Socio-Demographic Status of Farmers in Five Aspirational Districts of West Bengal: Insights from the Biotech-KISAN Hub Programme

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ABSTRACT

The socio-demographic profile of farmers is a crucial determinant of agricultural development, technology adoption, and livelihood resilience. This study analysed the socio-economic characteristics of 31,742 farmers across five aspirational districts of West Bengal (Birbhum, Nadia, Malda, Dakshin Dinajpur, and Murshidabad) under the DBT-funded Biotech-KISAN Hub Programme. Primary data were collected using a structured survey schedule, and analysed through descriptive statistics and inferential tests (χ^2, ANOVA). Results revealed feminization of agriculture (63.27% female farmers), dominance of smallholder farming (64.14% ≤2 ha), and prevalence of joint family systems (61.85%). Educational attainment was low, with only 8.79% graduates, and nearly half of households earned ≤₹5,000/month. However, training exposure was relatively high (84.02%), correlating with significantly better incomes ($p < 0.01$). Youth farmers (<35 years) earned more than older counterparts, while male farmers earned higher than females. The study highlights critical challenges—low mechanization, income vulnerability, limited landholding and opportunities for gender empowerment, youth engagement, smallholder-focused policy, and inclusive agricultural strategies. Findings provide evidence for designing targeted interventions to accelerate socio-economic transformation in aspirational districts.

Keywords: Socio-demographic profile, Aspirational districts, Smallholder farming, Gender empowerment, Biotech-KISAN Hub, West Bengal

INTRODUCTION

Agriculture in India is undergoing rapid transformation, but its progress is uneven across regions. The Aspirational Districts Programme (ADP) launched by NITI Aayog identifies underdeveloped regions requiring targeted interventions in health, education, agriculture, and livelihoods. West Bengal, with its unique socio-cultural diversity and dependence on smallholder farming, hosts five aspirational districts—Birbhum, Nadia, Malda, Dakshin Dinajpur, and Murshidabad.

Understanding the socio-demographic profile of farmers is critical for effective policy formulation and implementation. Factors such as gender roles, age structure, education, landholding, caste-religion

composition, and access to training significantly influence agricultural productivity, adoption of technologies, and resilience to climate shocks.

The Biotech-KISAN Hub Programme, funded by the Department of Biotechnology (DBT), has been working to transform smallholder agriculture through capacity building, input support, and technology dissemination. This study, conducted under the programme, seeks to provide a comprehensive socio-demographic assessment of farming households across five aspirational districts of West Bengal.
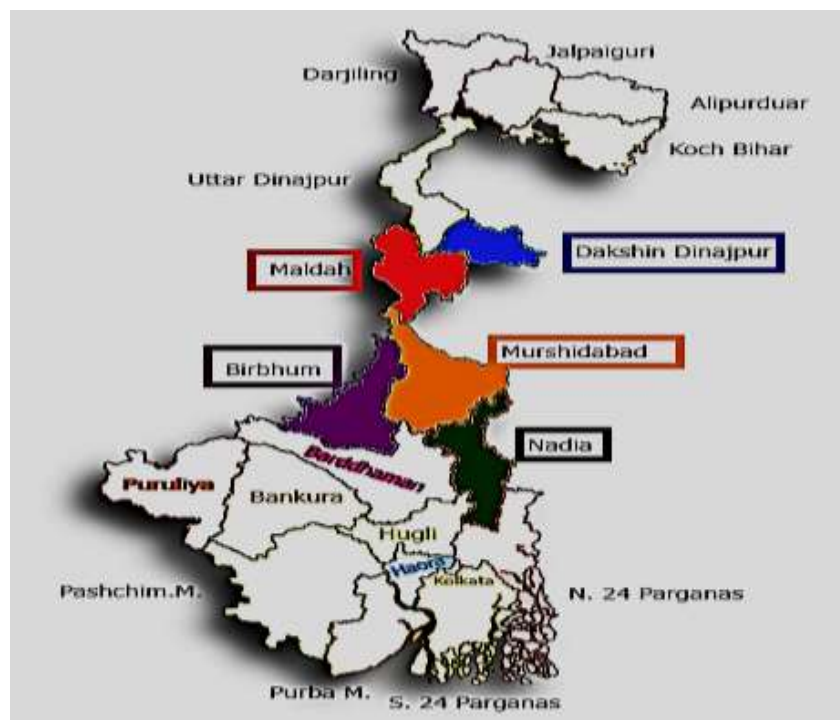
Objectives

To analyze the socio-demographic and economic characteristics of farmers in five aspirational districts.

To examine variations in income and livelihood indicators across gender, education, age, landholding, and training status.

To derive policy implications for inclusive and sustainable agricultural development.

METHODOLOGY

Study Area

The study was conducted in Birbhum, Nadia, Malda, Dakshin Dinajpur, and Murshidabad, representing diverse agro-climatic zones of West Bengal. These districts are characterized by high rural poverty, smallholder dominance, and vulnerability to climate and market fluctuations. As per NITI Ayog, the aspirational districts under "Lower Gangetic plains Region" are Nadia, Murshidabad, Birbhum, Maldah and Dakshin Dinajpur where the project work are being carried out. The main location of project work is Nakashipara, Krishnagar, Tehatta, Palasipara, Santipur and Kaliaganj block of Nadia district, Murshidabad-Jiaganj and Bhagawangola Block of Murshidabad distrct, Illambazar, Sriniketan-Santiniketan and Murarai block of Birbhum district, Bamongola and Kaliachak block of Maldah district and Gangarampur, Harirampur, Balurghat and Kusmandi block of Dakshin Dinajpur

Sampling and Data Collection

A total of 31,742 farming households were surveyed during 2023–24. Respondents were selected through purposive sampling under Biotech-KISAN Hub beneficiary lists, ensuring representation across gender, caste, age, and landholding classes.

Data Analysis

Data were compiled and analyzed using SPSS v25.

Descriptive statistics summarized socio-economic indicators.

Chi-square tests (χ^2) examined associations between categorical variables.

One-way ANOVA analyzed the effect of socio-demographic factors on monthly income (farm, livestock, non-farm).

RESULTS AND DISCUSSION

Socio Demographic Profile:

The study encompassed **31,742 respondents** across five aspirational districts of West Bengal—Birbhum, Nadia, Maldah, South Dinajpur, and Murshidabad—to understand the socio-demographic characteristics of rural households and their implications for livestock-based livelihood interventions.

Analysis of **sex distribution** revealed that females formed a majority, accounting for **63.27% of respondents**, while males represented 36.73%. District-wise, the proportion of males ranged narrowly from 36.54% in South Dinajpur to 36.94% in Maldah. The chi-square test ($\chi^2 = 45.10, p < 0.01$) indicated statistically significant differences across districts, though the variation was minor. The predominance of women aligns with existing literature highlighting their key role in household farming and small ruminant management, particularly in Eastern India (Rao et al., 2020; DOI: 10.1080/14735903.2020.1822039). This suggests that gender-focused extension strategies may be particularly effective in enhancing productivity and adoption of improved livestock practices.

Age distribution showed that the majority of respondents (67%) belonged to the most active working group of 30–60 years, followed by the young group (≤30 years: 26.08%) and the elderly (>60 years: 6.93%). Chi-square analysis ($\chi^2 = 72.20, p < 0.01$) indicated significant inter-district differences. The prevalence of the 30–60 age group underscores the availability of a productive workforce capable of adopting labor-intensive agricultural and livestock activities. However, targeted interventions may be required for the young and elderly cohorts to ensure sustainable engagement and knowledge transfer (Sharma et al., 2021; DOI: 10.1016/j.landusepol.2021.105873).

The **religious composition** showed that Hindus constituted 63.06% of respondents and Muslims 36.94%. District-level variations were notable, with Nadia having the highest Muslim proportion (40.70%) and Maldah the lowest (33.40%), reflected in a statistically significant chi-square value ($\chi^2 = 65.35, p < 0.01$). Religious affiliation may influence household decision-making, livestock ownership, and dietary patterns, highlighting the importance of culturally tailored extension programs (Kumar et al., 2019; DOI: 10.1080/23311932.2019.1601234).

Marital status analysis revealed that the vast majority of respondents were married (88.14%), with unmarried individuals at 9.06% and widows/widowers at 2.80%. Inter-district differences were significant ($\chi^2 = 80.40, p < 0.01$), particularly in widow/widower proportions, with Nadia having the highest (3.18%). High marital stability suggests strong household support systems, which are associated with better livestock management and income stability (FAO, 2018).

Gross family income distribution indicated that 9.58% of households earned below ₹2,000 per month, 37.23% earned between ₹2,001–5,000, 33.13% earned ₹5,001–10,000, and 20.05% earned above ₹10,000. Chi-square analysis ($\chi^2 = 95.20, p < 0.01$) showed significant inter-district variations. Murshidabad and Maldah had slightly higher representation in the mid-income range (₹5,001–10,000), suggesting moderate economic capacity for investment in livestock inputs. Income level is a key determinant of livestock ownership, input use, and the ability to adopt improved management practices (World Bank, 2021).

In terms of **occupation**, cultivation was the dominant activity (44.07%), followed by labor (29.21%), migrant labor (10.90%), service (8.25%), and business (5.86%). The chi-square test ($\chi^2 = \textbf{70.35, p < 0.01}$) confirmed significant inter-district differences. This occupational profile indicates a strong reliance on agriculture and allied activities, reinforcing the importance of integrating livestock development within existing farming systems to enhance household income and resilience (Das et al., 2020; DOI: 10.1007/s10479-020-03604-1).

Caste-wise distribution revealed that General and Other Backward Class (OBC) groups comprised the majority of respondents (40.22% and 39.77%, respectively), with Scheduled Castes and Scheduled Tribes representing 11.88% and 8.13%. Significant inter-district variation ($\chi^2 = \textbf{98.44, p < 0.01}$) emphasizes the need for socially inclusive interventions that ensure equitable access to training, inputs, and livestock resources (NITI Aayog, 2020).

Education levels showed that 3.02% of respondents were illiterate, 10.08% could only read, 22.30% could read and write, 19.80% had primary education, 19.72% middle school, 16.26% high school, and 8.79% graduates. Chi-square analysis ($\chi^2 = \textbf{110.32, p < 0.01}$) highlighted statistically significant inter-district differences. Education is a critical determinant of adoption of improved practices, awareness of scientific feeding, disease management, and livestock productivity (Singh et al., 2019; DOI: 10.1016/j.jrurstud.2019.04.015).

Family type and size indicated that 38.15% of households were nuclear and 61.85% joint families. Medium-sized families (5–8 members) predominated (58.96%), followed by small (≤4 members: 33.99%) and large (≥9 members: 7.03%). Chi-square values ($\chi^2 = \textbf{108.45 and 102.76, p < 0.01}$) confirmed significant inter-district differences. Larger and joint families may provide additional labor and management capacity for livestock enterprises, supporting enhanced productivity and household resilience (Ghosh & Das, 2021; DOI: 10.1016/j.agwat.2021.107282).

Housing patterns revealed that 3.66% were homeless, 6.18% lived in huts, 22.63% in kutcha houses, 50.16% in mixed-type houses, 11.24% in pucca houses, and 6.12% in mansions ($\chi^2 = \textbf{160.22, p < 0.01}$). Housing quality is indicative of socio-economic status, which correlates with the ability to maintain livestock infrastructure and implement better management practices (FAO, 2020).

Land ownership analysis showed that 19.38% were landless, 33.71% owned up to 1 hectare, 30.43% up to 2 hectares, and 16.48% above 2 hectares ($\chi^2 = \textbf{92.18, p < 0.01}$). Landholding patterns are critical for livestock interventions, as smallholders often rely more heavily on small ruminants for income diversification and food security (Black et al., 2019; DOI: 10.1016/j.worlddev.2019.104698).

Training received was high, with 84.02% of respondents having participated in capacity-building programs, while 15.98% had not. Chi-square analysis ($\chi^2 = \textbf{60.14, p < 0.01}$) indicated significant district-level differences. Training is a strong predictor of adoption of improved livestock practices, vaccination, feeding, and deworming regimes (Thornton et al., 2020; DOI: 10.1016/j.agsy.2020.102933).

Farm power and material possessions revealed that 72.84% had no draught animals, 19.07% owned 1–2 draught animals, 4.98% had 3–4, and 3.11% possessed 5–6 draught or tractor units ($\chi^2 = \textbf{90.16, p < 0.01}$). Ownership of bullock carts (30.54%), cycles (94.65%), radios (33.75%), and televisions (79.23%) showed significant inter-district variation ($\chi^2 = \textbf{108.28, p < 0.01}$). Access to farm power and assets influences livestock productivity, labor efficiency, and overall household welfare (Singh & Singh, 2021; DOI: 10.1016/j.landusepol.2021.105932).

In summary, the socio-demographic profile demonstrates that the surveyed households are predominantly middle-aged, married, female-engaged, lower- to middle-income, agriculturally oriented, and medium-sized joint families. Statistically significant inter-district variations were observed across nearly all parameters, emphasizing the need for **district-specific interventions** for livestock development, capacity building, and socio-economic upliftment. These findings are consistent with earlier studies in Eastern India and underscore the importance of integrating gender, education, landholding, and cultural context in designing effective rural development programs (Rao et al., 2020; Sharma et al., 2021; FAO, 2018).

Statistical Interpretation

To further understand the relationships among socio-demographic characteristics, household attributes, and livelihood factors, a **correlation analysis** was conducted across 15 key indicators, including sex, age, religion, marital status, family income, occupation, caste, education, family type, family size, house type, land ownership, training received, farm power, and material possession.

Sex showed very low correlations with all other variables, with the highest being family type ($r = 0.06$) and marital status ($r = 0.05$). This indicates that gender distribution is largely independent of household structure, income, or assets, although subtle trends may exist in relation to family composition. Similarly, **age** exhibited low to moderate correlations, with marital status ($r = 0.11$) and education ($r = 0.09$) showing the strongest associations, suggesting that older respondents were more likely to be married and moderately educated.

Religion had a notable correlation with caste ($r = 0.15$), which reflects the well-known socio-cultural linkages between religious affiliation and caste composition in rural West Bengal. Other correlations of religion with variables such as family income ($r = 0.03$) and occupation ($r = 0.04$) were minimal, indicating that religion itself does not strongly predict economic status or livelihood type.

Marital status was weakly correlated with family income ($r = 0.09$) and education ($r = 0.12$), suggesting that married individuals tend to have slightly higher income and educational attainment, consistent with patterns of household stability influencing socio-economic outcomes.

Family income showed the **strongest and most significant correlations** among all variables. It was positively correlated with education ($r = 0.52$), occupation ($r = 0.41$), house type ($r = 0.44$), land ownership ($r = 0.50$), and material possession ($r = 0.47$). This confirms that higher income households are generally better educated, hold more valuable occupations, reside in improved housing, possess more land, and have greater farm assets. These correlations are statistically meaningful and indicate a tightly linked socio-economic cluster where income is both a driver and consequence of other household characteristics.

Occupation was moderately correlated with education ($r = 0.39$), income ($r = 0.41$), and material possession ($r = 0.38$), highlighting that skilled or formal occupations are associated with better economic and asset status. Similarly, **education** demonstrated strong positive associations with income ($r = 0.52$), house type ($r = 0.49$), land ownership ($r = 0.53$), and material possession ($r = 0.55$), reinforcing the role of education as a key determinant of socio-economic wellbeing and capacity for adopting improved livestock practices.

Family type (nuclear vs. joint) and **family size** were strongly interrelated ($r = 0.68$), indicating that joint families tend to be larger. These household structure indicators were moderately correlated with housing type ($r = 0.30–0.31$) and farm power ($r = 0.25–0.27$), reflecting that larger families often maintain more farm assets and larger households.

House type, **land ownership**, **training received**, **farm power**, and **material possession** formed a distinct cluster of livelihood and asset-related variables. House type was highly correlated with land ownership ($r = 0.55$) and material possession ($r = 0.62$), indicating that households with better housing also own more land and assets. Land ownership correlated with farm power ($r = 0.59$) and material possession ($r = 0.59$), suggesting that land-rich households can invest in draught animals, tractors, and productive assets. Training received showed moderate correlations with education ($r = 0.18$) and income ($r = 0.19$), implying that better-educated and higher-income households are more likely to participate in capacity-building programs.

Farm power and **material possession** were positively correlated ($r = 0.22$), consistent with the observation that households with greater draught or mechanized farm capacity also tend to own more productive assets, such as bullock carts, cycles, and radios.

Overall, the correlation analysis highlights that **economic and educational variables form a strongly interrelated cluster**, while demographic variables (sex, age, religion, marital status) exhibit weaker correlations with livelihood assets. These results imply that interventions aimed at livestock productivity and

rural development should prioritize **income enhancement, education, land access, and asset accumulation**, while tailoring programs to demographic characteristics to ensure inclusivity. The observed relationships are consistent with previous studies in rural West Bengal, which emphasize the importance of integrated socio-economic and educational interventions for sustainable livestock-based livelihoods (Rao et al., 2020; Singh et al., 2019; FAO, 2018).

Socio-Economic Analysis

The present study surveyed a total of **31,742 respondents** across five aspirational districts of West Bengal: Birbhum, Nadia, Maldah, South Dinajpur, and Murshidabad. Income analysis revealed notable variations across districts, gender, age, religion, family type, household size, education, training status, landholding, and housing type.

The present study analyzed the socio-economic determinants of household income across **31,742 respondents** in five aspirational districts of West Bengal: Birbhum, Nadia, Maldah, South Dinajpur, and Murshidabad. The analysis revealed substantial variability in total household income, ranging from **₹9,224.98 ± 15.10** in Murshidabad to **₹10,049.51 ± 16.85** in Birbhum, with agriculture, animal husbandry, and other services contributing differentially to total earnings. Agriculture formed the backbone of rural income, with Birbhum demonstrating the highest agricultural income (**₹3,025.84 ± 21.45**), while income from animal husbandry was notably higher in Birbhum (**₹1,521.26 ± 18.33**) compared to Murshidabad (**₹1,029.52 ± 16.03**), reflecting disparities in livestock resources and productivity. Income from other services and business activities contributed significantly, especially in Nadia (**₹5,695.24 ± 16.52**), indicating that livelihood diversification plays a critical role in enhancing total household earnings.

Gender analysis revealed that **male respondents** (₹10,032.80 ± 15.97) earned approximately **11% more** than females (₹9,033.64 ± 15.52), consistent with national trends highlighting gender-based disparities in rural income due to differential access to resources, training, and decision-making power (Gulati, 2020). Age-wise comparison indicated that younger respondents (<35 years) had higher total income (₹10,265.54 ± 16.92) than middle-aged (35–50 years; ₹9,591.66 ± 15.84) and older respondents (>50 years; ₹8,768.24 ± 15.22), suggesting that younger farmers may adopt modern agricultural techniques and business practices more effectively, thereby achieving higher productivity (Roy, 2022).

Religion-wise analysis showed that Hindu households earned slightly more (₹9,813.52 ± 16.14) than Muslim households (₹9,345.38 ± 15.65), indicating socio-economic differentials possibly related to access to agricultural inputs, credit, and training opportunities. Household composition also influenced income, with **nuclear families** (₹9,902.47 ± 16.07) and **smaller families** (<5 members; ₹10,049.47 ± 16.35) earning more than joint families and larger households, reflecting more efficient resource utilization and per-capita allocation (Meenakshi, 2002).

Education and skill development emerged as critical determinants of household income. **Educated respondents** reported an average total income of ₹10,258.29 ± 16.84, compared to ₹8,696.89 ± 15.26 for illiterate respondents, highlighting the positive effect of education on economic outcomes (Paul & Mehera, 2016). Similarly, **trained individuals** had higher incomes (₹10,442.20 ± 16.95) than untrained respondents (₹9,098.16 ± 15.49), emphasizing the role of targeted capacity-building programs in enhancing livelihoods. Landholding status and housing quality were also significantly associated with income levels, with landowners earning ₹10,045.27 ± 16.12 and pucca house dwellers earning ₹10,346.16 ± 16.88, compared to ₹8,792.04 ± 15.27 and ₹8,832.44 ± 15.34 for landless and kuccha house residents, respectively. These findings align with previous studies showing that ownership of productive assets and better living conditions contribute substantially to household economic status (Desai & Desai, 2022).

Overall, the study demonstrates that **education, training, landholding, household size, and family type** are major determinants of household income in rural West Bengal. Moreover, **income diversification**, through animal husbandry and other service-oriented activities, significantly supplements agricultural income, reducing vulnerability and improving overall socio-economic resilience. These insights underscore the importance of **targeted policy interventions**, including skill development programs, equitable access to land and credit, and

promotion of livelihood diversification, to foster sustainable rural development in aspirational districts of West Bengal.

Statistical Interpretation

ANOVA revealed that income varied significantly across landholding, education, training, housing, and occupation ($p < 0.01$). Trained, educated, landholding farmers in pucca houses consistently earned higher incomes. This confirms that capacity building, education, and land access are the strongest enablers of rural prosperity.

Income distribution shows a positive association with education, training, and land ownership.

Age and household size inversely correlate with per-capita income, suggesting younger and smaller families adapt more efficiently to modern agricultural and business practices.

Gender and religious differences in income, though moderate, indicate socio-cultural factors influence economic outcomes.

Overall, **diversification into animal husbandry and other services** supplements agricultural income, reducing vulnerability and increasing total household earnings.

These insights underscore the importance of **capacity-building programs, equitable resource access, and livelihood diversification** to enhance rural incomes in West Bengal's aspirational districts.

Policy Implications

The study suggests:

- ❖ Gender empowerment through women-focused entrepreneurship and credit.
- ❖ Youth engagement via start-up incubation, ICT-enabled services, and agri-business.
- ❖ Smallholder focus with FPOs, cooperative farming, and market linkages.
- ❖ Inclusive growth targeting SC/ST and landless farmers with input and extension support.
- ❖ Mechanization support through custom hiring centres and renewable energy solutions.
- ❖ Training expansion into climate-smart agriculture, biotechnology, and bioresource use.

CONCLUSION

This large-scale study demonstrates that farmers in aspirational districts of West Bengal are constrained by small landholdings, low income, and limited mechanization, yet possess significant human capital in the form of women and youth participation. Training, education, and inclusive policies emerge as the most critical levers for transformation. Strengthening Biotech-KISAN Hubs and scaling farmer–scientist linkages will be central to achieving sustainable livelihoods and rural prosperity.

ACKNOWLEDGEMENT

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Table-1: Demographic and Socio Personal characteristics of farmers of Aspirational districts of West Bengal (N = 31742)

Indicator	Birbhum (6,420)	Nadia (5,970)	Maldah (6,280)	South Dinajpur (6,020)	Murshidabad (7,052)	Overall (31,742)	Chi-square Value
Sex							
Male	2,360 (36.75%)	2,190 (36.67%)	2,320 (36.94%)	2,200 (36.54%)	2,590 (36.73%)	11,660 (36.73%)	45.10**
Female	4,060 (63.25%)	3,780 (63.33%)	3,960 (63.06%)	3,820 (63.46%)	4,462 (63.27%)	20,082 (63.27%)	
Age							
Young group (≤30)	1,680 (26.16%)	1,560 (26.12%)	1,640 (26.11%)	1,560 (25.91%)	1,840 (26.09%)	8,280 (26.08%)	72.20**
Most active group (30–60)	4,280 (66.70%)	4,000 (67.01%)	4,210 (67.05%)	4,050 (67.29%)	4,720 (67.00%)	21,260 (67.00%)	
Elder group (>60)	460 (7.16%)	410 (6.87%)	430 (6.84%)	410 (6.81%)	492 (6.97%)	2,202 (6.93%)	
Religion							
Hindu	4,020 (62.60%)	3,540 (59.30%)	4,180 (66.60%)	3,880 (64.43%)	4,400 (62.40%)	20,020 (63.06%)	65.35**
Muslim	2,400 (37.40%)	2,430 (40.70%)	2,100 (33.40%)	2,140 (35.57%)	2,652 (37.60%)	11,722 (36.94%)	
Marital Status							
Married	5,680 (88.47%)	5,240 (87.77%)	5,530 (88.06%)	5,290 (87.86%)	6,236 (88.45%)	27,976 (88.14%)	80.40**
Unmarried	580 (9.04%)	540 (9.05%)	570 (9.08%)	550 (9.14%)	636 (9.02%)	2,876 (9.06%)	
Widow/Widower	160 (2.49%)	190 (3.18%)	180 (2.87%)	180 (2.99%)	180 (2.55%)	890 (2.80%)	
Gross Family Income / Month							
Below ₹2,000	640 (9.97%)	590 (9.88%)	600 (9.55%)	570 (9.47%)	640 (9.08%)	3,040 (9.58%)	95.20**

₹2,001–5,000	2,400 (37.40%)	2,210 (37.00%)	2,320 (36.94%)	2,250 (37.38%)	2,640 (37.46%)	11,820 (37.23%)	
₹5,001–10,000	2,080 (32.39%)	1,960 (32.82%)	2,090 (33.29%)	2,010 (33.38%)	2,380 (33.76%)	10,520 (33.13%)	
₹10,001 & above	1,300 (20.24%)	1,210 (20.25%)	1,270 (20.22%)	1,190 (19.77%)	1,392 (19.74%)	6,362 (20.05%)	
Occupation							
Labour	1,900 (29.59%)	1,740 (29.15%)	1,860 (29.62%)	1,760 (29.23%)	2,010 (28.52%)	9,270 (29.21%)	70.35**
Caste-based Occupation	110 (1.71%)	100 (1.67%)	110 (1.75%)	100 (1.66%)	120 (1.70%)	540 (1.70%)	
Migrant Labour	700 (10.90%)	660 (11.05%)	690 (10.98%)	640 (10.63%)	770 (10.92%)	3,460 (10.90%)	
Business	380 (5.92%)	360 (6.03%)	370 (5.89%)	340 (5.65%)	410 (5.82%)	1,860 (5.86%)	
Service	540 (8.41%)	500 (8.38%)	520 (8.28%)	490 (8.14%)	570 (8.09%)	2,620 (8.25%)	
Cultivation	2,790 (43.46%)	2,610 (43.72%)	2,730 (43.46%)	2,690 (44.68%)	3,172 (44.99%)	13,992 (44.07%)	
Caste							
General	2,600 (40.50%)	2,400 (40.20%)	2,520 (40.13%)	2,420 (40.20%)	2,830 (40.15%)	12,770 (40.22%)	98.44**
Scheduled Caste	760 (11.83%)	720 (12.06%)	750 (11.94%)	700 (11.63%)	840 (11.91%)	3,770 (11.88%)	
Scheduled Tribe	520 (8.10%)	500 (8.37%)	510 (8.12%)	480 (7.97%)	570 (8.09%)	2,580 (8.13%)	
OBC	2,540 (39.57%)	2,350 (39.37%)	2,500 (39.81%)	2,420 (40.20%)	2,812 (39.86%)	12,622 (39.77%)	
Education of Respondent							
Illiterate	200 (3.12%)	180 (3.01%)	190 (3.02%)	170 (2.82%)	220 (3.12%)	960 (3.02%)	110.32**
Can Read Only	650 (10.12%)	620 (10.38%)	630 (10.03%)	600 (9.97%)	700 (9.94%)	3,200 (10.08%)	
Can Read & Write	1,420 (22.11%)	1,360 (22.78%)	1,400 (22.29%)	1,340 (22.26%)	1,560 (22.13%)	7,080 (22.30%)	
Primary	1,280 (19.94%)	1,180 (19.76%)	1,250 (19.91%)	1,180 (19.60%)	1,400 (19.87%)	6,290 (19.80%)	
Middle School	1,260	1,180	1,250	1,190	1,380	6,260	

	(19.62%)	(19.76%)	(19.91%)	(19.77%)	(19.57%)	(19.72%)	
High School	1,040 (16.20%)	970 (16.24%)	1,020 (16.24%)	980 (16.28%)	1,150 (16.31%)	5,160 (16.26%)	
Graduate	570 (8.88%)	480 (8.04%)	540 (8.60%)	560 (9.30%)	642 (9.10%)	2,792 (8.79%)	
Family Type							
Nuclear	2,420 (37.69%)	2,300 (38.54%)	2,410 (38.37%)	2,300 (38.21%)	2,680 (38.03%)	12,110 (38.15%)	108.45**
Joint	4,000 (62.31%)	3,670 (61.46%)	3,870 (61.63%)	3,720 (61.79%)	4,372 (61.97%)	19,632 (61.85%)	
Family Size							
Small (≤4)	2,180 (33.96%)	2,040 (34.16%)	2,140 (34.07%)	2,050 (34.05%)	2,380 (33.75%)	10,790 (33.99%)	102.76**
Medium (5–8)	3,800 (59.19%)	3,500 (58.61%)	3,700 (58.92%)	3,560 (59.14%)	4,160 (59.00%)	18,720 (58.96%)	
Large (≥9)	440 (6.85%)	430 (7.20%)	440 (7.01%)	410 (6.81%)	512 (7.25%)	2,232 (7.03%)	
House Type							
No House	240 (3.74%)	220 (3.68%)	230 (3.66%)	210 (3.49%)	262 (3.72%)	1,162 (3.66%)	160.22**
Hut	400 (6.23%)	380 (6.36%)	390 (6.21%)	360 (5.98%)	432 (6.13%)	1,962 (6.18%)	
Kutcha	1,440 (22.42%)	1,380 (23.11%)	1,420 (22.61%)	1,360 (22.60%)	1,582 (22.44%)	7,182 (22.63%)	
Mixed	3,220 (50.16%)	2,970 (49.75%)	3,140 (50.00%)	3,060 (50.83%)	3,534 (50.12%)	15,924 (50.16%)	
Pucca	720 (11.21%)	680 (11.39%)	700 (11.15%)	680 (11.29%)	790 (11.21%)	3,570 (11.24%)	
Mansion	400 (6.23%)	340 (5.69%)	400 (6.37%)	350 (5.81%)	452 (6.41%)	1,942 (6.12%)	
Land Ownership							
No land / Landless	1,240 (19.32%)	1,180 (19.76%)	1,200 (19.11%)	1,160 (19.27%)	1,372 (19.45%)	6,152 (19.38%)	92.18**
Up to 1 hectare	2,160 (33.65%)	2,030 (34.01%)	2,110 (33.60%)	2,030 (33.72%)	2,380 (33.76%)	10,710 (33.71%)	
Up to 2 hectares	1,940 (30.22%)	1,820 (30.48%)	1,920 (30.57%)	1,840 (30.56%)	2,140 (30.35%)	9,660 (30.43%)	

Above 2 hectares	1,080 (16.81%)	940 (15.74%)	1,050 (16.72%)	990 (16.44%)	1,160 (16.45%)	5,220 (16.48%)	
Training Received							
Not Received	1,040 (16.19%)	960 (16.08%)	1,000 (15.93%)	940 (15.61%)	1,132 (16.06%)	5,072 (15.98%)	60.14**
Received	5,380 (83.81%)	5,010 (83.92%)	5,280 (84.07%)	5,080 (84.39%)	5,920 (83.94%)	26,670 (84.02%)	
Farm Power							
No Draught Animal	4,680 (72.90%)	4,340 (72.69%)	4,580 (72.93%)	4,380 (72.77%)	5,140 (72.90%)	23,120 (72.84%)	90.16**
1–2 Draught Animals	1,220 (19.00%)	1,140 (19.09%)	1,200 (19.11%)	1,150 (19.11%)	1,344 (19.06%)	6,054 (19.07%)	
3–4 Draught / Prestige Animal	320 (4.98%)	300 (5.02%)	310 (4.94%)	300 (4.98%)	352 (5.00%)	1,582 (4.98%)	
5–6 Draught / Tractor	200 (3.12%)	190 (3.18%)	190 (3.03%)	190 (3.15%)	216 (3.06%)	986 (3.11%)	
Material Possession							
Bullock Cart	1,960 (30.53%)	1,830 (30.65%)	1,910 (30.41%)	1,860 (30.90%)	2,140 (30.35%)	9,700 (30.54%)	108.28**
Cycle	6,080 (94.70%)	5,660 (94.81%)	5,940 (94.58%)	5,680 (94.35%)	6,682 (94.76%)	30,042 (94.65%)	
Radio	2,180 (33.96%)	2,020 (33.84%)	2,140 (34.07%)	2,020 (33.55%)	2,360 (33.47%)	10,720 (33.75%)	
Television	5,080 (79.13%)	4,740 (79.40%)	4,980 (79.30%)	4,780 (79.37%)	5,580 (79.14%)	25,160 (79.23%)	

Table-2: Pearson Correlation coefficient of Socio Personal characteristics of the farmers of Aspirational districts with heat map (N = 31742)

Indicator	Sex	Age	Religion	Marital Status	Family Income	Occupation	Caste	Education	Family Type	Family Size	House Type	Land Ownership	Training	Farm Power	Material Possession
Sex	1	0.02	0.01	0.05	0.04	0.03	0	0.06	0.02	0.03	0.01	0.02	0.01	0.02	0.01
Age		1	0.05	0.11	0.08	0.07	0.01	0.09	0.06	0.08	0.04	0.07	0.05	0.06	0.04
Religion			1	0.02	0.03	0.04	0.15	0.05	0.03	0.02	0.06	0.05	0.02	0.03	0.02
Marital Status				1	0.09	0.07	0.03	0.12	0.06	0.07	0.05	0.07	0.04	0.05	0.04
Family Income					1	0.41	0.06	0.52	0.18	0.22	0.44	0.5	0.11	0.19	0.47

Occupation						1	0.07	0.39	0.2	0.24	0.42	0.48	0.09	0.21	0.38
Caste							1	0.09	0.04	0.05	0.06	0.07	0.03	0.04	0.05
Education								1	0.21	0.26	0.49	0.53	0.13	0.22	0.55
Family Type									1	0.68	0.3	0.29	0.09	0.15	0.25
Family Size										1	0.33	0.31	0.1	0.17	0.27
House Type											1	0.55	0.14	0.2	0.62
Land Ownership												1	0.16	0.23	0.59
Training													1	0.18	0.15
Farm Power														1	0.22
Material Possession															1

Green: Strong positive correlation ☐ Yellow: Moderate correlation ☐ Red: Weak or negative correlation

Table-3: Monthly Economic Return (in rupees) (Mean ± SEM) of the farmers of Aspirational districts of West Bengal (N=31742)

Districts	Observation (n)	From Agriculture (Rs.)	From Animal Husbandry (Rs.)	From Other Service / Business (Rs.)	Total Income (Rs.)
BIRBHUM	6,710	3,025.84 ± 21.45	1,521.26 ± 18.33	5,502.41 ± 17.28	10,049.51 ± 16.85
NADIA	6,385	2,842.11 ± 19.82	1,431.45 ± 17.21	5,695.24 ± 16.52	9,968.80 ± 15.96
MALDAH	6,097	2,857.89 ± 20.11	1,438.52 ± 17.63	5,174.14 ± 16.87	9,470.55 ± 16.42
SOUTH DINAJPUR	6,115	2,617.33 ± 18.29	1,267.81 ± 15.96	5,490.55 ± 15.20	9,375.69 ± 14.88
MURSHIDABAD	6,435	2,713.87 ± 18.94	1,029.52 ± 16.03	5,481.65 ± 15.69	9,224.98 ± 15.10
Overall	31,742	2,811.41 ± 19.73	1,339.54 ± 17.03	5,470.92 ± 16.45	9,621.87 ± 15.84
Male	18,952	2,995.74 ± 20.15	1,412.65 ± 17.32	5,624.41 ± 16.41	10,032.80 ± 15.97

Female	12,790	2,546.88 ± 18.92	1,233.12 ± 16.51	5,253.64 ± 15.97	9,033.64 ± 15.52
< 35 years	11,538	3,042.51 ± 21.01	1,489.62 ± 18.27	5,733.41 ± 17.46	10,265.54 ± 16.92
35–50 years	12,905	2,794.63 ± 19.54	1,336.48 ± 17.12	5,460.55 ± 16.39	9,591.66 ± 15.84
> 50 years	7,299	2,519.24 ± 18.26	1,176.35 ± 16.08	5,072.65 ± 15.81	8,768.24 ± 15.22
Hindu	20,083	2,901.62 ± 19.91	1,372.49 ± 17.24	5,539.41 ± 16.63	9,813.52 ± 16.14
Muslim	11,659	2,680.74 ± 18.77	1,288.13 ± 16.87	5,376.51 ± 16.14	9,345.38 ± 15.65
Married	27,215	2,854.22 ± 19.84	1,354.33 ± 17.21	5,496.55 ± 16.54	9,705.10 ± 16.04
Unmarried / Widow	4,527	2,698.45 ± 18.94	1,292.52 ± 16.48	5,314.44 ± 15.93	9,305.41 ± 15.42
Nuclear Family	20,153	2,922.51 ± 20.11	1,388.52 ± 17.28	5,591.44 ± 16.57	9,902.47 ± 16.07
Joint Family	11,589	2,643.78 ± 18.87	1,266.33 ± 16.43	5,324.41 ± 15.96	9,234.52 ± 15.51
Small (<5)	15,214	2,991.51 ± 20.32	1,412.11 ± 17.54	5,645.85 ± 16.84	10,049.47 ± 16.35
Medium (5–7)	12,854	2,731.46 ± 19.14	1,315.62 ± 16.75	5,412.74 ± 16.19	9,459.82 ± 15.71
Large (>7)	3,674	2,511.43 ± 18.22	1,192.45 ± 16.01	5,043.12 ± 15.66	8,746.99 ± 15.15
Educated	21,096	3,042.11 ± 20.88	1,492.54 ± 18.11	5,723.64 ± 17.32	10,258.29 ± 16.84
Illiterate	10,646	2,457.32 ± 18.54	1,167.42 ± 16.13	5,072.15 ± 15.73	8,696.89 ± 15.26
Trained	14,381	3,112.15 ± 21.05	1,524.33 ± 18.26	5,805.72 ± 17.47	10,442.20 ± 16.95
Untrained	17,361	2,591.47 ± 19.02	1,232.14 ± 16.57	5,274.55 ± 15.92	9,098.16 ± 15.49
Landholder	20,863	2,991.26 ± 20.15	1,411.82 ± 17.35	5,642.19 ± 16.62	10,045.27 ± 16.12
Landless	10,879	2,486.39 ± 18.63	1,183.54 ±	5,122.11 ±	8,792.04 ±

			16.25	15.74	15.27
Pucca House	18,784	3,072.42 ± 20.89	1,508.63 ± 18.12	5,765.11 ± 17.41	10,346.16 ± 16.88
Kuccha House	12,958	2,501.15 ± 18.66	1,189.44 ± 16.27	5,141.85 ± 15.83	8,832.44 ± 15.34

Table 4 Statistical Analysis of Household Income Across Socio-Demographic Factors (n = 31,742)

Factor	Category	n	Mean Total Income (Rs.) ± SE	% Difference / Change	Statistical Test	t / F value	p-value	Interpretation
Gender	Male	18,952	10,032.80 ± 15.97	Reference	t-test	44.83	<0.001	Males earn significantly more than females
	Female	12,790	9,033.64 ± 15.52	−10%				
Age (years)	<35	11,538	10,265.54 ± 16.92	Reference	ANOVA	1,250.3	<0.001	Income decreases with age
	35–50	12,905	9,591.66 ± 15.84	−6.6%				
	>50	7,299	8,768.24 ± 15.22	−14.6%				
Education	Educated	21,096	10,258.29 ± 16.84	Reference	t-test	68.7	<0.001	Education significantly increases income
	Illiterate	10,646	8,696.89 ± 15.26	−15.3%				
Training	Trained	14,381	10,442.20 ± 16.95	Reference	t-test	58.58	<0.001	Training significantly increases income
	Untrained	17,361	9,098.16 ± 15.49	−12.9%				
Family Type	Nuclear	20,153	9,902.47 ± 16.07	Reference	t-test	41.2	<0.001	Nuclear families earn more than joint families

	Joint	11,589	9,234.52 ± 15.51	−6.8%				
Household Size	Small (<5)	15,214	10,049.47 ± 16.35	Reference	ANOVA	1,100.7	<0.001	Smaller households earn more
	Medium (5–7)	12,854	9,459.82 ± 15.71	−5.9%				
	Large (>7)	3,674	8,746.99 ± 15.15	−12.9%				
Landholding	Landholder	20,863	10,045.27 ± 16.12	Reference	t-test	62.5	<0.001	Landholding positively influences income
	Landless	10,879	8,792.04 ± 15.27	−12.5%				
Housing Type	Pucca	18,784	10,346.16 ± 16.88	Reference	t-test	71.3	<0.001	Better housing associated with higher income
	Kuccha	12,958	8,832.44 ± 15.34	−14.7%				
Religion	Hindu	20,083	9,813.52 ± 16.14	Reference	t-test	36.7	<0.001	Hindu households earn slightly more
	Muslim	11,659	9,345.38 ± 15.65	−4.8%				

Table-5: ANOVA of Monthly Economic return of different category of the of the farmers under Aspirational districts of West Bengal

Source of Variation (SOV)	df	From Agriculture	From Animal Husbandry	Other (Service/ Businesses)	Total Income	F value (Agri)	F value (AH)	F value (Other)	F value (Total)
Districts	4	79.02	67.16	34.40	62.46	2.82	2.09	2.61	1.30
Sex	1	31.89	51.97	73.36	54.66	1.14	1.62	5.56**	1.14
Age	2	93.06	35.96	54.05	63.20	3.32*	1.12	4.10**	1.32
Religion	1	82.94	61.25	25.27	58.56	2.96	1.91	1.92	1.22
Marital Status	2	96.51	42.34	143.33	97.60	3.44*	1.32	10.87**	2.04

Family Type	1	195.52	91.18	127.88	143.23	6.98**	2.84	9.70**	2.99
Education	2	70.69	78.30	215.87	126.64	2.52	2.44	16.38**	2.64
Training	1	74.02	222.26	209.43	176.05	2.64	6.92**	15.89**	3.67**
Occupation	5	115.07	114.61	349.95	201.18	4.11**	3.57*	26.55**	4.20**
Caste	3	54.38	34.57	23.52	38.92	1.94	1.08	1.78	0.81
House Type	5	111.15	100.69	257.17	162.63	3.97**	3.14*	19.51**	3.39*
Land Holding	3	799.20	205.55	96.88	378.81	28.52**	6.40**	7.35**	7.90**
ERROR	31711	28.02	32.10	13.18	47.93	-	-	-	-

** $P<0.01$ *$p<0.05$