anaemia. The government commonly uses Nutritional Rehabilitation Centres (NRC) and Anganwadi Centres (AWC) to provide supplemental nutrition, but they face severe criticism for their functioning. Children under five generally stay inside their houses and are more exposed to the household environment. Thus, among these children, there are multiple risk factors causing anaemia and nutritional deficiencies. There should be a holistic approach toward anaemia control, inculcating household environmental conditions and socio-economic determinants. The results underline the need for preventing early marriages and the consequent high adolescent pregnancies in India, particularly in high-prevalence states (Onyeneho et al., 2019).

By tracking the children through a real-time approach, such as the Jatak initiative in Kerala that identified the malnourished children through a geographic information system (GIS), it would be beneficial to combat malnutrition systematically. The Jatak–Janani Nutrition Surveillance System was an effort begun in Attappadi, a tribal block of Kerala, and health and nutrition were monitored using a GIS-backed management information system. A similar attempt was made in the Jhabua district of Madhya Pradesh as well. Large-scale implementation of such tracking at the community level could help identify high concentrations of malnourished and anaemic children for targeted intervention. Integrating a flexibly administered MNP supplementation into the ICDS effectively reduces and treats eating anaemia in children six months to six years of age (Chandran & Kirby, 2021).

Nutritional Outlook

Nutritional anaemia is one of India's major public health problems. Causes of nutritional anaemia might be nutritional iron deficiency or folate and nutritional B12 deficiency. It has been observed that the main cause of anaemia in the country is low intake of nutrients below minimum dietary requirements. The Indian population is either vegetarian or eats much less animal protein, which results in lower body stores of vitamin B12 (Refsum et al., 2001). The high risk of dietary iron deficiency is based on the Indian Council of Medical Research recommendation of 21 mg/d, but there. Still, this population has a secure and transparent determination of the estimated average requirement (EAR) of iron. In non-pregnant, non-lactating women of reproductive, the EAR of iron was determined to be 15 mg/d. Applying this value to daily iron intakes among WRA in nationally representative Indian state-based data showed that the median risk of dietary iron deficiency was lower than previously thought, with considerable heterogeneity between states (Ghosh et al., 2019).

Clinical studies on iron fortification in salt, rice, wheat flour, and other foods in the Indian population have been shown to improve Hb concentrations and

serum ferritin (SF) levels and alleviate iron deficiency anaemia. In 2016, the Food Safety and Standards Authority of India (FSSAI) adopted standards to fortify common staple foods such as wheat flour, rice, and salt with iron. Food fortification is an inexpensive, effective, and scalable public health solution successfully implemented in many countries to increase dietary iron intake. According to the WHO, if iron-fortified foods were available to 50% of the population in the Southeast Asian sub-region (including India), it would save an estimated 587,052 Disability-Adjusted Life Years (DALYs), resulting in USD 43 per DALY averted (Bhatnagar & Padilla-Zakour, 2021).

In the past, India has succeeded, to some extent, in implementing a few compulsory food fortification initiatives. Since 1998 iodine fortification of salt was made mandatory, about 91% of households have reported consuming iodine-fortified salt daily (Pandav et al., 2013). In 1997, in a move to the consumption of iodised salt, the Government of India banned the sale of non-iodised salt for human consumption. Also, to maintain quality, flour requires pre-packaging at a centralised facility with trained personnel to maintain quality and cost-effectiveness in the long term for local millers to cover the initial capital costs associated with the purchase and maintenance of balances, feeders and blenders needed for fortification and employing trained personnel to operate the equipment. Moreover, the markets for commonly fortifiable foods could be more organised.

In India, the government implemented a four-year food-based safety net programme from 2008 to 2012 involving the provision of fortified wheat flour through its public distribution system. There should be efforts to maximise the synergy between maternal, infant, and young children's nutrition and family planning in India. This integration is less time-consuming and cost-effective for the healthcare system; it helps improve birth spacing and avoids unintended births. In India, to a great extent, the integration of family planning with maternal, new-born and child health and nutrition has not succeeded to the extent that it was targeted under successive population policies due to a lack of a true integration strategy at the implementation level, service delivery at the peripheral level, a shortage of frontline health workers and consequent overburdening of them (Rana et al., 2019).

Neglect of Health Machinery: Testing and Treatment

Hb estimation and study of peripheral smear are good indicators for diagnosis of anaemia. There are several methods for the estimation of Hb. However, despite the limitations of the present form of Hb estimation, it is a useful method of diagnosis for anaemia. If the peripheral smear looks pale, hypochromic (large central vacuoles) and microcytosis (small, deformed red cells) suggest iron deficiency. Another test, Complete Blood Count, is done by the physician to check the anaemia level; Other special laboratory investigations on total iron binding capacity (TIBC), SF, serum folic acid, and bone marrow studies are not available everywhere and are expensive. Therefore, they are not used routinely to diagnose pregnancy anaemia (Singla et al., 1997).

The accuracy of Sahli's haemoglobinometer, commonly used for detecting anaemia in public health settings, is also questionable (Neogi et al., 2019). Hence, the practice is felt to be replaced with a more accurate and easier-to-use method. Currently, several invasive and non-invasive devices are available for detecting anaemia. In the absence of concrete evidence, there is a need to examine the devices that have the potential to be included in public health programmes. Given that most of the screening happens in community and outreach settings where provision for laboratory support seems difficult, the device should be tested in field settings with health workers (Auxiliary Nurse Midwives) as end users. Currently, four such devices have been identified that have the potential to be used in public health settings, namely, digital haemoglobinometers (True Hb and Hemocue) and non-invasive devices, that is, Masimo Pulse Oximetry test and AJO spectroscopic device test. They need to be evaluated to identify the most cost-effective device suitable for use in Indian and similar settings. Additionally, user-friendliness across key attributes (ease of use, efficiency in daylight, the scope of subjective errors, portability, convenience to the patient, interpretation of Hb results, need for power/battery, the average time taken for performing one test, and expertise required) should be analysed. Accordingly, all the devices have to be updated (Neogi et al., 2019). Another point of view is that the current Hb norms are based on Western populations. In India, the normal standards could be different due to various genetic/environmental factors. Therefore, deeper research is needed.

ASHA workers should conduct more tests by identifying people from low-income families for distributing iron supplements to children. The existing framework of the Polio Drops Immunisation process can also be adapted. Recommendations during antenatal visits, the significance of iron–folic acid (IFA) tablets should be repeatedly explained and enforced. Health education sessions should be conducted for pregnant mothers regularly, and the same implementation has to be percolated to all cadres of health service providers. Anaemia continues to be a problem with the existing healthcare resources.

Socio-Economic Factors

There is a dire need to analyse anaemia through a gender lens and social context to increase iron supplement use and iron-rich food intake successfully. Understanding how gender norms contribute to anaemia could change the narrative from a biomedical to a social justice issue (Sedlander et al., 2021). Although some reasons for higher rates of anaemia in women compared with men are biological, including iron loss during menstruation and sharing nutrients during pregnancy, societal determinants also affect these disparities. For example, although anaemia is prevalent in rural and urban India, less affluent women and those with lower educational attainment are more likely to be diagnosed with anaemia. But higher educational attainment was also protective against anaemia in India, where an increase in anaemia prevalence was observed between 1998 and 2006 (52%–56%) (Owais et al., 2021).

Moreover, inequitable gender norms exacerbate anaemia among women from different castes and tribes in the following ways:

- Due to a double burden of work outside the home and completing most unpaid work there, women lack time to visit health centres to get tested for anaemia and obtain iron supplements.
- Women are expected to prioritise their family's health over their own, thus affecting their access to health care. Women's autonomy to leave the house to seek health care is limited.
- Men are the primary breadwinners for the family but often spend their money on alcohol rather than on a proper diet at home.
- Intra-household food allocation favours men, in-laws, and children; thus, women serve their family first, often left with little food.
- Household food insecurity (HFI) is associated with one or multiple micronutrient (MMN) deficiencies among women and children. Chronic food insecurity leads to various deficiency disorders, among which anaemia is the most prevalent.

Geographical and Spatial Effect

The variability in environmental factors, nutrition, military, and climate can partially explain the geographical differences that cause anaemia. When we have to consider a perfect Indian example based on NFHS, there is a higher presence of anaemia in cold areas: the Himalayan Cold area. In Ladakh, 92.5% of children, 92.8% of women and 76% of men are anaemic. In Lahaul and Spiti (Himachal Pradesh), 91% of children and 82% of women are anaemic. Meanwhile, the prevalence is comparatively lower in Jammu & Kashmir and the rest of Himachal. Seasonality also plays an important role in the intake of various food groups, noting seasonal differences in the consumption of vegetables, fruits, eggs and meat and energy intake (Chungkham et al., 2021).

In the Pune Maternal Nutrition Study, pregnant Indian women reported dietary variations in different seasons, with a higher percentage of women meeting nutritional recommendations in the winter compared to summer or monsoon seasons (Talegawkar et al., 2021). Even with family income being relatively steady throughout the year, the food variety score, diet diversity score, and energy intake were higher in winter than in summer. Food prices and the fluctuation in household incomes across the year also play a role in food accessibility and food selection. In addition, dietary traditions or norms dictate that different foods are consumed across seasons; for example, more high-calorie foods are commonly consumed in winter than in other seasons.

Similarly, anaemia-associated diseases such as thalassemia are particular to a few ethnic groups: Italian, Greek, Turkish, Middle East, South Asian, and African descent. The influence of unobserved factors on childhood anaemia is powerful in the Northern and Central parts of India. However, most states in the Northeastern part of India showed negative spatial effects. A U-shape non-linear relationship

was observed between childhood anaemia and the mother's age. This indicates that mothers of young and old generations are more likely to have anaemic children, in particular, mothers aged 15 years to about 25 years. Then the risk of childhood anaemia starts declining after the age of 25 years, and it continues till the age of around 37 years; after that, it again starts increasing. Further, the non-linear effects of the duration of breastfeeding on childhood anaemia show that the risk of childhood anaemia decreases till 29 months after that increases (Chungkham et al., 2021).

Strong evidence of a residual spatial effect on childhood anaemia in India is observed. Government child health programmes should gear up in treating childhood anaemia by focusing on known measurable factors such as the mother's education, mother's anaemia status, family wealth status, child health (fever), stunting, underweight, and wasting, which are significant in this study. At the community level, attention should also be given to the effects of unknown or unmeasured factors on childhood anaemia. Special attention to unmeasurable factors should be focused on the states of central and northern India, which have shown significant positive spatial effects. Communally underprivileged children are highly likely to be anaemic compared to those in other areas requiring special attention. Childhood anaemia was highest in Central India, followed by North, Union Territories, East, West, and South of India. In addition to the biological naivety of young mothers, being from a communally underprivileged group also affects health outcomes among under-fives (Yadav & Nilima, 2021). The percentage of childhood anaemia was highest in Central India, followed by North, Union Territories, East, West, and South of India. Children born in the Northeast region are observed to be at the least risk of being anaemic compared to all other areas of India. Among the Empowered Action Group (EAG) states, anaemia was associated with several factors among women, like rural residence, parity, diet, schedule tribe, educational status and body mass Index (BMI) (Dubey et al., 2019).

Anaemia rates also differ by caste/tribe, and women in the tribal community have higher rates than their counterparts. Tribal communities are 'at risk' of undernutrition due to geographical isolation and suboptimal utilisation of health services. Tribal people have been observed to have a higher prevalence of anaemia, and the factors causing it varies according to their geographical location and cultural practices (Ghosh-Jerath et al., 2013). The geriatric age group and low socio-economic status people were particularly vulnerable to developing anaemia, and special focus must be given to them while administering preventive and control measures. Increasing age and low socio-economic class were found to be common risk factors associated with anaemia among both sexes, whereas menorrhagia was found to be a significant factor in females (Ismail et al., 2016).

Interventions must focus on tribal culture, medical training of indigenous people, a health care delivery system catering to the community's needs, and more research. Modern medicine is not accepted in most tribal areas, where magico-religious health care systems prevail. Health conditions in tribal areas have been described as deficient in sanitary conditions, personal hygiene, and health education.

Effect of Water and Sanitation on Anaemia

Iron-focused interventions have only reportedly resolved 50% of anaemia in children (Kothari et al., 2019). This fact shows that some other factors need to be addressed (apart from nutritional reasons). Water, sanitation and hygiene (WASH) practices, in addition to safe water provision, a supply of adequate sanitation, and proper hygiene education, can significantly reduce illness and death and improve child health outcomes and socioeconomic development. About 50% of the underweight or malnutrition burden in children under five can be attributed to recurrent diarrhoea or intestinal helminth infections that result from poor WASH.

Conclusion

Though the Indian government has exerted efforts to battle anaemia, the burden of anaemia is increasing and leading to long-term damage to development. New and innovative strategies are needed, particularly those improving overall health and nutrition. These strategies should be tailored to local conditions, considering anaemia-specific aetiology and prevalence in a given setting and population group (van Zutphen et al., 2021).

On the face of it, anaemia looks like simply a physical ailment resulting from low iron and protein intake, irked by hookworm, malaria, or haemorrhage. But anaemia is a much more complicated fusion. It is a symptom of serious socio-economic and political illness. So, it is seen that despite the progress made in anaemia reduction in the last decade, especially in children and women, anaemia continues to be a major public health concern in India. To accelerate anaemia reduction, health interventions should be targeted at pregnant women and interventions for women and children during childhood; a holistic approach is needed.

Since anaemia is more among women who did not receive adequate antenatal care, strengthening antenatal care services and increasing their utilisation could be an important measure to control anaemia during delivery. The World Health Organisation recommends at least four antenatal care (ANC) visits during pregnancy. Indian guidelines also suggest that along with a minimum of three ANC visits, a woman should consume 90 or more IFA tablets and take two tetanus toxoid (TT) injections.

In India, there always needs to be a link between policy and practice. As India's 'bloody' problem, anaemia stands at the intersection of health, nutrition, culture, and gender. Various perceptions and myths have to be removed from people's minds through aggressive awareness campaigns. One out of two women is anaemic in India, which shows that India needs to intensively work on removing the remark as 'the Anaemic capital of the world'. Every year on 26th November, India commemorates Iron Deficiency Day to raise awareness about the serious health consequences posed by the deficiency. Iron is the real wealth. 'Fight off the symptoms of Iron Deficiency Anaemia by consuming fortified staples like rice, wheat flour, and double fortified salt, rich in iron', as per FSSAI standards.

Sanitation and hygiene standards have to be maintained because only a clean India can lead to a healthy India.

Declaration of Conflicting Interests

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

Funding

References

Bhatnagar, R.S., & Padilla-Zakour, O.I. (2021). Plant-based dietary practices and socioeconomic factors that influence anemia in India. *Nutrients*, *13*(10) 1–19.

Brannon, P.M., & Taylor, C.L. (2017). Iron supplementation during pregnancy and infancy: Uncertainties and implications for research and policy. *Nutrients*, *9*(12), 1–17.

Chandran, V., & Kirby, R.S. (2021). An analysis of maternal, social, and household factors associated with childhood anemia. *International Journal of Environmental Research and Public Health*, *18*(6), 1–17.

Chungkham, H.S., Marbaniang, S.P., & Narzary, P.K. (2021). Childhood Anemia in India: An application of a Bayesian geo-additive model. *BMC Pediatrics [Internet]*, *21*(529), 1–12. https://doi.org/10.1186/s12887-021-03008-0

De Benoist, B., McLean, E., Egli, I., & Cogswell, M. (2008). Worldwide prevalence of anaemia 1993–2005: WHO Global Database on Anaemia. WHO.

Dubey, D.K. (2019). Socio-demographic determinants of anemia among women: A study about empowered action group (EAG) states of India. *Indian Journal of Public Health Research & Development*, *10*(5), 720–723.

Ghosh, S., Sinha, S., Thomas, T., Sachdev, H.S., & Kurpad, A.V. (2019). Revisiting dietary iron requirement and deficiency in Indian women: Implications for food iron fortification and supplementation. *Journal of Nutrition*, *149*(3), 366–371.

Ghosh-Jerath, S., Singh, A., Bhattacharya, A., Ray, S., Yunus, S., & Zodpey, S.P. (2013). Dimensions of nutritional vulnerability: Assessment of women and children in Sahariya tribal community of Madhya Pradesh in India. *Indian Journal of Public Health*, *57*(4), 260–267.

Ismail, I., Kahkashan, A., Antony, A., & VK, S. (2016). Role of socio-demographic and cultural factors on anemia in a tribal population of North Kerala, India. *International Journal of Community Medicine and Public Health*, *3*(5), 1183–1188.

Kothari, M.T., Coile, A., Huestis, A., Pullum, T., Garrett, D., & Engmann, C. (2019). Exploring associations between water, sanitation, and anemia through 47 nationally representative demographic and health surveys. *Annals of the New York Academy of Sciences*, *1450*, 249–267.

Neogi, S.B., Devasenapathy, N., Singh, R., Bhushan, H., Shah, D., Divakar, H., Zodpey, S., Malik, S., Nanda, S., Mittal, P., Batra, A., Chauhan, M.B., Yadav, S., Dongre, H., Saluja, S., Malhotra, V., Gupta, A., …, Baswal, D. (2019). Safety and effectiveness of intravenous iron sucrose versus standard oral iron therapy in pregnant women with moderate-to-severe anaemia in India: A multicentre, open-label, phase 3, randomised, controlled trial. *Lancet Global Health*, *7*(12), e1706–e1716.

Onyeneho, N.G., Ozumba, B.C., & Subramanian, S.V. (2019). Determinants of Childhood Anemia in India. *Scientific Reports [Internet]*, *9*(1), 1–7. http://dx.doi.org/10.1038/s41598-019-52793-3

Owais, A., Merritt, C., Lee, C., & Bhutta, Z.A. (2021). Anemia among women of reproductive age: An overview of in low- and middle-income countries. *Nutrients*, *13*, 2745.

Pandav, C.S., Yadav, K., Srivastava, R., Pandav, R., & Karmarkar, M.G. (2013). Iodine deficiency disorders (IDD) control in India. *Indian Journal of Medical Research*, *138*(SEP), 418–433.

Rana, M.J., Gautam, A., Goli, S., Uttamacharya Reja, T., Nanda, P, Datta, N., & Verma, R. (2019). Planning of births and maternal, child health, and nutritional outcomes: Recent evidence from India. *Public Health [Internet]*, *169*, 14–25. https://doi.org/10.1016/j.puhe.2018.11.019

Refsum, H., Yajnik, C.S., Gadkari, M., Schneede, J., Vollset, S.E., Örning, L., Guttormsen, A.B., Joglekar, A., Sayyad, M.G., Ulvik, A., & Ueland, P.M. (2001). Hyperhomocysteinemia and elevated methylmalonic acid indicate a high prevalence of cobalamin deficiency in Asian Indians. *American Journal of Clinical Nutrition*, *74*(2), 233–241.

Sedlander, E., Talegawkar, S., Ganjoo, R., Ladwa, C., Di Pietro, L., Aluc, A., & Rimal, R.N. (2021). How gender norms affect anemia in select villages in rural Odisha, India: A qualitative study. *Nutrition [Internet]*, *86*, 111159. https://doi.org/10.1016/j.nut.2021.111159

Singla, P.N., Tyagi, M., Kumar, A., Dash, D., & Shankar, R. (1997). Fetal growth in maternal anaemia. *Journal of Tropical Pediatrics*, *43*(2), 89–92.

Talegawkar, S.A., Jin, Y., Sedlander, E., Ganjoo, R., Behera, S., Dipietro, L., & Rimal, R. (2021). A social norms-based intervention improves dietary diversity among women in rural India: The reduction in anemia through normative innovations (rani) project. *Nutrients*, *13*, 2822.

van Zutphen, K.G., Kraemer, K., & Melse-Boonstra, A. (2021). Knowledge gaps in understanding the etiology of anemia in Indonesian adolescents. *Food and Nutrition Bulletin*, *42*(1 supp.), S39–S58.

Yadav, J., & Nilima, N. (2021). Geographic variation and factors associated with anemia among under-fives in India: A multilevel approach. *Clinical Epidemiology and Global Health [Internet]*, *9*, 261–268. https://doi.org/10.1016/j.cegh.2020.09.008

Book Review

Prabhu Pingali, Anaka Aiyar, Mathew Abraham, Adaleeb Rahman, *Transforming Food Systems for a Rising India*. Palgrave Macmillan, 2019, 382 pp., Open access, ISBN 978-3-030-14409-8 (eBook), DOI: https://doi.org/10.1007/978-3-030-14409-8

The book *Transforming Food Systems for a Rising India* presents scientific evidence to demonstrate the current state of food systems and nutrition outcomes in India in a timely and efficient way, focusing on regional patterns accentuating small farmers' issues and environmental sustainability. The 382 pages book, published by Palgrave Macmillan, is divided into 11 chapters and focuses on agriculture-led development strategies and policies to ensure nutrition security and rural prosperity in India. It explores farmers' challenges and provides recommendations to policymakers with appropriate actions for shaping the future food systems while considering small farmers, regional imbalance, environmental sustainability, and climate change threats. The author(s) of the book adopted a *Food System Approach* while considering the economic development-agricultural production-nutrition-nexus and reviews policies that cost the environment while increasing productivity and economic growth at the expense of regional inequality hurting small farmers and top-down approaches that aim to reduce undernutrition with focusing less on tackling growing obesity. Each chapter provides information systematically and critically evaluates policy gaps, introducing the following chapter's scope.

The contours of the green revolution in the 1960s, followed by economic liberalisation in the 1990s, have undoubtedly been credited with steering India onto a path of high growth while adversely affecting regional disparities. There is a need for more infrastructure and institutional support to benefit small farmers. The discrepancies in resource endowment and nationwide policies cause some states to resemble poor countries of Sub-Saharan Africa (SSA) while others to developing countries in Latin America. Regional inequality has been observed in terms of the GDP, rate of urbanisation, poverty, and nutrition. It shows the horrifying scene across states, where some states are comparable with SSA, Latin America, and Southeast Asia regarding per capita GDP. Although agricultural development reduces rural poverty and improves food and nutrition security, there is a significant difference across states. For example, agricultural development reduced rural poverty in Punjab, but it failed in Odisha due to low productivity and a lack of other employment opportunities. Nutrition inadequacy in Madhya

Pradesh and the increased obesity in Kerala pose challenges. States vary in terms of their level of urbanisation as well as investment in agriculture, industry, and commercial sectors. Agriculturally advanced states like Punjab and Andhra Pradesh experienced growth from the green revolution with a concentration on staple grain production, slowing down income growth. The agro-climatic constraints and underdeveloped infrastructural facilities lagged from the benefits of the green revolution for eastern states like Odisha and Bihar.

The following chapter of the book focuses on identifying livelihood challenges faced primarily by the rural people and the causes of their increased moving out of agriculture. Rapid urbanisation increased the demand for high-valued nutritious food on a large scale, necessitating changes in the food policies to feed the poor sustainably and developing urban agriculture and the value chain to create jobs for surplus labour left out of the rural production system. Such inclusivity may enhance agricultural growth and the rural-urban continuum, eventually creating ample job opportunities for small farmers. The rural-urban cluster can benefit local economies by allowing exchanges of goods and services for consumption and agricultural production. A recently published book highlighted such scheme, that is, *Custom Hearing Centres (CHCs)* developed by the state government of Madhya Pradesh to make modern equipment available for agriculture in the village and use them at each stage of cultivation, providing small farmers easy access to modern equipment of agriculture near their farms (Gulati et al., 2021). Here, a state can learn from the successful policies of other states and apply them for the betterment of farmers in their communities. The next chapter clarifies that economic growth and the rise in per capita income resulting from the diversification of agriculture shifted the consumption preference from quantity to quality with greater emphasis on fruits, vegetables, and other livestock products. Later globalisation eventually increased the consumption of processed food across rural-urban nexus and enhanced income inequality creating challenges for the availability, accessibility, and affordability of such non-staple foods. Also, price volatility, seasonal supply, lack of storage, and value chain are the major concerns for an affordable price. Along with poor nutrition, obesity among the rapidly growing urban population emerged as a challenge.

Chapter 5 focuses on the issues of nutrition and obesity while bringing light to nutrition transformation. The structural changes in India have made commendable progress in reducing hunger and undernutrition while growing obesity and rising non-communicable diseases (NCD) remain alarming concerns. A close relationship exists between dietary diversity and a lower prevalence of hidden hunger and nutritional outcomes, although this is not beyond debate. To secure access to diverse food at the household level, the local food production system must be diversified, and the intervention to improve the affordability of diets must be comprehensive. The continued focus on staple crops in India is weakening the availability of a diversified diet. Thus, it is needed to create efficient and well-functioning markets for non-staple crops. The following chapter focuses on food safety nets in India which are critical for poverty reduction drives in India. Public work and life-cycle-based food assistance programs must be designed to associate with the local agrarian economy. Most policies have yet to consider the growing

urban population and changing demand for food and employment there. The existing policies primarily have a greater rural preference, that is, MGNREGA has only been designed for rural jobs. The PDS has especially procured staple grain; thus, those policies need to rectify, considering that by 2050, this country will have more urban population.

The country is undergoing a structural transition, and in this process, small farmers will face acute challenges such as accessing markets, credits and adopting modern, improved technology, etc. At the same time, diversification towards high-value crops can improve income and access to varied food baskets. For small farmers to avail diversification opportunities, institutional intervention can be a way to mitigate transition costs by organising group access through FOPs and cooperatives. Regions such as Northern and Eastern India require special attention, where farmers face dire challenges. Investment in infrastructure and promotion of contract farming can be viewed as creating a favourable environment for small farmers. But small farmers in contract farming need to reap substantial benefits compared with their large counterparts, although they diversify agriculture and increase income and production (Kumar et al., 2020). The existing policy on contract farming suggested to be rectified transparently and made more farmer-friendly so that small farmers can benefit from this practice. The following chapters extend the focus on existing markets that can reduce transition costs and enhance farmers' bargaining power. The changing demand for food necessitated the value chain and vertical coordination enabling direct linkages such as *e-NAM, Rashtriya eMarket Services Pvt. Ltd* to bypass traditional markets. Those online marketing platforms can be viable alternatives for perishable crops and reduce transition costs. Policies must be designed considering the local environment for addressing the likely challenges of digital mode of marketing. Promoting FPOs and cooperatives can help small farmers access markets, better prices, and alter commercial crops in lagging states. Agriculture-led states and urbanising states are already highly commercialised. Thus, alternative models, such as contract farming, are more likely to succeed in them. Newer policies must focus on small farmers' access to the market, reducing transition costs and diminishing the challenges of adopting new technologies, information, and extension services.

Technology in the past played a critical role during the green revolution for India to become self-sufficient in cereals, especially rice, and wheat. Nevertheless, it has regional imbalance as it only succeeded in better-endowed regions (like Punjab and Haryana). It has limited it with certain cereals crops and the environmental impact leading to water and land degradation. However, technology remains crucial in India to face the future food demand with rising demand for quality food items. Crop improvement technology is prioritised to improve yields, especially coarse cereals like millets and pulses. Thus, infrastructural and environmental management through public sectors in accessing the public sectors interventions is crucial for small farmers. The authors in the following chapter argue that diversification can improve the cultivation of high-value crops, but it should follow environmental sustainability. Otherwise, it can adversely affect agriculture severely. It is well documented that the rising temperature impacts major staples, such as rice and wheat decking productivity. Also, there needs to be

more focus on understanding the impact of climate change on crops like millet and sorghum, which are more significant for people with low incomes. Moreover, few studies on nutrient-rich food like fruits and vegetables, pulses, and livestock demand are rising. Also, advanced technology is needed to safeguard against the effects of climate change on productivity, which adversely affect nutrition security. The current development policies integrating adaptation and mitigation of climate change on a limited scale would build severe issues in the future. Policies should include investment in clean energy resources, climate-smart infrastructure, and natural resource conservation & preservation, and the progress of policies must be measured and tracked through accountability.

The book systematically summarised the challenges of Indian agriculture while focusing on regional inequality, rural-urban nexus, farm size, and climatic conditions. The book's final chapter highlights how food systems can enable rural prosperity and nutrition security. The specific focus on the productivity of cereals, particularly rice, and wheat, resulted in regional imbalance. Today India is in a crisis of malnutrition and obesity that need to be tackled by diversification of agriculture. Further, the quality of health and hygiene environment also plays a role that can be promoted by policy intervention to improve water and sanitation development. Behaviour changes programs such as using hygienic toilets, developing a healthy housing environment, and bringing women empowerment through education, delay in child marriage, safety, and others will lead to positive nutrition and health outcomes.

Based on this book and more recent literature, it is indicated that agricultural diversification and value chain linkages would be crucial for agricultural development in India. Globalisation has consolidated the *front-end* activity, for example, post-harvest activities, that is, allowing direct procurement through the private sector, agro-processors, processing industries, retail businesses, and advanced supply chains. While the *back-end* activities, that is, cultivation shifting towards fragmentation rather than consolidation, will continue to be fragmented, and smallholder farmers will be more in the coming days. The future of agriculture development, particularly smallholder farmers' performance, would be crucial and rely on the successful linkages of front-end and back-end activities. Agriculture diversification can be seen as a viable option for food security and economic and environmental sustainability. That entails diversifying crops, enhancing farmers' income growth, and generating employment opportunities for smallholders and rural labourers. Further, promoting contract farming without a legal framework and government intervention in contract mechanisms would be exploitative. A recently published book suggested cooperative models like AMUL (Gujarat farmers receive almost 57–80 per cent of consumer spending) can be applied to other commodities like fruits and vegetables to return more to farmers (Gulati et al., 2021).

This book is a comprehensive discussion of agriculture challenges at the regional level, that is, across states, rural-urban contexts, small farmer perspectives, and finally, environmental conditions. One of the book's limitations is that it may have overemphasised the role of diversification as a remedy. It did not consider the arguments against diversification at the level required. Still, this book may

assist policymakers in adjusting old practice models, and the authors should be applauded for their contribution to the agriculture-food-nutrition-systems, which are under stress now.

References

Gulati, A., Roy, R., & Saini, S. (2021). *Revitalizing Indian agriculture and boosting farmer incomes* . Springer Nature. https://doi.org/10.1007/978-981-15-9335-2

Kumar, P., Manjunatha, A. V., & Sourav, S. K. (2020). *Contract farming and land tenancy in Indian agriculture*. Sage.

Prasenjit Barik
Doctoral Research Scholar
Indian Institute of Technology Guwahati, Assam, India
E-mail: pbarik@iitg.ac.in