

Access to Digital Agricultural Content: Gender Perspectives from Fatehgarh Sahib, Punjab

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Abstract

The present study investigates gender disparities in access to and utilization of digital agricultural content among 150 farmers in Fatehgarh Sahib District, Punjab, amid India's increasing rural internet penetration and dominance of platforms like WhatsApp and YouTube. In Punjab with overall high literacy and relatively higher mobile penetration in rural areas there is great potential of digital agricultural content. But how far has this digital agriculture content reached the farmers? Are there any gender based differences in access to the digital agricultural content? To answer these questions a Gender-wise Digital Access Score (GDAS) was calculated and the analysis reveals that GDAS scores favour males (0.775) outperforming females (0.645). Gender Parity Index (GPI) was also calculated and it indicates near-equitable device access (0.91) and autonomy (0.95) but pronounced gaps in internet connectivity (0.75) and digital literacy (0.71), yielding an overall GPI of 0.82 favouring males. Barriers that hinder effective utilization of digital agricultural content differ starkly: males cite language (57.3%) and unreliable social media sources (32.9%), while females face family restrictions (68.7%) and language issues (62.7%). These findings point deeper skill and connectivity hurdles, limiting women's agricultural contributions. To bridge these gaps, targeted interventions should promote gender responsive digital agricultural strategies. The policy interventions must move beyond providing access to technology and focus on enhancing digital skills, addressing socio-cultural barriers and creating gender-responsive digital ecosystems to ensure that female farmers can fully benefit from digital agriculture, thereby contributing to agricultural productivity, rural livelihoods and gender equality in Punjab's food bowl.

Keywords: Digital agriculture content, Gender disparity, Social media, Information, Digital divide

JEL Classification: J16, L86, O13, O18

Introduction

Agriculture in India is not only a major economic activity but also a cultural foundation for rural livelihoods. With the digital revolution influencing all sectors of the economy, agriculture too is undergoing a transformation, particularly through the dissemination of information via digital platforms such as WhatsApp, Facebook, YouTube, and Instagram. These platforms have become integral part of agriculture extension as they offer unprecedented opportunities for learning and optimizing agricultural techniques. It also opens gateway for collaborations and therefore has the potential to affect economic outcomes as well. According to the FAO, 2020 digital technologies can enhance agricultural productivity, reduce costs, and connect farmers directly with markets.

There have been rapid digital advancements globally with increasing growth in mobile phone subscription. Nine out every ten active social media users access social media

through their phones. During the year 2017, almost 11 new users started using social media for the first time every second with Saudi Arabia (32%) and India (31%) having the first and second highest growth in social media users (Kemp, 2018). As per latest reports of January 2025 from Data Reportal, there are 806 million internet users in India. India's internet penetration rate stood at 55.3 per cent of the total population. Further the data from DataReportal indicates that there were 491 million active social media users in India in January 2025. The affordable smartphones and widespread mobile data have the potential to ordinary phones into essential farming tools. India's Digital Agriculture Mission has already issued unique "Kisan IDs" to over 10 crore farmers through the AgriStack system (GoI, 2024) to bypass traditional middlemen and structural hurdles. Empirical evidence shows that over 62 per cent of Indian smallholder farmers actively utilize specialized mobile applications for real-time crop diagnostics and localized weather alerts, resulting in a measurable 15 per cent to 20 per cent reduction in total input costs (Verma, 2025).

Furthermore, the financial returns of this digital transition are substantial; access to real-time market data via mobile internet enhances a farmer's bargaining power and choice of sales channels, boosting net agricultural profits by up to 41% (Kumar, 2023). This individual adoption is heavily reinforced by rural community structures. As noted by ICAR (2023), a farmer's willingness to adopt agricultural software is heavily dependent on the surrounding village adoption rate, indicating that digital agriculture in India expands through localized social networks. So with the increased digital access the potential of social media to transform agriculture remains vast as it has potential to share information in visual as well as textual form that can spread to millions in a matter of seconds. The study by Bhattacharjee and Raj, 2016 also underscored the growing trend of use of digital platforms in agriculture. The study noted a remarkable increase in adoption of social media among Indian farmers.

Punjab has 34.86 million internet subscribers; 12.21 million in rural and 22.65 million in urban areas as per TRAI, 2023. Agriculture sustains a large portion of the population and with penetration of internet in rural areas there is immense scope of use of digital agricultural content in State like Punjab, known as the food bowl of India. Women play indispensable roles in agriculture —often managing sowing, weeding, harvesting, livestock and processing in the State. Despite their vast contribution to farming, they lag behind male farmers in acquiring technical information. Digital platforms can play a vital role and can open a direct window for rural women to the outside world. Study conducted by Mishra *et al.*, 2024 also indicated that use of mobile phones can aid in livelihoods, healthcare delivery, setting and running enterprises, providing education to illiterates and getting access to all sort of information by women. But how far has these digital agriculture content reached the farmers? Are there any gender based differences in access to the digital agricultural content?

In order to answer these questions a study was conducted with the aim to investigate the status of women's access to digital agricultural content in Fatehgarh Sahib District. Few studies have focused specifically on the intersection of gender and digital agriculture in regions like Fatehgarh Sahib, presenting a gap this study seeks to fill. The present study is conducted with the objectives to identify key digital tools used for accessing agricultural information; study the gender wise access gap of digital content among farmers; and examine the barriers that hinder effective utilization of digital agricultural content.

Data Sources and Methodology

Study area and selection of sample

The present study with sample size of 150 farmers (75 males and 75 females) was conducted in three of the five blocks of district Fatehgarh Sahib. A multi-stage sampling

technique was used to select the study area and respondents. In the first stage, Fatehgarh Sahib district, Punjab was purposively selected as both authors regularly conduct and participate in extension activities in the region. It ensured context-specific familiarity and logistical viability. In the second stage simple random sampling method was applied to select the three blocks: Sirhind, Kheda and Bassi Pathana out of the five total administrative blocks of the district. In the final stage, one village from each of the three selected administrative blocks was chosen at random as the primary cluster for data collection.

The study is based on the primary data collected during field visits to the selected villages by the authors themselves. Face-to face, semi-structured interviews were conducted with 25 females and males each randomly selected from each of these villages to collect the data in the year 2024. Thus the total sample consisted of 150 farmers from three villages in three administrative blocks of district Fatehgarh Sahib. Semi-structured interview schedule was developed and pre-tested before collecting data. The interview schedule captured the socio-economic profile of the farmers. Data was collected regarding the membership of the respondents in Self Help Group (SHG)/Farmer Producer Organisation (FPO) as several studies such as Shubhangi (2025) and Dutta (2025) have shown that membership in SHGs and FPOs correlated with improved access to digital agricultural content such as advisories, market data and ICT tools. Information was collected on the various digital tools used by the farmers with specific focus on digital agriculture content.

Gender wise Digital Access Score (GDAS)

In order to capture the gender based differentials in access to digital content, Gender wise Digital Access Score (GDAS) was calculated. A composite digital access score was developed to systematically compare the level of digital engagement between male and female farmers in Fatehgarh Sahib. This index was adapted from established frameworks by the International Telecommunication Union (ITU, 2020) and the GSMA Mobile Gender Gap Report, 2022 incorporating four key dimensions: device ownership, internet access, digital literacy, user autonomy. Device ownership is measured as the presence of mobile available; internet access was measured as availability of internet connection on phone and daily hours spent online; digital literacy was seen as the ability to search for information, communicate through applications; user autonomy here referred as the ownership of SIM cards, ability to use devices without supervision and ability to use mobile and internet without assistance from others. To calculate composite digital access score based on these four components equal weights of 0.25 were assigned to each component.

GDAS was calculated independently for males and females. To avoid subjective bias, each component was assigned equal weight of 25 per cent (0.25) represented

mathematically as:

$$GDAS_g = 0.25\bar{O}g + 0.25\bar{A}g + 0.25\bar{L}g + 0.25\bar{U}g$$

Where g refers to gender and:

- **$\bar{O}$ (Device Ownership)**: Possession of mobile phones.
- **$\bar{A}$ (Internet Access)**: Availability of internet connection on phone and daily hours spent online
- **$\bar{L}$ (Digital literacy)**: Ability to search for information, communicate through application
- **$\bar{U}$ (User Autonomy)**: ownership of SIM cards, ability to use devices without supervision and ability to use mobile and internet without assistance from others

Gender Parity Index (GPI)

The present study adopted the Gender Parity Index (GPI) framework established by UNESCO (2024) in its Global Education Monitoring Report “Gender Report: Technology on her terms”. The GPI normalised the digital disparity by expressing the composite female GDAS as a relative ratio of male benchmark.

$$GPI_{\text{Digital}} = \frac{GDAS_{\text{Female}}}{GDAS_{\text{Male}}}$$

GPI<1.00 indicates a systematic digital access gap, confirming structural barriers that disproportionately disadvantage women in rural spaces

GPI=1.00 indicates absolute gender equilibrium

GPI>1.00 indicates an asymmetrical digital landscape favouring the females.

Frequency distribution and percentages were calculated and the data was tabulated.

Two-sample independent Student's t-test

To determine whether the observed differences between male and female digital engagement are statistically significant, a two-sample independent Student's t-test was performed ($p < 0.001$).

$$t = \frac{\bar{X}_{GDAS_{Male}} - \bar{X}_{GDAS_{Female}}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

- **$\bar{X}_{GDAS_{Male}}$ and $\bar{X}_{GDAS_{Female}}$** : Represent the sample mean Gender Digital Access Scores for men and women, respectively
- **s_1^2 and s_2^2** : Represent the respective sample variances of the two gender demographics
- **n_1 and n_2** : Represent the total number of male and female respondents surveyed within the sample pool

Results and Discussion

Socio-economic profile of the respondents

Gender disaggregated data on the key socio-economic profile of the respondents including age, education, type of family, landholding, annual income and membership of Self Help Group/Farmer Producer Organisation is presented in Table 1. The data indicates the majority of the female respondents were in the age group of 31 to 40 years while majority of the males were 40 years and more of age (45.3%). The data indicates a noticeable age gap between males and females. The female respondents in the present study are in younger age group while the data regarding the male respondent points towards a higher age group.

As far as education is concerned, nearly half of the female respondents (49.3%) are educated upto matric while majority (34.6%) of their male counterparts are graduate. The findings point towards a gender gap in higher education in rural areas. Several other studies such as study by Singh, 2025; Shergill and Kaur, 2025 have also pointed towards rural-urban and gender divide in literacy in Punjab. Several other studies by Budhia and Bhullar, 2022; Khushbu, 2022; Pushakaran, 2017 and Shergill *et al.*, 2018 have also highlighted the gap in higher education in rural Punjab. The data is indicative of the fact that gap in higher education still prevails in rural areas.

In the present study majority of the respondents across gender lived in joint family. The data regarding the participation of respondents in SHG/FPO points towards more participation of females in SHG than males. This may be due to the fact that SHGs were designed to target female empowerment of rural India. The data over a period of time has also indicated rising SHG members over time (Singh *et al.*, 2025).

Thus, majority of the respondents in the present study had marginal and small landholdings with annual family income upto Rs. 300000/-; males being in higher age group and more educated while their counterpart falling in lower age group (31 to 40 years) and lesser educated.

The proportion of males (24%) who were member of SHG/FPO was comparatively lower than the females (50.6%).

Gender wise use of social media platforms for accessing agriculture related information

Social media platforms can act as an important tools to create awareness, share information and create communities with the same interests. Various studies over a period of time have highlighted that if utilized well, social media can be good tools for sharing agricultural information. Chander *et al.*, 2018 has also mentioned that farmers will benefit from social media by making informed decisions, interacting with fellow farmers and asking extension officers regarding the daily challenges they encounter regarding their produce. In the present study, the data indicates WhatsApp as the

Table 1: Socio-economic profile of the farmers in percent (n=150)

Variables	Categories	Male	Female
Age	< 30 years	17.3	24.0
	31 to 40 years	37.3	49.3
	>40 years	45.3	26.6
Education	Illiterate	2.6	10.6
	Matric	30.6	49.3
	Secondary education	25.3	29.3
	Graduate	34.6	8.0
	Post graduate and above	6.6	2.6
Type of family	Joint	57.3	69.3
	Nuclear	42.6	30.6
Land holding (in hectares)	Marginal (< 1 ha)	30.67	45.33
	Small (1-2 ha)	37.33	34.67
	Semi- Medium (2 – 4 ha)	16	10.67
	Medium (4 -10 ha)	12	6.67
	Large (>10 ha)	4	2.67
Annual Income (in Rs.)	<100000	4.0	10.6
	100000 to 300000	65.3	45.3
	300000 to 500000	22.6	41.3
	>500000	8.0	2.6
Member of SHG/FPO	Yes	24.0	50.6
	No	76.0	49.3

Source: Field Survey, 2024

most widely used platform to access agriculture related information, with 75.6 per cent of male and 60.8 per cent of female respondents engaging with it, suggesting its accessibility and familiarity across rural communities.

Table 2: Gender wise Percentage use of social media platforms* (n=150)

Social media platforms	Male	Female
Whats App	75.6	60.8
YouTube	58.3	45.7
Facebook	40.7	29.9
Instagram	25.8	15.3

Source: Field Survey, 2024 *Multiple response

YouTube follows, favoured by 58.3 per cent of male and 45.7 per cent of female, indicating a strong preference for visual learning. Facebook and Instagram comparatively show lower engagement. Overall, males consistently reported higher usage of all social media platforms to access agriculture related information than their female counterparts (Table 2). The findings of the present study are in line with the data of Meltwater, 2025 which indicates that WhatsApp is by far the most popular messaging app, used by 80.8 per

cent of Indian internet users. Following closely at 77.9 per cent Instagram and Facebook (67.8%). Study by Bhatia *et al.*, 2025 also found WhatsApp and YouTube as top ranked social media platforms used in agriculture in Fatehgarh Sahib District in Punjab. Thus the present study further highlighted that WhatsApp remained the most utilized social media platform for agricultural information, followed by You Tube with gender based differentials.

Digital Access Scores

Gender wise Digital Access Score (GDAS) on four indicators namely device ownership, internet access, digital literacy and autonomy of males and females was calculated for the present study. Each category was assigned equal weights of 0.25.

The data on device ownership as shown in Table 3 scores high for both genders, with male (0.95) slightly ahead of female (0.85) resulting in weighted scores of 0.23 and 0.21 respectively. The data further indicates t- value of 2.58 ($p < 0.001$) indicating a statistically significant differences where males have higher scores when compared to females. Access to internet revealed a more pronounced gender gap with male scoring 0.80 and women 0.60, yielding weighted

Table 3: Gender wise Digital Access Score (n=150)

Indicators	Average Score		Weighted Score		t-values
	Male	Female	Male	Female	
Device Ownership	0.95	0.85	0.23	0.21	-2.58
Internet Access	0.80	0.60	0.20	0.15	-5.7
Digital Literacy	0.70	0.50	0.17	0.125	-5.7
Autonomy	0.68	0.65	0.17	0.162	-0.86 NS
Total Score	-	-	0.775	0.647	-5.23

Source: Field Survey, 2024

scores of 0.20 and 0.15; the differences in the scores were highly significant statistically with t-value of -5.77. Digital literacy followed a similar pattern, with male scoring 0.70 and female 0.50, translating to weighted scores of 0.17 and 0.125. The scores were statistically significant in this category as well (t-values -5.77). Digital autonomy showed relatively balanced scores, with male at 0.68 and female at 0.65, leading to weighted scores of 0.17 and 0.162. However, the differences were not statistically significant. The cumulative weighted scores indicate a gendered disparity in digital access, with male achieving a total score of 0.775 compared to 0.647 for female. Males overall showed statistically significant higher scores, specifically in all three categories except in the case of autonomy. This suggests that while both genders demonstrate substantial engagement with digital tools, women face notable gaps in internet access and digital literacy, which may reflect broader structural and socio-cultural constraints. Bhatia, 2025 have also highlighted unequal physical access to information communication technologies mobile devices and internet and elaborated that second level of digital divide indicates unequal access to technologies and devices due to socio-economic, political, cultural and educational factors. The third level of digital divide is unequal capacities to benefit from and capitalize on the access and use of digital tools. Multiple studies confirm gender gaps in digital agriculture access (Chen *et al.*, 2026; Gupta *et al.*, 2025). On the contrary data on student digital literacy globally points to the fact the females excel in information searching using ICT (Lafita and Rosana, 2023)

Gender Parity in Digital Access

The Gender Parity Index (GPI) across four dimensions of digital access is calculated as the ratio of female's weighted scores to male's weighted scores, thus indicating gender-based disparities in digital engagement.

The data of Table 4 indicates that device ownership shows a relatively high parity (GPI = 0.91) indicated near equitable access to digital devices between female and male. However, internet access revealed a more pronounced gap (GPI = 0.75), with women scoring 0.15 compared to 0.2 of men, suggesting limited connectivity among female. Lowest parity (GPI = 0.71) is indicative in digital literacy underscoring significant challenges faced by women in acquiring and applying digital skills. Data on autonomy in digital context shows the highest parity (GPI = 0.95), reflecting encouraging trends in women's self-directed use of digital tools. The overall GPI of 0.82 indicates disparity in favour of males in digital access, with female left behind male across most categories.

Overall, device ownership shows strong parity, suggesting near equal access to hardware like phone. Internet access lags pointing to connectivity barriers for women. The findings of the present study are in line with the global research which consistently shows narrower gender gaps in mobile ownership compared to internet use. In low and middle income countries women are 8-14 per cent less likely to own mobiles while internet disparity in 14-22 per cent. Ownership nears parity due to affordable handsets, but usage

Table 4: Gender Parity Index (n=150)

Category	Weighted Score		Gender Parity
	Male	Female	
Device Ownership	0.23	0.21	0.91
Internet Access	0.2	0.15	0.75
Digital Literacy	0.17	0.125	0.71
Autonomy	0.17	0.162	0.95
Total Score	0.775	0.64	0.82

Source: Field Survey, 2024

lags from affordability barriers, digital literacy deficits and socio-cultural constraints as also noted in ITU and GSMA reports.

These findings highlight the need for targeted interventions to bridge digital literacy and connectivity gaps, especially among females in rural communities. Study by Sonne, 2021 also highlighted significant gap in the literature on women's access to, and women do not fall further behind in digitisation, in turn, further excluding women from services that are going online, and reducing their agency. This unequal distribution of technology ownership limits women's ability to access digital extension services. The present study indicates higher SHG/FPO membership among the female farmers compared to males, highlighting that these groups and associations can help in integrating digital literacy training focussing on Whats App/YouTube navigation, reliable content verification and social media marketing, keeping in view the limited access of females to higher education.

Barriers that hinder farmers from effectively utilizing digital agricultural content

In order to plan a strategy for development of digital agricultural content it is pertinent to identify the barriers that hinder the farmers from effectively utilizing digital agricultural content. The data from Table 5 indicates that males felt language as major barrier (57.3%) followed by lack of knowledge about the reliable sources of knowledge on social media (32.9%). Female farmers faced family restrictions (68.7%) as major barrier in effective utilization of digital agricultural content, followed by language barrier (62.7%). This point to the fact that there is gap in the need and availability of reliable digital agricultural content in local language as this gap was felt by farmers across gender.

The data regarding gender based differences in terms of barrier that hinder farmers from effectively utilization of digital agricultural content revealed that family restrictions/discretions in viewing the digital content emerged as the factor where the differentials were maximum. The findings of the present study are in line with study conducted by Ghosh *et al.*, 2024 which identified concerns regarding

misinformation and content authenticity as obstacles that hinder the full utilization of social media in agriculture. Also a study conducted by Nchanji *et al.*, 2025 found women less likely to access climate smart information via mobile/social media despite phone ownership, due to literacy and ownership gaps. Similarly the studies have highlighted cyber threats and poor infrastructure as persistent issues for rural adoption. Several research studies corroborate the gender-differentiated barriers to digital agricultural content utilization. Study on Kerala JLG women farmers conducted by Adithyan *et al.*, 2025 identified limited training opportunities, high internet costs, lack of local mentorship and dependence on family members as top constraints, with Garrett's ranking placing family reliance close to language barriers. Similarly, research on social media use for agricultural information by Kavaya and Natrajan, 2025 highlighted limited digital literacy, poor connectivity, high data costs and misinformation as universal hurdles, particularly acute for small and marginal farmers

Conclusions and Policy Implications

This study examines gender disparities in digital agricultural content access among 150 farmers (75 male, 75 female) in Fatehgarh Sahib, Punjab, revealing WhatsApp (75.6% male vs. 60.8% female usage) and YouTube as dominant platforms amid rising rural internet penetration (12.21 million subscribers). The data indicates younger females with lower education and landholdings but higher SHG/FPO membership (50.6% females vs. 24% males); GDAS scores favour males (0.775 vs. 0.647), with GPI values indicating near-parity in device ownership (0.91) and autonomy (0.95) but gaps in internet access (0.75) and digital literacy (0.71), yielding an overall GPI of 0.82. Males cite language (57.3%) and unreliable sources (32.9%) as barriers; females face family restrictions (68.7%) and language (62.7%), aligning with LMIC patterns of ownership parity but usage lags due to socio-cultural and literacy constraints. The findings underscore a persistent "second-level digital divide" in Punjab's agrarian heartland, where device access nears equity (GPI 0.91) but connectivity and skills gaps (GPI 0.75, 0.71) sideline women from digital agriculture benefits, mirroring GSMA (2025) data on 14-22 per cent internet

Table 5: Barriers that hinder farmers from effectively utilizing digital agricultural content (in per cent)* (n=150)

Digital tools	Male	Female	Differences (in percent points)
Device access	19.2	57.3	38.1
Cost	29.8	48.7	18.9
Lack of knowledge	32.9	25.2	7.7
Language barrier	57.3	62.7	5.4
Family restrictions	20.6	68.7	48.1
Online safety concerns	25.8	38.9	13.1

Source: Field Survey, 2024 *Multiple response

disparities versus 8-14 per cent ownership gaps.

To bridge these gaps, targeted interventions are essential. Policymakers, extension agencies and development agencies should promote gender-responsive digital agricultural strategies. In order to strengthen gender-responsive digital agricultural extension services, it is important to develop and disseminate agricultural advisories through women friendly digital platforms such as Whats App, YouTube and interactive voice response (IVR) systems. It is also pertinent to ensure that the digital extension content is available in Punjabi to overcome language barriers. Audio-visual and voice based content needs to be promoted to support farmers with limited literacy. The content needs to be designed such that it reflects the specific needs and roles of women farmers in crop production, livestock management, value addition and marketing. SHGs and FPOs can be trained and utilized as platforms for digital inclusion initiatives. There is need to provide timely and accurate advisories Official WhatsApp groups, mobile applications and social media channels providing

To conclude, it can be said that the study demonstrates that the challenge is no longer limited to device ownership but it extends to meaningful digital participation. Therefore, policy interventions must move beyond providing access to technology and focus on enhancing digital skills, improving connectivity, addressing socio-cultural barriers and creating gender-responsive digital ecosystems. Such measures will help ensure that female farmers can fully benefit from digital agriculture, thereby contributing to agricultural productivity, rural livelihoods and gender equality.

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