Bridging the Digital Divide in Agriculture: An Investigation to ICT Adoption for Sustainable Farming Practices in Banaskantha district of Gujarat

ABSTRACT

This article investigates the difficulties farmers encounter in adopting and utilising ICT technologies for sustainable agriculture, with a particular emphasis on bridging the digital divide. To assess the digital divide among farmers, the study examines access to technology, digital literacy levels, and internet connectivity. Affordability, awareness, and complexity are highlighted and analysed as barriers to ICT adoption. To address these barriers, customised ICT solutions, including user-friendly tools, are being developed. The influence of these solutions on long-term farming practises were assessed. The interpretations emphasise solutions such as cost reduction, subsidisation, improved power supply, information delivery in local languages, the establishment of service centres, and the provision of training programmes. Implementing these solutions can help to bridge the digital divide, improve information access, and promote sustainable agriculture. This article examines the challenges that farmers encounter when adopting and utilizing ICT (Information and Communication Technology) solutions for sustainable agriculture, with a particular focus on addressing the digital divide. The research investigates the accessibility of technology, levels of digital literacy, and internet connectivity to determine the extent of the digital divide among farmers. It identifies and examines affordability, awareness, and complexity as obstacles to ICT adoption. To overcome these barriers, customized ICT solutions are being developed, including user-friendly tools. The long-term impact of these remedies on farming practices is being studied. The findings highlight the importance of cost-cutting measures, subsidies, improved electricity supply, information dissemination in local languages, the establishment of service centres, and the provision of training programs. Implementing these solutions can help bridge the digital divide and enhance farming practices.

Keywords: Barriers, Digital Divide, ICT tools, Solution, Sustainable Agriculture.

1. INTRODUCTION

In the year 1990 the word “digital divide”1st came in united states to describe the observed disparities in access to computers, the Internet, and other digital technology initially, and afterwards. The digital divide was initially described as the difference between those who physically have access to technology and those who do not, but over time, a more complex picture of the issue has formed [1]. According to Oxfam India Inequality report Only 31% of

the population of rural areas uses the internet. the ICT sector and the Digital Economy are important economic drivers for the country. India plans to develop the ICT sector to $1 trillion by 2025, or 20 percent of GDP [2]. As of September 2022, Reliance Jio was the leading company, having over 419 million wireless telecom subscribers across India. The south Asian country had the world's second-largest telecom market [3]. 1.3 billion digital ID users, India leads the global e-governance race [4]. The ICT industry is expected to reach $191 billion in FY2020 and increase to $350 billion by 2025 [5]. The Internet is used by 67% of India's urban population [6]. ICT tools are one of the holistic development pillars for any country to gain national and international competitive advantages. In order to improve human life quality, boost knowledge resources, promote improved information access, accelerate agricultural expansion, and increase knowledge resources, ICT is required in agriculture. Digital divide become one of the emerging problems in agriculture along with other sectors. So, for sustainable agriculture bridging this disparity and ensuring equal access to ICT tools is critical for boosting innovation, increasing production, and tackling pressing agricultural concerns in the context of sustainable farming practises. The goal of this study project is to investigate the digital gap in agriculture, identify the constraints that prevent farmers from embracing and effectively utilising ICT tools, and offer tailored solutions to these difficulties. For farmers, the implementation and utilization of ICT tools within agriculture presents several obstacles. These limiting factors can impede the incorporation of technology into everyday sustainable farming practices. Access to Technology, Digital Literacy, Affordability, Language and Content, Technical Support, Infrastructure and Connectivity, Perceived Relevance and Complexity, Socio-cultural Factors are few major constraints faced by the farmers in utilization and adaptation of ICT tools. To address these barriers necessitates personalised solutions that take into account farmers' individual needs and environments. Initiatives focused on digital literacy training, infrastructure development, affordability schemes, localised content, and easily accessible technical assistance can help farmers overcome these barriers and promote greater adoption and effective use of ICT tools. Sustainable agriculture encompasses numerous types of nontraditional agriculture that are sometimes referred to as organic, alternative, regenerative, ecological, or low-input agriculture. To bridge the gap Govt. also take various initiatives like eNam [7,8] Mobile applications [9] Agro-met Advisory Services [10] Aaqua, Kisan call centre etc. Just because a farm is organic or alternative does not make it sustainable; nevertheless, for a farm to be sustainable, it must produce appropriate amounts of high-quality food while remaining environmentally safe and lucrative. Rather than relying on purchased commodities such as

fertilisers, a sustainable farm relies as much as possible on beneficial natural processes and renewable resources derived from the farm itself [11].

2. OBJECTIVE

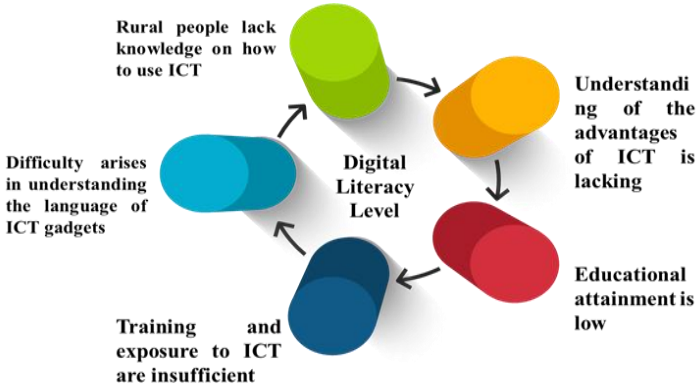
The General objective of this study is to explore the digital divide in agriculture, identify impediments to ICT adoption, and create customised solutions to bridge the gap, promoting fair access to and effective use of ICT tools for sustainable farming practises.

3. METHODOLOGY

Research can be two type comparative and non-comparative [12,13] for the study, a non-comparative, mixed-methodologies research technique was used to collect data utilising both quantitative and qualitative methods. A survey questionnaire was distributed to 150 potato growers in the Banaskantha district of Gujarat. Because the independent variables were already present in the study area, the study was limited to an "ex-post facto" [14] research design. The study employed a multistage random sampling technique. Dantiwada, Deesa, and Lakhani talukas were chosen at random from the district. The data was analysed using descriptive statistics and content analysis methodologies.

4. RESULT AND DISCUSSION

The outcomes of the study focused on bridging the digital divide among farmers in terms of adopting and utilising ICT technologies for sustainable agriculture. The examination of the digital gap looked at farmers' access to technology, digital literacy levels, and internet connectivity. Affordability, awareness, and complexity difficulties were cited as barriers to ICT adoption. To address these barriers, the study advocated the creation of user-friendly and context-specific ICT solutions. The impact of these solutions on sustainable agricultural practises was assessed, with metrics such as productivity, resource management, market access, and environmental sustainability taken into account.



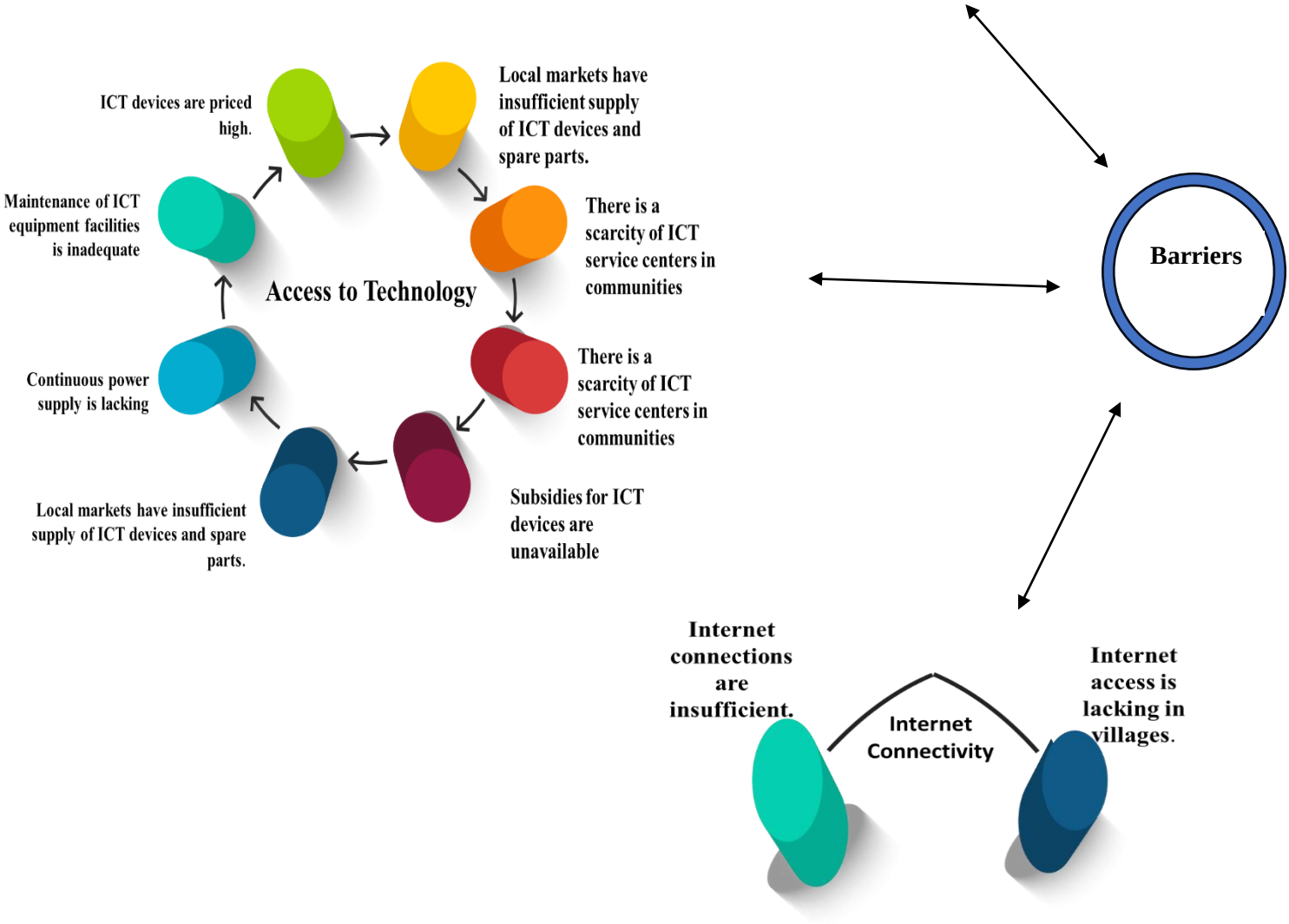


Fig 1. Outline of Barriers related to ICT adaptation and Utilization Pattern

4.1. The barriers related to ICT adaptation and utilization were divided into three categories

1) Digital Literacy Level: which is based on farmers' knowledge and skill in using ICT tools, proficiency in using software, navigating online platforms, and accessing relevant agricultural information. 2) Access to technology: which is based on Availability, Affordability of ICT

tools and accessibility of necessary infrastructure such as electricity and reliable internet connectivity in rural areas. 3) Internet Connectivity: which is based on the Availability, Reliability, speed, coverage and affordability of internet.

The barriers were listed in Ranking system based on the frequency and percentage of the respondents' response.

Table 1. Barriers associated with the adaptation and utilization pattern of ICT tools

(n=150)

Sl. No.	Barriers	Frequency	Percentage	Rank
1	ICT devices are priced high.	121	80.66	**I**
2	Maintenance of ICT equipment facilities is inadequate.	73	48.66	**XIV**
3	Rural people lack knowledge on how to use ICT.	112	74.66	**III**
4	Educational attainment is low.	87	58.00	**IX**
5	Continuous power supply is lacking.	75	50.00	**XIII**
6	Training and exposure to ICT are insufficient.	111	74.00	**IV**
7	Understanding of the advantages of ICT is lacking.	85	56.66	**X**
8	There is a scarcity of ICT service centres in communities.	80	53.33	**XII**
9	Internet connections are insufficient.	102	68.00	**V**
10	Servicing charges for ICT gadgets are high.	119	79.33	**II**
11	Difficulty arises in understanding the language of ICT gadgets.	100	66.66	**VI**
12	Local markets have insufficient supply of ICT devices and spare parts.	84	56.00	**XI**
13	Internet access is lacking in villages.	93	62.00	**VII**
14	People in rural areas have poor economic conditions.	71	47.33	**XV**

15	Subsidies for ICT devices are unavailable.	90	60.00	**VIII**

The barriers to ICT adoption were assessed and ranked based on their frequency and percentage as follows:

I. ICT devices are priced high (80.66%) II. Servicing charges for ICT gadgets are high (79.33%) III. Rural people lack knowledge on how to use ICT (74.66%) IV. Training and exposure to ICT are insufficient (74%) V. Internet connections are insufficient (68%) VI. Difficulty arises in understanding the language of ICT gadgets (66.66%) VII. Internet access is lacking in villages (62%) VIII. Subsidies for ICT devices are unavailable (60%) IX. Educational attainment is low (58%) X. Understanding of the advantages of ICT is lacking (56.66%) XI. Local markets have insufficient supply of ICT devices and spare parts (56%) XII. There is a scarcity of ICT service centres in communities (53.33%) XIII. Continuous power supply is lacking (50%) XIV. Maintenance of ICT equipment facilities is inadequate (48.66%) XV. People in rural areas have poor economic conditions (47.33%).

The rankings' interpretation gives information on the frequency and percentage of key impediments to ICT adoption in rural areas. The rankings were determined using data obtained and indicate the importance of each obstacle in impeding the use of ICT tools. The most prominent barrier found is the high cost of ICT gadgets, which is a substantial barrier for farmers in accessing and purchasing these technologies. The high cost of servicing ICT equipment follows close behind, adding to the financial hardship on rural areas. Other significant impediments include rural people's lack of information about how to utilise ICT, emphasising the significance of digital literacy programmes and training activities. Inadequate ICT training and exposure also contribute to the challenges faced by farmers in adopting these tools effectively. The restricted availability of internet connections, as well as insufficient infrastructure maintenance, have an impact on the accessibility and reliability of ICT services, further restricting their adoption. Similarly, a lack of understanding of the benefits provided by ICT tools highlights the importance of awareness campaigns and education on the possible benefits in agricultural practises. The rankings also identify impediments relating to local market limits, such as a lack of ICT service centres and a lack of devices and spare parts. These constraints make it difficult for rural populations to access and use ICT resources. Furthermore, limitations related to low educational attainment and

bad economic situations in rural areas highlight larger socioeconomic issues that must be addressed in order to increase ICT usage. The lack of subsidies for ICT gadgets exacerbates the situation. Overall, this interpretation provides a thorough understanding of the specific barriers to ICT adoption faced by farmers in rural areas, providing valuable insights for policymakers, organisations, and stakeholders working to bridge the digital divide and promote sustainable agricultural practises.

4.2. Plausible Solutions to overcome the barriers related to ICT Tools adoption and utilization

Some solutions were suggested by the respondents and those were listed and ranked.

Table 2. Seek solutions for the solutions of the barriers associated with the adaptation and utilization pattern of the ICT tools

(n=150)

Sl. No.	Suggestions	Frequency	Percentage	Rank
1	Reduce the cost of ICT equipment.	126	84.00	I
2	Ensure the availability of infrastructure facilities.	71	47.33	XIII
3	Offer training programs to develop ICT skills.	91	60.66	VIII
4	Establish educational institutions near villages.	68	45.33	XIV
5	Improve internet service provision.	79	52.66	XI
6	Ensure a consistent power supply.	111	74.00	IV
7	Provide training on ICT technology usage.	99	66.00	VII
8	Conduct public awareness campaigns on the benefits of ICT.	89	59.33	IX
9	Establish service centers across villages.	102	68.00	VI
10	Decrease service fees.	114	76.00	III
11	Deliver information in local	105	70.00	V

	languages.			
12	Create large marketplaces.	76	50.66	XII
13	Enhance internet connectivity.	85	56.66	X
14	Ensure fair pricing for farmers' products.	66	44.00	XV
15	Make subsidies available for ICT devices.	119	79.33	II

The suggestions to address the constraints were ranked based on their frequency and percentage. The interpretations and rankings are as follows:

I. Reduce the cost of ICT equipment (84.00%) II. Make subsidies available for ICT devices (79.33%) III. Decrease service fees (76.00%) IV. Ensure a consistent power supply (74.00%) V. Deliver information in local languages (70.00%) VI. Establish service centers across villages (68.00%) VII. Provide training on ICT technology usage (66.00%) VIII. Offer training programs to develop ICT skills (60.66%) IX. Conduct public awareness campaigns on the benefits of ICT (59.33%) X. Enhance internet connectivity (56.66%) XI. Improve internet service provision (52.66%) XII. Create large marketplaces (50.66%) XIII. Ensure the availability of infrastructure facilities (47.33%) XIV. Establish educational institutions near villages (45.33%) XV. Ensure fair pricing for farmers' products (44.00%)

The analysis of the rankings offers information on the frequency and proportion of suggested solutions to overcome hurdles to rural ICT adoption. The rankings highlight the importance of each option in resolving farmer restrictions. Reduce the cost of ICT equipment, which has been regarded as the most widespread and essential barrier. Making ICT gadgets more inexpensive would increase farmer accessibility and adoption. The availability of ICT equipment subsidies came in second, emphasising the importance of financial assistance in facilitating farmers' access to technology. Another critical solution listed third is lowering service fees. Lowering the costs of ICT services will relieve financial stresses and encourage farmers to use them more effectively. Ensuring a continuous power supply is listed fourth, emphasising the importance of stable energy in supporting the long-term usage of ICT tools in rural regions. The fifth ranking is for information delivery in local languages, recognising the importance of linguistic accessibility in improving farmers' understanding and adoption of ICT. Establishing service centres across communities came in sixth place, emphasising the

importance of accessible support networks and technical help to assist farmers in properly utilising ICT tools. Providing ICT technology training placed eighth, emphasising the need of developing digital skills and knowledge among farmers in order to fully utilise ICT instruments. Offering training programmes to develop ICT skills, conducting public awareness campaigns on the benefits of ICT, improving internet connectivity, improving internet service provision, creating large marketplaces, ensuring the availability of infrastructure facilities, establishing educational institutions near villages, and ensuring fair pricing for farmers' products are among the other ranked solutions. This analysis provides a thorough knowledge of the proposed remedies to the challenges to ICT adoption. It emphasises the various tactics required to overcome obstacles and encourage the effective use of ICT technologies in rural regions, allowing farmers to benefit from greater information access, increased productivity, and sustainable agricultural practises. The research topic investigates the difficulties farmers face when adopting and utilising ICT tools for sustainable agriculture. Sustainable agriculture includes farming practises that take into account environmental, economic, and social concerns in order to meet current and future requirements. Farmers obtain real-time access to weather, market pricing, and agricultural practises by using ICT tools, enabling informed decision-making and lowering environmental effect. Precision agriculture practises are also made easier by ICT technologies, which promote efficient resource management and reduce chemical use. Furthermore, these technologies promote knowledge sharing and capacity building among farmers, thereby encouraging the adoption of sustainable practises. Addressing ICT adoption issues enables farmers to engage in sustainable agriculture, thereby contributing to resource efficiency, climatic resilience, biodiversity conservation, and socioeconomic development in rural areas. The finding is also similar with other researchers result like “ICT an Important information Tool for Sustainable Agriculture Productivity”: The biggest impediments to ICT adoption may include a lack of infrastructure, a lack of education and English proficiency, and a power shortage. As a result, it would be desirable to conduct additional research into the factors that prohibit farmers from using ICT. [15]

4.3. How ICT use is boosting sustainable agriculture

The research topic investigates the difficulties farmers face when adopting and utilising ICT tools for sustainable agriculture. Sustainable agriculture includes farming practises that take into account environmental, economic, and social concerns in order to meet current and future requirements. Farmers obtain real-time access to weather, market pricing, and agricultural practises by using ICT tools, enabling informed decision-making and lowering

environmental effect. Precision agriculture practises are also made easier by ICT technologies, which promote efficient resource management and reduce chemical use. Furthermore, these technologies promote knowledge sharing and capacity building among farmers, thereby encouraging the adoption of sustainable practises. Addressing ICT adoption issues enables farmers to engage in sustainable agriculture, thereby contributing to resource efficiency, climatic resilience, biodiversity conservation, and socioeconomic development in rural areas.

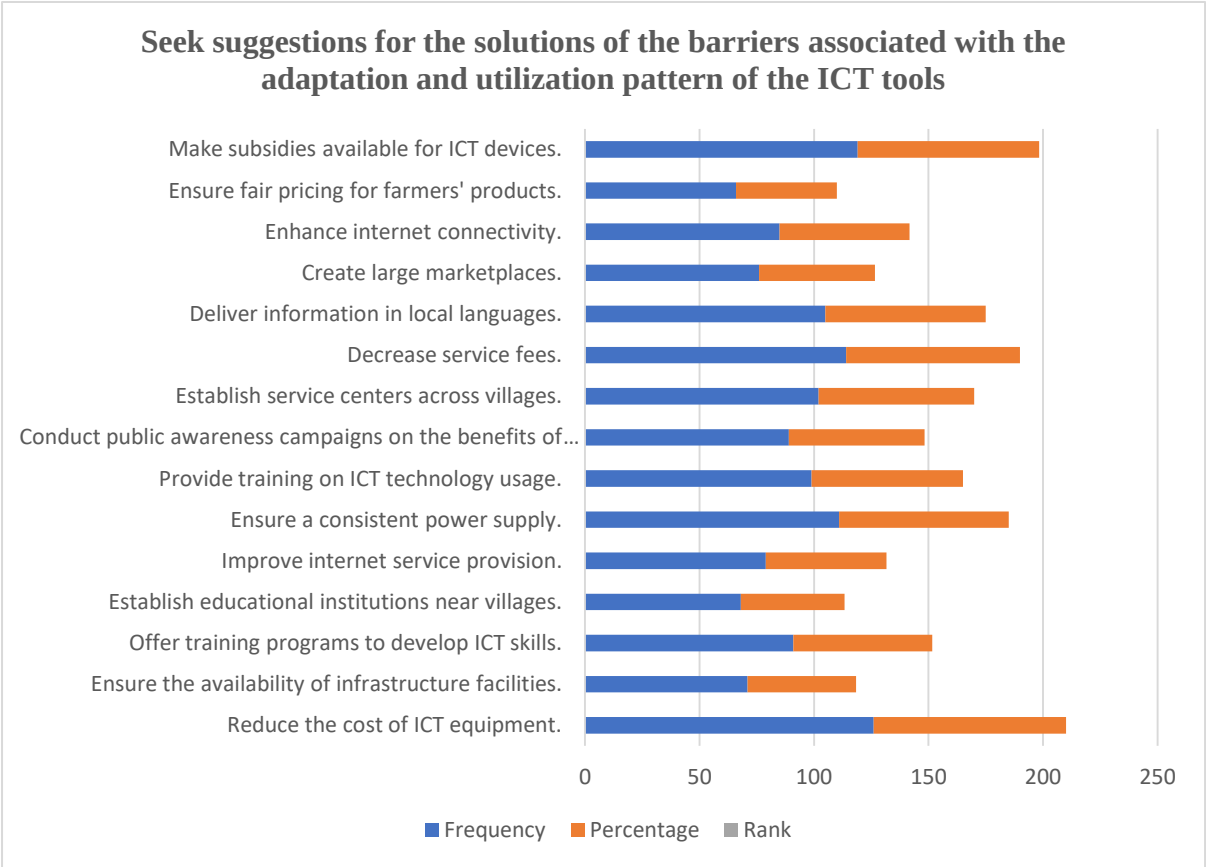


Fig 2. Barriers associated with the adaptation and utilization pattern of ICT tools

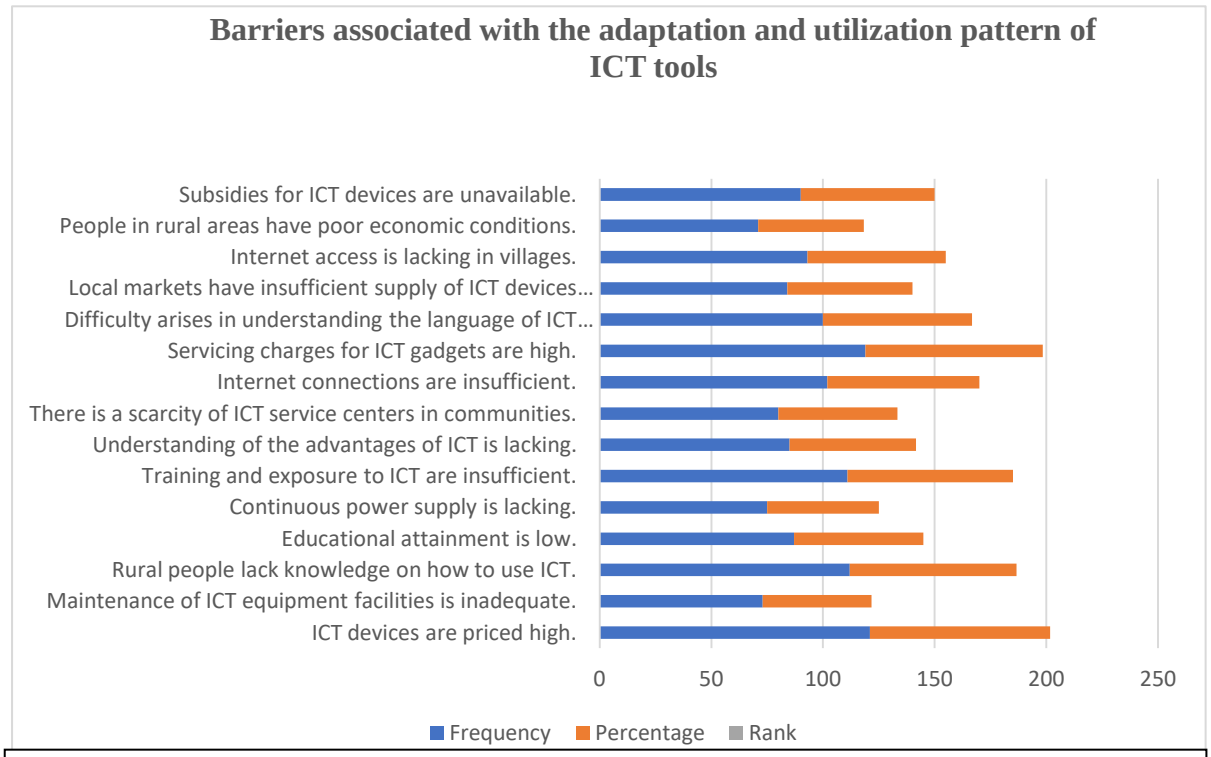


Fig 3. Seek suggestions for the solutions of the barriers associated with the adaptation and utilization pattern of the ICT tools

5. CONCLUSION

This article sheds light on the hurdles and solutions in bridging the digital divide in agriculture. Valuable insights have been gathered through the analysis of numerous elements such as access to technology, digital literacy levels, internet connectivity, affordability, awareness, complexity difficulties, and the development of customised ICT solutions. The assessment of the digital divide among farmers found the presence of barriers such as high ICT device costs, poor infrastructure maintenance, limited knowledge of ICT usage, low educational attainment, insufficient power supply, and a lack of training and exposure to ICT tools. These findings highlight the numerous hurdles that farmers confront when adopting and deploying ICT tools for sustainable agriculture. The study did, however, identify intriguing strategies to overcome these limitations. The interpretations emphasised the importance of lowering the cost of ICT equipment, providing subsidies for ICT devices, lowering service fees, ensuring a consistent power supply, providing information in local languages, establishing service centres, providing training programmes, conducting awareness campaigns, improving internet connectivity, improving service provision, creating marketplaces, ensuring infrastructure availability, and establishing educational institutions. It is possible to overcome the digital gap and empower farmers to effectively embrace and use ICT tools for sustainable agriculture by applying these solutions. These activities can improve information availability, increase production, encourage effective farming practises, ease market access, and eventually contribute to the socioeconomic development of rural areas. Overall, this article contributes to a better knowledge of the problems farmers experience while adopting and implementing ICT technologies for sustainable agriculture. The interpretations provide vital insights into the constraints and solutions, enabling policymakers, stakeholders, and researchers in developing strategies and initiatives to bridge the digital gap and increase farmers' equitable access to technology.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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