



The Participation Pattern of Women in Agriculture: A Study in Agro-Climatic Regions of West Bengal

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ABSTRACT

Agriculture plays an important role in the economy of West Bengal. It accommodates the largest share of the labour force. The sustainability of the rural economy of West Bengal solely depends on agricultural productivity. The physiography, soil, and climatic conditions are much more congenial to diverse agricultural development. More than fifty per cent of total workers are engaged in agricultural activities, and among them, the women workers share more than thirty-five per cent. Eight per cent of women workers are cultivators, and the rest are marginal workers, which makes them economically vulnerable. In this context, an attempt has been made through this paper to illustrate the women's participation pattern in agriculture in the agro-climatic region of West Bengal. The study is based on secondary data from the 2011 District Census Handbook. The work participation rate of women, the literacy rate, and the correlation matrix have been examined in this study. The QGIS platform has also facilitated a zonal variation of women's work participation. A shift has been identified in the agro-economy with the increasing rate of women's literacy and urbanisation. So, the women's participation pattern in agricultural activities has changed. Dependency on the agro-economy has reduced. The workforce participation rate has declined from 73.8 to 40.4 per cent from 1981 to 2011. This decline reflects broader societal changes and shifts in economic structures, where women are increasingly engaging in diverse sectors beyond agriculture. Consequently, these trends highlight the need for policies that support women's empowerment and workforce integration across various industries.

Keywords: Agro-climatic Region, Agriculture, Women's Participation, Vulnerability, Economy, Empowerment.

1. Introduction

Agriculture is the most rudimentary economic activity in human history. India's economy is largely dependent on agricultural productivity and activity (Bollem et al., 2022; Khan, 2021). Its physical diversity and unequal distribution of rainfall encourage many types of agricultural systems and crop production (Agrawal et al., 2021). Agriculture employs more than 54.6 per cent of the overall workforce (Census, 2011). Agriculture and related industries absorbed skilled, semi-skilled, and unskilled labour. Women make significant contributions to agriculture and rural economies in all developing countries worldwide (Tian et al., 2015). Women work as labourers and cultivators in agriculture around the world (Burton & White, 1984). Women's participation in agriculture in South Asia and Southeast Asia ranges from 35 to 50 per cent. Nepal is one of the leading countries in Asia in terms of female participation in the agricultural labour force (Mishra et al., 2023). In India, however, women's participation in agriculture has remained stable at somewhat more than 40%. The average for African countries is between 40 and 50 per cent. Latin American developing countries have a lower average (just over 20%) of female agricultural labour force. So, in this international scenario, agriculture is the most important source of employment for women in South Asia and Sub-Saharan Africa. In India, over 47% of women work in agriculture, whereas approximately 33% are cultivators (Ghosh & Ghosh, 2014). Cereal production accounted for over 94 per cent of female agricultural labour force participation. The nature or type of crop production

determines women's agricultural participation rates (Rasheed et al., 2020). Female agricultural participation (94%) is strong in cereal production. Only 1.4 per cent of women in agriculture work in vegetable cultivation. Production of nuts, beverages, and spices employs approximately 3.72 per cent of the labour force (Quisumbing et al., 2014). In West Bengal, women's agricultural labour force participation rates range from 57 to 70 per cent, while women cultivators account for approximately 30 per cent (Agarwal, 1986). Women's engagement in agricultural pursuits varies by district. Agro-climatic zones in West Bengal have been identified to research women's participation in agriculture and understand the causes driving this zonal variance (Aktar, 2015). Regionalisation is an important feature of geography for developing planning and policy for a spatial unit. Women's participation in agriculture varies depending on the type of farming and cropping system used in the region (Huyer, 2016; Saud, 2021). Crop choices and agricultural systems are directly influenced by land topography, rainfall amount, temperature intensity, soil properties, and water resource availability (Banerjee et al., 2019; Tian et al., 2015). From this perspective, various organisations and institutions have made significant attempts to designate the agro-climatic regions of India and West Bengal (Mandal et al., 2022). The agro-climatic zone is the unit of land identified by primary climates, terrain, soil compatibility for specific crops and cultivars (ICRISAT, 1980). In 1972, Krishnan and Mukhtar Sing used the "Thorntwait" indices to split West Bengal into 24 agro-climatic zones. In 1988, the Planning Commission of India proposed 15 zones and 73 sub-zones for India's agro-climatic region. These zones are defined by topographic homogeneity, soil type, rainfall, temperature, and cropping pattern characteristics. West Bengal is classified as zone 3, named after the lower Gangetic plains region. In 1979, the Indian Council of Agricultural Research (ICAR) proposed the National Agricultural Research Project (NARP), which aimed to focus on the concerns of each agro-climatic zone. It also divides India into 127 agro-climatic zones, with West Bengal having six. In this study, six agro-climatic zones in West Bengal, as defined by ICAR, were considered to focus on regional diversity in participation patterns and their determinants. The Northern Hill Zone is the first zone, which includes the districts of Darjeeling and Kalimpong. The Terai-Teesta Alluvial Zone is the second and includes the districts of Jalpaiguri, Alipurduar, Cooch Behar, and Uttar Dinajpur. The third one is the Vindhyan Alluvial zone, which includes Dakshin Dinajpur and Malda districts. The Gangetic Alluvial zone is the fourth in this group, covering the districts of Murshidabad, Nadia, North 24 Parganas, Howrah, Kolkata, Hooghly, Purba Bardhaman, and Paschim Bardhaman. Purulia, Bankura, Paschim Medinipur, and Birbhum make up the fifth zone, which is undulating red and laterite in nature. The coastal saline zone is the sixth, and only two districts, Purba Medinipur and South 24 Parganas, come under this zone.

2. Database and methodology

2.1 Sources of data

In this study, various secondary data related to socio-economic characteristics of female agricultural labour, cultivators, literacy rate, scheduled caste and scheduled tribe population, percentage of food grain area, and urban population have been used. The data has been collected from the Census of India, 2011. The information related to agro-climatic zones in West Bengal has been collected from the National Agricultural Research Project (NARP), 1979. The secondary data has also been collected from the National Sample Survey Office (NSSO) - 2019.

The agro-climatic region has been considered when studying women's participation in agricultural activities. The participation pattern can be studied in three different ways. First, investigate the changes in participation rates produced by multiple factors throughout a period (1981-2011). Second, women engage in a variety of farming occupations, with variable patterns. Third, evaluate the wage disparity and payment systems. This study used several essential methodologies to establish the pattern of women's participation in agriculture. The list is as follows.

2.2 Compound Annual Growth Rate (CAGR)

This study uses compound annual growth rate to determine the average yearly growth rate of women's participation in agricultural activities from 1981 to 2011. This growth rate is commonly used in economics to compute the compound annual growth rate of an investment over a given period. In this study, the CAGR is highly beneficial in determining the direction and quantity of change in women's agricultural participation. The formula for CAGR is shown below.

$$\text{Compound Annual Growth Rate (CAGR)} = \left(\frac{V_b}{V_e} \right)^{\frac{1}{n}} - 1 \dots\dots\dots (\text{Eq. - i})$$

Where: V_b refers to the beginning value, V_e refers ending value, and n refers number of years.

2.3 Work Participation Rate (WPR)

Work participation is an important measure of any economy. It measures the percentage of the total population that participates in the labour force. In this study work participation rate measures both cultivators and the agriculture labour percentage of main and marginal workers.

Women's work participation rate as agricultural labourers

$$= \frac{\text{Total women agricultural labour (main+marginal)}}{\text{Total workers}} * 100 \dots \dots \dots (\text{Eq. - ii})$$

Women's work participation rate as cultivators

$$= \frac{\text{Total women cultivators (main+marginal)}}{\text{Total workers}} * 100 \dots \dots \dots (\text{Eq. - iii})$$

2.4 Female literacy rate

Female literacy plays a significant role in agricultural practices and production. Education enables women to make decisions about farming, marketing, food processing and maintaining the household consumption and nutrition. Sometimes education makes them cultivators in the place of agricultural labour. The following formula has been used here to obtain the female literacy rate.

$$= \frac{\text{Femlae literate population}}{\text{Total female population (exclude 0-6 age group)}} * 100 \dots \dots \dots (\text{Eq. - iv})$$

2.5 Urbanism and agricultural activities

Urbanism reduces agricultural activities. Every day, the number of people living in cities grows. They eventually engaged in non-agricultural pursuits. As a result, the pattern of participation in agricultural activities has shifted dramatically during the last decade. Urbanism has a direct impact on our way of living. The following measures were used to assess the inclination of females residing in urban regions in West Bengal.

$$\text{Urbanism} = \frac{\text{Femlae population living in urban areas}}{\text{Total female population}} * 100 \dots \dots \dots (\text{eq. - V})$$

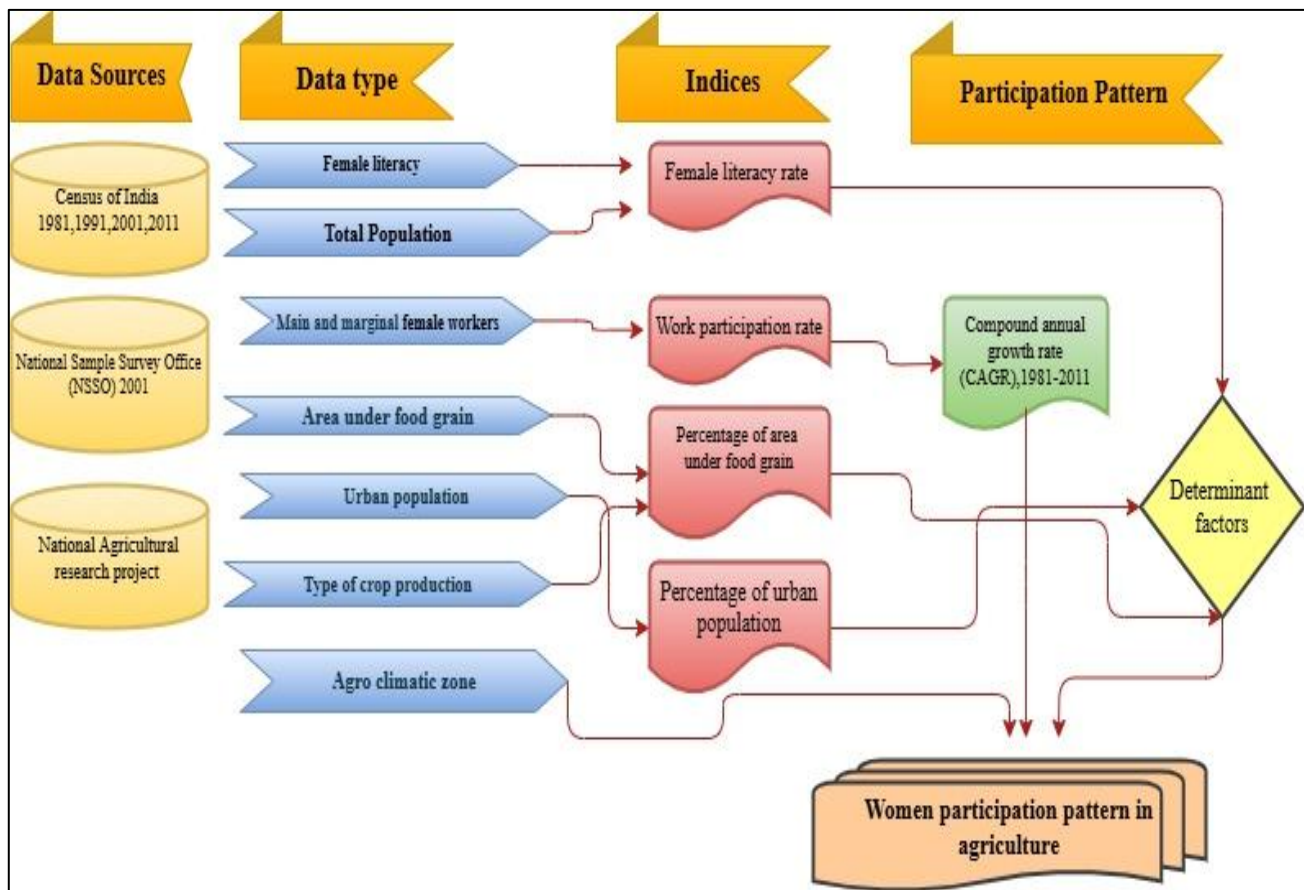


Figure 1: Methodological flow chart of the study

3. Results and discussion

3.1 Women's Participation in Agriculture

There are two ways that women participate in agriculture. Women engage in agricultural labour as paid workers, performing tasks like ploughing, planting, transplanting, weeding, and harvesting (Prathibha & Reddy, 2022). A woman is considered a cultivator when she works on her land and makes all agricultural decisions, including selecting and producing crops. As previously mentioned, this study uses agro-climatic zones to examine women's participation patterns in West Bengal. Every climatic zone has its features, which also determine the nature as well as the pattern of participation of women in agriculture.

Table 1: Agro-climatic zone of West Bengal (NARP, 1979)

Agro-climatic zone	Name of the districts
Northern Hill Zone	Darjeeling
	Kalimpong
	Jalpaiguri
Terai - Teesta Alluvial Zone	Alipurduar
	Cooch Behar
	Uttar Dinajpur
	Mushidabad
	Nadia
Gangetic Alluvial Zone	North 24 Parganas
	Kolkata
	Howrah
	Hooghly
	Purba Bardhaman
	Paschim Bardhaman
	Dakshin Dinajpur
Vindhyan Alluvial Zone	Malda
	Purulia
	Bankura
Undulating Red and Laterite Zone	Paschim Medinipore
	Jhargram
	Birbhum
	South 24 Parganas
Coastal Saline Zone	Purba Medinipore

According to the Census of India, 2011, a high percentage of women participate in agricultural activities as agricultural labour compared to the cultivators. In the district of Jhargram, about 80 per cent of women are engaged as agricultural labour. In the Cooch Bihar district, about 30 per cent of women participate in agriculture as cultivators. The district of the Gangetic alluvial zone shows a very poor percentage of participation of women in agriculture. Kolkata is the capital city of West Bengal, so the percentage of women in agricultural labour and cultivators is very low in number. Cooch Behar is the only district where both the women agricultural labourers and cultivators are in significant percentages.

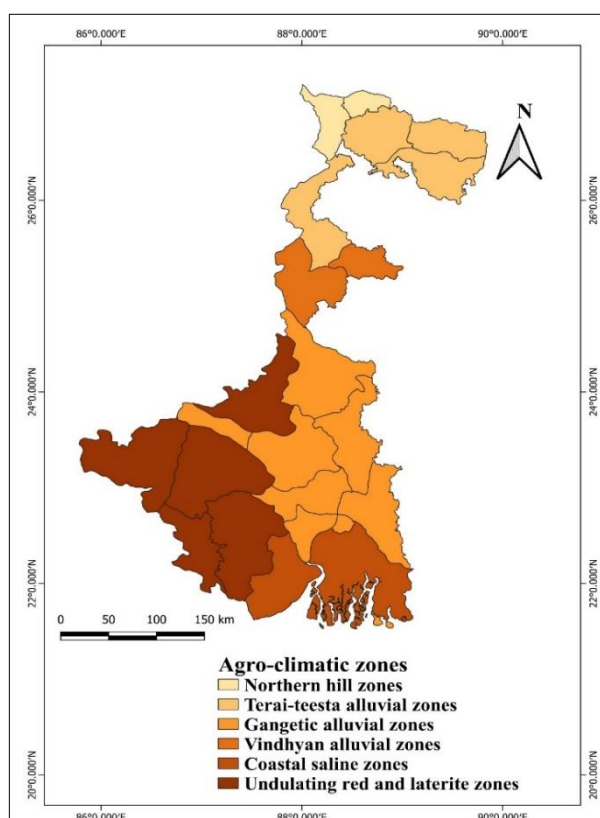
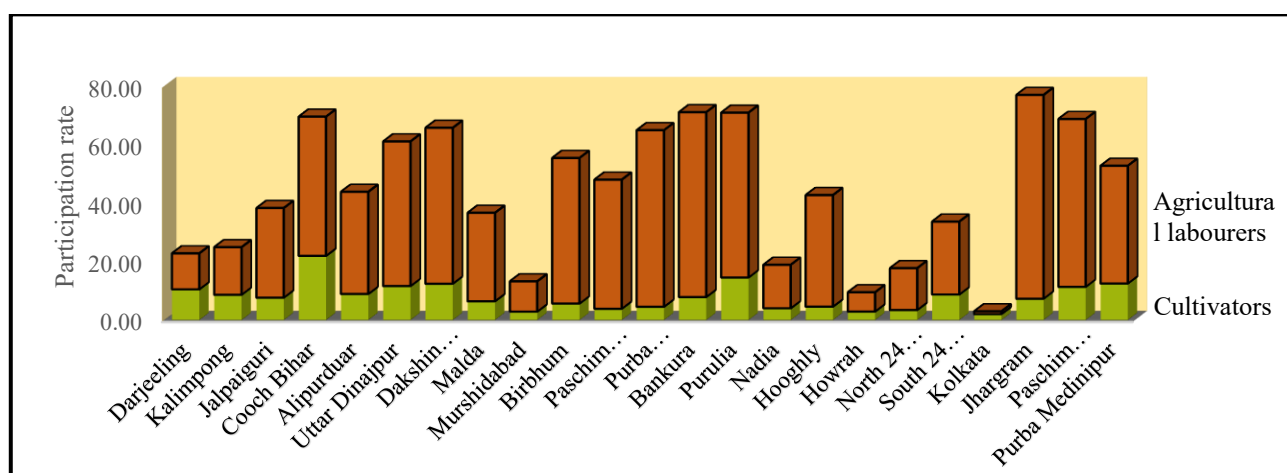
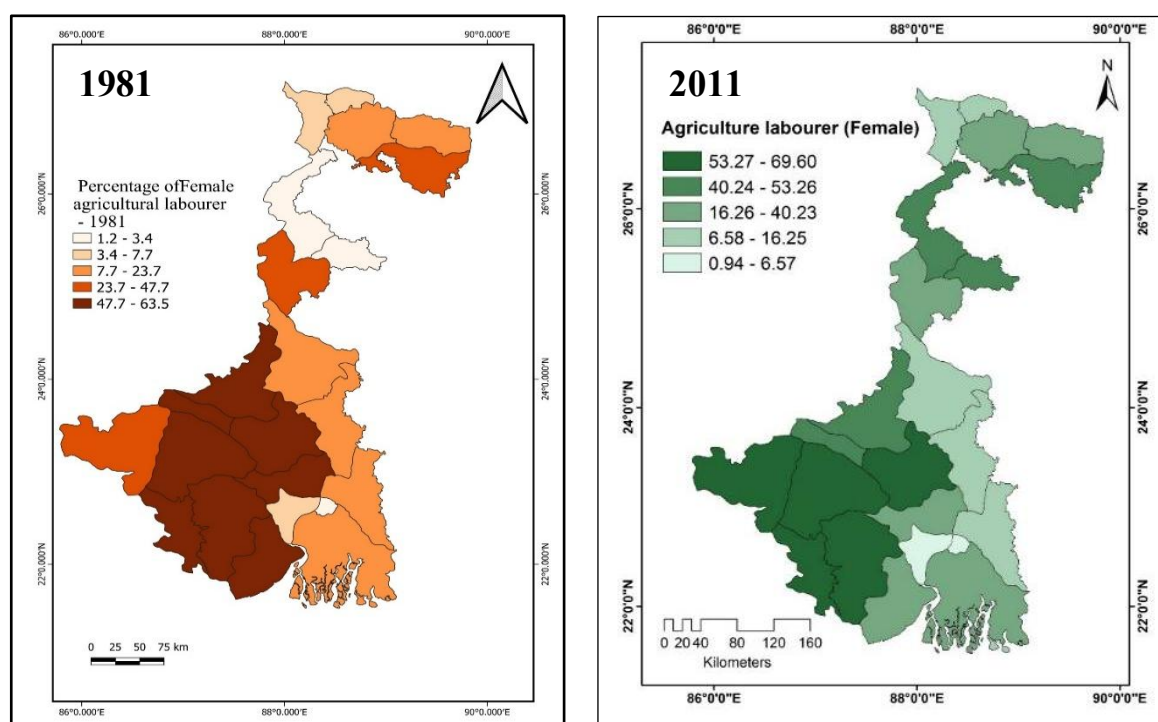


Figure 2: Agro climatic zones of West Bengal (NARP, 1979)**3.2 Women agricultural labour**

Women have a vital part in agricultural growth. Agriculture is a mostly unorganised sector of the economy that employs both skilled and unskilled workers. To learn about the temporal changes in the pattern of women's participation in agriculture, a comparative study was conducted between the census years 1981 and 2011 using the Compound Annual Growth Rate (CAGR). From 1981 to 2011, the proportion of women working in agriculture increased in the Terai-Teesta Alluvial Zone and Northern Hill Zone. Uttar and Dakshin Dinajpur are districts with a compound growth rate of more than 9%. In contrast, a falling CAGR has been detected in the agro-climatic zone of the Gangetic Alluvial zone. The districts of Howrah, Hooghly, Purba, and Paschim Bardhaman in North 24 Parganas have all seen a rise in female agricultural labour. A distinct picture has been observed in the Vindhyan Alluvial zone, where Dakshin Dinajpur has had a significant increase (more than 9%) in female agricultural participation. In contrast, the Maldah district has a decreasing rate. A different pattern has been observed in the coastal saline zone, where Purba Medinipur shows a decline rate and South 24 Parganas shows an increasing rate in the agricultural labour sector. In 2011, significant changes were seen between the districts of the Gangetic Alluvial zone and the Undulating Red and Laterite zone.

**Figure 3: District-wise percentage distribution of women's work participation in WB, 2011****Figure 4: Percentage of female agricultural labour 1981, 2011**

In some circumstances, literacy rates, urbanisation, and agricultural mechanisation reduce the amount of labour required for agricultural activities. In the Gangetic alluvial zone, there has been a remarkable increase in urbanisation, which provides job opportunities for women while simultaneously reducing women's reliance

on agriculture for income (Ghosh & Chakma, 2014). Women's literacy rates have grown, expanding career opportunities in several sectors of the economy. All of these elements have a direct impact on women's agricultural participation in West Bengal's agro-climatic zones.

Table 2: Compound annual growth rate (CAGR) 1981 to 2011 for women cultivators and labourers

Agro-climatic Zone	Name of the districts	CAGR (%) Cultivators	CAGR (%) Agricultural labour
Northern Hill Zone	Darjeeling	▼ -3.51	▲ 1.55
	Kalimpong	▼ -4.14	▲ 2.51
Terai - Teesta Alluvial Zone	Jalpaiguri	▲ 0.10	▲ 3.02
	Alipurduar	▲ 0.61	▲ 4.55
	Cooch behar	▲ 0.38	▼ -0.88
	Uttar Dinajpur	▲ 9.10	▲ 9.36
	Mushidabad	▼ -0.52	▼ -1.07
Gangetic Alluvial Zone	Nadia	▼ 0.22	▼ -1.54
	North 24 Parganas	▼ -1.39	▼ -0.50
	Kolkata	▲ 3.87	▼ -0.89
	Howrah	▲ 1.82	▲ 0.16
	Hooghly	▼ -1.30	▼ -1.43
	Purba Bardhaman	▼ -1.42	▼ -0.17
	Paschim Bardhaman	▼ -0.88	▼ -1.21
	Dakshin Dinajpur	▲ 9.12	▲ 9.64
	Malda	▼ -0.77	▼ -1.51
Undulating Red and Laterite Zone	Purulia	▼ -3.71	▲ 0.90
	Bankura	▼ -3.52	▲ 0.14
	Paschim Medinipore	▼ -1.81	▼ -0.08
	Jhargram	▼ -3.24	▲ 0.57
	Birbhum	▼ -2.97	▼ -0.68
Coastal Saline Zone	South 24 parganas	▲ 1.73	▲ 1.35
	Purba Medinipore	▼ -1.50	▼ -1.25

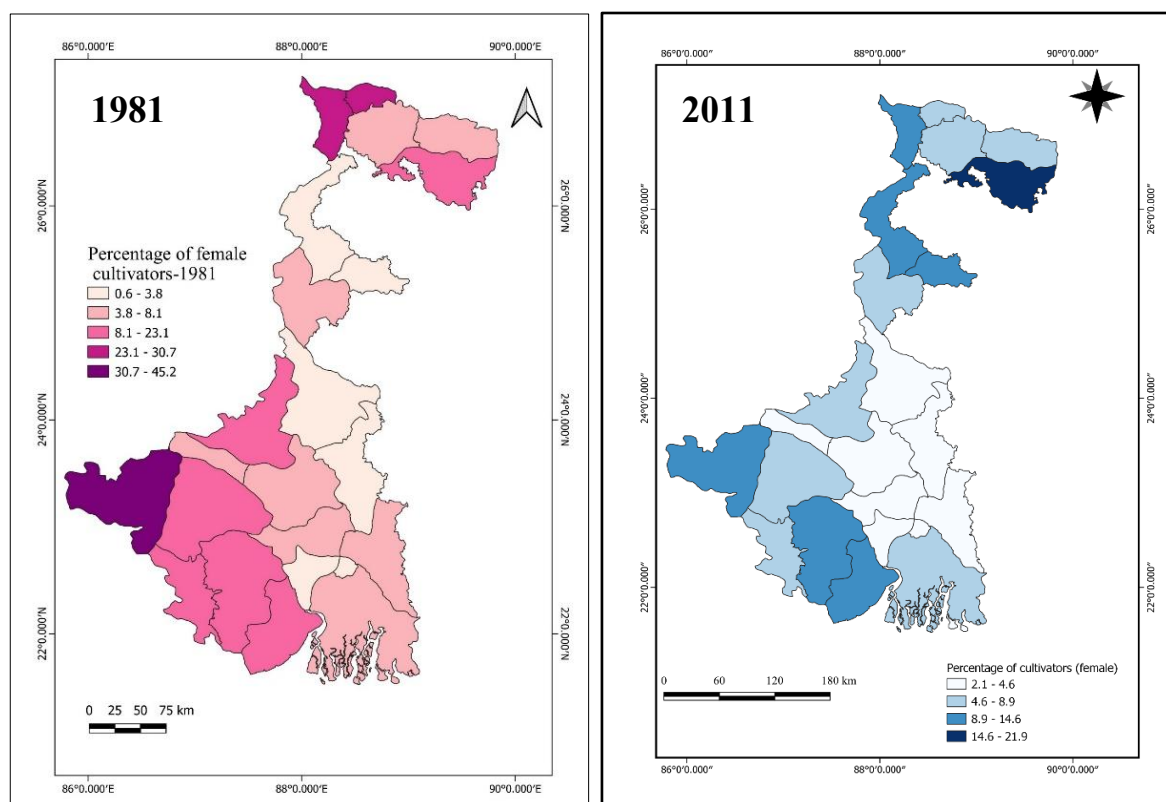


Figure 5: Percentage of Female cultivators 1981, 2011

3.3 Women Cultivators

Women's participation in agriculture as cultivators provides them with greater economic autonomy and decision-making power over agricultural activities (Pal & Haldar, 2016). Kalimpong and Darjeeling, two districts in the Northern Hill Zone, have seen a reduction in cultivators. The regions in the Terai-Teesta Alluvial zone have seen a significant growth in the number of female cultivators (Chakraborty & Kumar, 2022). In this zone, the Uttar Dinajpur district has a significant increase in the proportion of female cultivators. In the Vindhyan Alluvial zone, the Dakshin Dinajpur district has a considerable increase (9.12%) of female cultivators, but the Malda area has a drop in cultivators. The Gangetic Alluvial and Undulating red-laterite zone exhibits a dramatic decline in the rate of female cultivators. The district of South 24 Parganas in the Coastal Saline Zone has experienced an increase in the number of female cultivators. So, with the exception of the Terai-Teesta Alluvial zone, all agro-climatic zones in West Bengal indicate a reduction in the number of female cultivators.

3.4 Factors of women's participation pattern in agriculture (WPPA)

The goal of this study is to identify the pattern and factors that influence women's agricultural participation rates as cultivators and labourers. This study identified four elements that determine women's participation in agriculture. First, the Female Literacy Rate (FLR) has a negative correlation (-0.595) with women's agricultural participation. It is clear that as literacy rates have increased, the participation of women in agriculture has declined. Literacy offers them a variety of work opportunities. From 1981 to 2011, the ratio of agricultural cultivators in the Gangetic alluvial zone declined, while the literacy rate increased from roughly 20% to 80%. This fundamental transition has had a significant impact on West Bengal's occupational structure. Second, the percentage of women in the population who are Scheduled Caste or Scheduled Tribe (SC/ST) is the most important determinant factor. The correlation matrix shows a positive (0.554) relationship between the percentage of women in the SC/ST population and women in agriculture. Women of the scheduled caste and scheduled tribal populations have greater freedom than any other group of women.

Sometimes their ignorance and poverty compel them to work in agriculture. Darjeeling, Cooch Bihar, Uttar and, Dakshin Dinajpur, Paschim Medinipur, Bankura, and Puruliya districts all have a high proportion of SC and ST women population. The aforementioned districts had a high rate of female agricultural participation from 1981 to 2011. The third significant influencing element in agricultural participation is the percentage of area under food grain (AFG). Agriculture is a labour-intensive task in West Bengal as land holdings are relatively small and inadequate for agricultural mechanisation. Because of the high population density, there is enough cheap labour available. Every step of agricultural production requires a significant number of workers. Before we can analyse women's engagement in agriculture, it is critical to understand the pattern, intensity, and kind of crop production. Cereal crop cultivation is a significant part of West Bengal agriculture. Rice cultivation is one of the most significant cereal crops. Rice is cultivated in practically all districts of West Bengal (Korikanthmath et al., 2010). One-acre rice production requires approximately 70-100-man man-days, whereas wheat production requires only 29 (Steve Hatfield-Dodds, 2007). Dakshin Dinajpur, Purba and Paschim Bardhaman, Murshidabad, Maldah, Nadia, and Birbhum are high rice-producing areas. In these districts, women participate in agriculture at a significant rate. A significant correlation (0.579) has been observed between the area under food grain (AFG) and the women's participation rate. Weeding, transplanting, and fertilising are all labour-intensive tasks performed by women. Another key aspect is the percentage of urban population (PUP), which has a direct impact on female participation in agriculture. Kolkata, West Bengal's capital city, and its surrounding regions are mostly urbanised, hence a small proportion of women participate in agricultural pursuits. There is a negative correlation (-0.691) between urban population proportion and agricultural workers.

Table 3: Correlation matrix of determinant factors in women's agriculture participation -2011

Factors	WPPA	FLR	SC/ STP	AFG	PUP
WPPA	1				
FLR	-0.595	1			
SC/STP	0.554	-0.367	1		
AFG	0.579	-0.251	-0.086	1	
PUP	-0.691	0.668	-0.357	-0.341	1

Table 4: Percentage distribution of males and females in agricultural activities

Activities	Male (%)	Female (%)
Ploughing	91.5	8.5
Sowing	64.5	35.5
Transplanting	56.7	43.3
Weeding	51.7	48.3
Harvesting	64.5	35.5

4. Conclusion

Agriculture is crucial to West Bengal's rural economy. Agricultural output provides food, fodder, and a source of income for around 65 per cent of the village population. Women have a vital role in agricultural production because it is a labour-intensive activity in West Bengal. Women's participation in agricultural activities varied by district and agro-climatic zone. Between 1981 and 2011, the participation rate decreased. Although several areas, such as Dakshin and Uttar Dinajpur, Cooch Bihar, Alipurduar, and Jalpaiguri, have had tremendous development in both agricultural workers and cultivators. Four elements have been highlighted as determinants of women's participation in agricultural activities. Among them, women's literacy rates and urban population are inversely associated with women's agricultural participation patterns. Two factors, the percentage of women in the SC and ST populations and the area under food grains, were found to be positively connected with women's participation patterns. This study found that the type of crop production had a direct effect on women's participation in agriculture. The labour intensity of agricultural production allows women to participate in agriculture. Rice, potatoes, jute, and tea are prominent crops in which women play an important role as labour contributors. Sometimes, agricultural mechanisation and the use of herbicides are beneficial for managing weeds; all of these small measures lower the per-acre man-days in agricultural production. Science 1991 highlighted a movement in the occupational structure from an agro-economy to a non-agro-based economy. As a result, both the public and commercial sectors should implement policies and programs to address the surplus labour.

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