The OCEM Journal of Management, Technology & Social Sciences, 3(2) [ISSN: 2705-4845]

Recieved: March 23, 2024 | Revised: April 13, 2024 | Accepted: May 23, 2024 | Published: July 15, 2024

DOI: https://doi.org/10.3126/ocemjmtss.v3i2.67858 **Paper Type: Research Article**

Information and Communication Technologies (ICTs) in Farming and Its Determinants: A Reference of Dhankuta, Nepal

Surya Mani Dhungana
Asst. Prof., Department of Agricultural Economics and Agribusiness Management, Agriculture and Forestry University, Nepal
Email: smdhungana@afu.edu.np
orcid: 0000-0003-0041-9373

Volume 3, Issue 2
ISSN Print:270548-4845
ISSN Online:270548-4845

Abstract

Traditional extension fails to fulfil the different demands of rural farmers, who are often cut off from mainstream information sources. The results highlight the importance of information and communication technologies (ICTs) in connecting smallholder farmers to larger agricultural information systems. A survey study was conducted in Danuta, Eastern Nepal, to assess the usage of ICTs and their determinants in farming. A total of two hundred and twenty-four households were randomly selected, and descriptive and inferential statistics were used to analyse the data. The findings revealed a significant reliance on traditional ICTs, mobile phones, radios, and televisions, with adoption rates ranging from 79% to 90.18%. However, newer technology, internet services and smartphone apps, had lower adoption, indicating a slow integration into farming methods. Market and weather information were highlighted as the key reasons for using ICTs in farming. A logistic regression analysis identified major factors in using ICTs in farming. Younger household heads were more likely to adopt ICTs, indicating a generational split in technology acceptability. Male household heads were more likely to use ICTs than females. Borrowing loans for farming has emerged as a significant facilitator of ICT adoption.

Interestingly, decreased ICT usage was associated with higher academic status, highlighting the necessity for focused efforts to bridge this disparity. Overall, the study implies the role of ICTs in improving agricultural productivity and livelihoods in Nepal. Policymakers and stakeholders can use ICTs to empower farmers, improve information distribution, and promote sustainable agriculture by removing access barriers and fostering the digital literacy.

Keywords: *agriculture, information, logistic regression, traditional extension, technology, use of ICTs*

How to cite this paper:
Dhungana, S. M. (2024). Information and communication technologies (ICTs) in farming and Its determinants: a reference of Dhankuta, Nepal. *The OCEM Journal of Management, Technology and Social Sciences, 3(2), 37-46.*

Introduction

Agriculture employs more than half of Nepal's population and accounts for 23.95% of GDP, making it the country's economic backbone (MOALD, 2023). Even with low productivity and instability, the agriculture sector is resilient. The government and other sources have a crucial need and great potential to enhance the dissemination of agricultural information to farmers (Armstrong & Gandhi, 2012). Traditional extension practices are insufficient for fulfilling farmer needs, as rural framings are frequently inaccessible from larger influences and information. Information and communication technologies (ICT) are critical for connecting smallholder farmers to the wider agricultural information system. Examples of ICT tools that facilitate information access include mobile smartphones and Agrippa, radios, televisions, printed mass media, the internet, and wireless networks. Modern farming increasingly relies on the above mentioned tools to connect farmers and teachers (Gautam, 2018). The use of ICT in a different kinds of industries has increased labour efficiency and production. Like other economically important sectors, agriculture now widely uses ICT in all aspects. According to Daum (2020), it has become one of the most important tools farmers use to manage different information connected to input parameters such as water, labour and fertilizer. Agricultural extension transfers information and skills to farmers to increase production, marketing, food security, and livelihoods. Which includes providing practical information on improved seeds, soil quality tests, tools, water and fertiliser management, pest control, and how to apply this knowledge on the farm (Ferroni & Zhou 2012). The use of ICT in agricultural extension has proven to be effective (World Bank, 2011), greatly increasing small farmers' production and sustainability (Gautam, 2018). ICT contributes to the transformation of rural communities by disseminating information and new technology, thereby boosting economic growth and productivity (Nihari, 2017).

In Nepal, the ratio of governmental extension officials to households is 1:1580 for crops and 1:1906 for livestock, indicating a shortage of agricultural extensionists (Gautam, 2018).This limited farmers' access to extension services, causing agricultural production failure due to a lack of timely and correct farming information (Regmi, 2016). Farmers have a knowledge gap regarding best production practices, which is exacerbated by risks and uncertainties from geography, climate, and natural disasters (Naharki, 2017). ICTs can help farmers during production by providing information and shielding them from disinformation. It assists farmers in making more informed decisions about the selection of varieties, when to plant intercultural operations, how to manage diseases and pests, when to harvest, and how to implement effective marketing strategies (Poudel et al., 2018). Also, ICT has improved agricultural opportunities and encouraged young people to pursue successful agricultural production in niche markets (Kharel, 2018). Although the government and private sector attempt to provide extension services, ICT-based advising services have changed in Nepal to fulfil the needs of farmers (Poudel et al., 2018). This paper seeks to assess the use of ICT in agriculture and its determinants in eastern Nepal.

Research Methodology

Dhankuta was purposefully selected for the study, which is situated in the mid-hill region of eastern Nepal. It is a potential farming area. The study population consisted of households engaged in farming in Dhankuta. We used descriptive and inferential statistics for analysis. A pretested interview schedule was used to collect the data from the sampled households. In different published articles, government official data were secondary information to validate it. In order to determine the factors that influence the use of ICT, a binary logistic regression model was employed to investigate the many socio-economic characteristics that influence the use of ICT. The decision of farmers to use ICT was estimated through logistic regression. To derive the several socio-economic factors that govern the ICT use probability (Yi=1). Several factors influence the use of ICTs on the farm. The probability of using ICTs was as follows:

If $Y_i = 1$; $P(Y_i = 1) = P_i$

$$Yi = 0;\ P(Y_i = 0) = 1 - P$$

Where,

Pi = E (Y= 1/X) represents the conditional mean of Y given certain values. Thus, the probability of use of ICT is expressed as (Hosmer & Lemshow, 2000).

$$P(Y_i = 1) = P_i = \frac{1}{1 + \exp^{-z}}$$

Where,

$$Z = \alpha + \Sigma \beta_i X_i + \varepsilon_i$$

Gujarati (2003) has definded the transformation of the binary logit of the probability of use of ICTs, P (Yi = 1) as:

$$L_i = \ln\left[\frac{Pi}{1-Pi}\right] = Z_i = \alpha + \sum_{i=1}^{n} \beta i\ Xi + \varepsilon_i$$

Where ,

Y_i (use of ICTs) = Dichotomous dependent variable (i.e., 1 if the farmer uses ICTs; and 0 if otherwise)

X_i= vector of variables included in the logit model,

β_i = parameters to be estimated,

ε_i = error term of the model,

exp (e) = base of natural logarithms,

L_i= Logit and P_i / (1- P_i) = Odd ratios.

The binary logit regression model for factors affecting the use of ICTs was as follows:

$Y_i = f(\beta_i x_i)$

Y_i = f (see Table 1)

Where I = probability of choice of use of ICTs.

Table 1: *List of independent variables used in logit regression*

Variables	Expected Sign
Age of household	+/-
Gender of Household head (Male =1)	+
House Type (Pakki=1)	+/-
Family type (Nuclear=1)	+/-
Ethnicity(Brahmin/ Chhetri=1)	+/-
Members involved in farming	+
Members aboard (Yes=1)	+
Experiences (Years)	+
Cultivated area (Ropani)	+
Membership in social organisation (Yes=1)	+
Irrigation Facility(Yes=1)	+/-
Borrow loan (Yes=1)	+/-
Training farming (Yes=1)	+
Livestock Standard Unit (LSU)	+/-
Education (Literate=1)	+/-
log income	+

Indexing of ICS

Household respondents' perceptions about the effectiveness of ICTs for farming were analysed using an indexing technique. ICT values were assigned using a scaling technique. The index value can be computed using the equation below.

$$I = \frac{\sum S_i f_i}{N}$$

Where,

I = Index value

S_i = Assigned value at i^{th} ICT

f_i = frequency of i^{th} ICT

N = Total number of households

Results

Sociodemographics of Farmers

The results revealed that the majority of household heads were male, accounting for 79.02% of the total, demonstrating a common pattern of male leadership within farming households. Regarding family structure, nuclear families dominate at 69.2%, implying smaller household sizes than joint families. Housing conditions vary, with a considerable proportion living in Kachchi/Semi-Pakki dwellings (71.40), which may indicate varying levels of infrastructure and living standards among households. Ethnically, the population was diverse, with Aadibasi/Janajati constituting the majority at 52.7% (see Table 2).

Table 2: *Demographic Characteristics of Farmers in the Study Area*

Variables	Categories	Frequency
Gender of household head	Female	47(20.98%)

	Male	177(79.02%)
Type of Family	Joint	69(30.8%)
	Nuclear	155(69.2%)
Type of House	Kacchi/ Semi Pakki	160(71.4%)
	Pakki	64(28.6%)
Ethnicity	Brahmin/Chhetri	94(42%)
	Aadibasi/Janajati	118(52.7%)
	Dalit	12(5.4%)

More than 38 % of households have members living abroad, likely influencing household dynamics and financial flows via remittances. The participation rate in social organisations (87.1%) indicated strong social cohesion and potential access to shared resources within the community. Irrigation facilities were widely available, and 91.5% of households had access, potentially impacting agricultural production, and cropping patterns. However, a sizable proportion of households (33%) had borrowed money, showing a reliance on external financial assistance for agricultural activity. Nearly half of households (46.4%) have received farming-related training, which could influence agricultural practices and adoption of innovation (see Table 3).

Table 3: *Distribution of Households by Different Attributes in the Study Area*

Variables	Frequency (Percentage)
Members Abroad	86(38.4%)
Membership of social organisation	195(87.1%)
Irrigation facility	205(91.5%)
Borrowed loan	74(33%)
Training regarding farming	104(46.4%)

In terms of decision-making in farming, it is worth noting that decisions were primarily shared, with roughly half of families incorporating both male and female members in decision-making processes. Furthermore, active involvement in farming was gender balanced, with 29.5% of females, 29.5% of males, and 41.1% of both actively involved in agricultural operations (see Table 4).

Table 4: *Distribution of Farming Households by Gender Dynamics in the Study Area*

Variables	Categories	Frequency (Percentage)
Decision farming	Female	14(6.3%)
	Male	89(39.7%)
	Both	121(54%)
Actively involved in farming	Female	66(29.5%)
	Male	66(29.5%)
	Both	92(41.1%)

The average age of household heads was 51.45 years, indicating the maturity of the farming community. The average family size was 6.68, indicating a relatively large family, which is likely to impact the allocation of resources and distribution of labour within the household. On average, 2.74 people in each household actively participated in farming activities, emphasising the importance of labour in agricultural production. The results show that the household had experience in farming, with an average of 20.09 years (see Table 5). This indicates a seasoned farming population with extensive knowledge and experience in agricultural operations.

Landholding sizes vary greatly, with an average of 41.44 Ropani, reflecting different land ownership patterns among households. Furthermore, the average cultivated land area surpasses the total landholding by 50.45 Ropani, demonstrating the effective use of available land resources for farming operations. Livestock holding was also common in farming households, with an average of 7.62 LSU. The presence of animals could assist with revenue diversification and agricultural sustainability. Finally, the average household income in the research area was 1,569,338 Nepalese Rupees, reflecting farming households' economic condition and livelihoods (see Table 5).

Table 5: *Socioeconomics of Farming in the study Area*

Variables	Mean	SD
Age of the HH head (Year)	51.45	8.26
Average family size	6.68	2.31
Members involved in farming	2.74	1.18

Experience farming(Years)	20.09	9.15
Total land holding (ropani)	41.44	31.27
Cultivated available land (ropani)	50.45	32.28
Livestock holding(LSU[1])	7.62	4.78
Average HH income (NRs)	1569338	1997399

Note: *[1]LSU= 1(cow) +1.5 (buffalo) +0.4 (goat and sheep) + 0.6 (pig) +0.02 (poultry)* (Adhikari, 2000)

Status of ICTs Utilization

The study revealed a thorough picture of adopting information and communication technologies (ICTs) in the research area. Mobile phones are the most commonly accepted ICT, with an amazing 90.18% of households using them daily. This high penetration highlights mobile communication's ubiquity and accessibility across the population, functioning as the major mode of connectivity and information distribution. Similarly, radios are very important, with 87.05% of families using them, demonstrating their long-term value as a trustworthy news and entertainment source, especially in places with limited access to other media. Television sets are also very popular, with 79.01% of families owning one. TV is an entertainment medium and an important source of information and instructional content for farming communities.

While emerging technologies, such as internet services and mobile apps, have lower acceptance rates than conventional media, they nonetheless see moderate utilisation, with over half of households accessing internet services and 62.05% using mobile apps or smartphones. This shows a gradual integration of digital technology into daily life but at a slower rate than traditional media. Interestingly, printed media, such as newspapers or magazines, had the lowest adoption rate of all the ICTs assessed, with only 23.66% of households using them. This demonstrates a shift toward digital platforms for information access, indicating significant opportunities to use online channels for community engagement and outreach projects (see Table 6).

Table 6: *Use of ICTs in the Study Area (N=224)*

ICTs	Frequency (Percentage)
Mobile	202(90.18%)
Radio	195(87.05%)
TV	177(79.01%)
Internet Services	115(51.34%)
Mobile APP/ Smart Mobile Phone	139(62.05%)
Printed media	53(23.66%)

Status of ICT Usage in Farming

The distribution of households based on their use of Information and Communication Technologies (ICTs) in farming revealed that 60.27% actively incorporate ICTs into their agricultural practices, whereas 39.73% do not utilise any form of ICT for farming activities. This demonstrates a significant usage of digital tools and platforms in the agricultural landscape, indicating a trend toward modernisation and efficiency development. However, the fact that a sizable proportion of households do not use ICTs reveals potential gaps in access or understanding among the agricultural community.

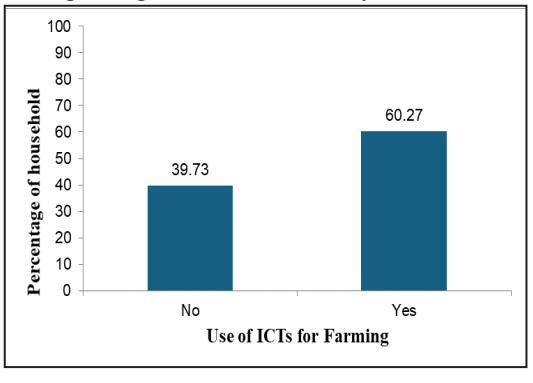

Figure 1: *Distribution of Household by Use of ICTs in Farming*

Household use of different ICTs for farming indicated a strong preference for conventional technology. Radio was the most popular ICT, with 34.81% of households using it for farming information. This was followed by television, which was used in 30.37% of households. Printed media was also rather popular, with an adoption rate of 25.19%. 22.96% of households utilised mobile phones, indicating a strong, albeit slightly reduced, trust in this technology. New technologies, like internet services and apps for smart mobile phones, were less popular,

with only 12.59% and 8.15% of families using these tools, respectively. Despite the limited use of modern ICTs, traditional ICTs remain the leading source of farming information.

Table 7: *Use of ICTs for Farming in the Study Area (N=135)*

ICTS	Frequency (Percent)
Mobile	31(22.96%)
Radio	47 (34.81)
TV	41 (30.37%)
Internet Services	17 (12.59%)
APP in Smart mobile phone	11 (8.15%)
Printed media	34 (25.19%)

The most popular reason for using ICTs was to gather market information; 73.33% of households use them. This is followed by 58.52% of households using ICTs to access weather information, 42.22% of households seeking production management information, and 36.29% using it for disease, and pest-related information. Furthermore, 24.44% of families use ICTs to know about subsidies and grants, while 20.74% seek information about government plans and initiatives. These findings showed that farmers utilising ICTs prioritise market and weather information, emphasising these technologies' crucial role in agricultural decision-making and management (see Table 8).

Table 8: *Distribution of Households by Purpose of ICTs Used for Farming in the Study Area (N=135)*

Purpose	Frequency (Percent)
Market information	99 (73.33%)
Production management information	57 (42.22%)
Weather information	79 (58.52%)
Insect, Diseases pest information	49 (36.29%)
Subsidies grant	33 (24.44%)
Government plan program	28 (20.74%)

In the research area, people regard mobile phones as the most effective Information and Communication Technology (ICT) for farming, with an index value of 0.41. Radio and TVP are closely tied for second and third rank, with index values of 0.38 and 0.39, respectively. With an index score of 0.36, printed media is considered moderately effective, ranking fourth. AGRIAPP, a special agricultural app, ranks fifth with an index value of 0.35. However, internet browsing is regarded as the least effective ICT for farming, with a low index value of 0.34 and a sixth placement, which shows the diverse opinions of efficacy among different ICTs, offering significant insights for stakeholders to prioritise their efforts and resources in improving agriculture (see Table 9).

Table 9: *Perceptions on the Effectiveness of ICTs for Farming in the Study Area*

ICTs	Index Value	Rank
Mobile	0.41	I
Radio	0.38	II
TVP	0.39	III
Internet Browsing	0.34	VII
AGRIAPP	0.35	V
Printed Media	0.36	IV

The age and gender of the household head, borrowing loans for farming, and education level were identified as major variables. The household head's age coefficient is -0.04, with a marginal effect of -0.01. This means that for every extra year of age, the likelihood of adopting ICTs for farming reduces by 1%, which is statistically significant at 5%. The gender of the household head has a coefficient of 0.81 and a marginal impact of 0.20, indicating that male household heads are 20% more likely to employ ICTs for farming than female household heads at the 5% significance level. Borrowing loans for farming is another important factor, with a coefficient of 1.01 and a marginal effect of 0.23.

Households that take out loans for farming are 23% more likely to use ICTs. This effect is quite significant, amounting to 1%. Conversely, education level reduces the likelihood of adopting ICTs for farming, with a coefficient of -0.98 and a marginal effect of -0.20. This suggests a 20% decline in the likelihood of using ICT among more educated people, which is significant at the 10% level (see Table 10).

Table 10: *Determinant of ICTs Used for Farming in the Study Area (Logit Regression)*

Determinants	Coef.	SE	dy/dx	z	P-Value
Age of HHH	-0.04	0.02	-0.01**	-2.10	0.04
Gender of HHH	0.81	0.40	0.20**	2.02	0.04
House Type	0.20	0.36	0.05	0.54	0.59
Family type	-0.31	0.36	-0.07	-0.84	0.40
Ethnicity	0.11	0.32	0.03	0.35	0.72
Members involved in farming	0.09	0.14	0.02	0.60	0.55
Members abroad	-0.46	0.31	-0.11	-1.48	0.14
Experience of farming	0.00	0.02	0.00	-0.19	0.85
Cultivated available land	0.00	0.01	0.00	-0.70	0.49
Membership social organisation	0.66	0.44	0.16	1.49	0.14
Irrigation facility	0.43	0.56	0.10	0.77	0.44
Borrow loan for farming	1.01	0.35	0.23***	2.88	0.00
Training regarding farming	0.37	0.33	0.09	1.12	0.26
LSU	-0.02	0.03	-0.05	-0.58	0.57
Education	-0.98	0.56	-0.20***	-1.76	0.08
log Income	0.09	0.22	0.02	0.42	0.68
Constant	0.69	3.27		0.21	0.83

Note: ****, **, * indicating the test is significant at 10%, 5% and 1% resectively*

Other variables, such as house type, ethnicity, members involved in the farming experience, cultivated available land, membership in social organisations, irrigation facilities, training regarding farming, and income, had a positive impact, whereas family type, members abroad, and livestock holdings had are negative impact but had no significant impact on the use of ICTs for farming. The model's projected probability of using ICTs is 61.53%, with a variance inflation factor (VIF) of 1.25, indicating no multicollinearity among the independent variables, which emphasises the complicated interrelationship.

Discussion

High usage rates for specific tools, such as mobile phones (90.18%), radio (87.05%), and television (79.01%) are found. This counterintuitive result could be due to more educated individuals having access to different information and resources beyond ICTs, or they can engage in more diverse and possibly non-farming. Interestingly, the research area recognises mobile phones as the most effective ICT for farming, implying that despite their widespread use, people still view them as valuable agricultural instruments, similar to Khan et al. (2019). However, despite the low usage rate, internet browsing is viewed as the least effective ICT for farming, implying potential constraints in receiving essential agricultural information through these ICTs, which aligns with Ruzzante et al. (2021). It emphasises the need to consider both usage trends and attitudes when evaluating the significance of ICTs in agriculture. High adoption rates may not always correlate with perceived efficacy, as evidenced by comparing mobile phones with internet browsing (Bano, 2020).

Furthermore, it emphasises the continuous use of traditional media for farming information despite the availability of newer digital platforms. Furthermore, it highlights possible areas for intervention and improvement. Attempts to promote the use of newer technologies, such as internet services and smartphone apps, may centre on addressing perceived efficacy and usability difficulties. Similarly, improving the agricultural content and accessibility of internet-

based platforms may help bridge the gap between usage rates (Khan et al., 2019).

The negative relationship between the age of the household head and ICT use suggests that younger farmers are more likely to adopt modern technologies. This could be attributed to younger individuals being more tech-savvy and open to innovation than their older counterparts, which can be more entrenched in traditional farming practices (Abdul-Wakeel Karakara & Osabuohien, 2022; Leng, Ma, Tang, & Zhu, 2020). This is possible because, with the increase in age, farmers' learning behaviour decreases relatively; they fear risk and prefer ease. Thus, they hesitate to adopt new technology. This result aligns with those of Vosough et al. (2015). Gender has a significant impact, with male household heads being 20% more likely to employ ICTs for farming. This huge discrepancy can reflect broader gender disparities in resource access, education, and training.

Borrowing loans considerably increases the likelihood of using ICTs (Balana & Oyeyemi, 2020). This research emphasises the relevance of financial resources in adopting new technologies. Loans may offer the funds required to purchase ICT tools and services, implying that improving access to agricultural credit could encourage technology adoption (Montfaucon, 2020). Interestingly, higher education status is associated with a lower likelihood of ICT use. This counterintuitive result could be due to more educated individuals having access to different information and resources beyond ICTs, or they could engage in more diverse and possibly non-farming occupations (Fernández-Gutiérrez, Giménez, & Calero, 2020). This scenario is mostly observed in small-scale farmers working off the farm (Uematsu & Mishra, 2010). Nyaupane and Gillespie (2009) found a negative correlation between education and adopting one of the best management practices (BMP). However, in a study of Tonny et al. (2019), the level of education had a positive effect on the use of ICT by farmers for marketing their agricultural products. different variables, including house type, family type, ethnicity, number of members involved in farming, members abroad, farming experience, cultivated land, social organisation membership, irrigation facilities, training regarding farming, livestock units, and log income, did not significantly impact ICT use.

Conclusion

The widespread use of conventional ICTs such as mobile phones, radios, and televisions emphasises their importance as key sources of information and communication for farmers. However, the comparatively low use of modern technologies such as internet services and smartphone apps indicate the need for focused interventions to increase their adoption and integration into farming methods. The study identified different significant factors influencing ICT use in agriculture, including age, gender, education, and financial availability. The study revealed that younger household heads and male farmers are more likely to use modern technologies, underscoring the need to address generational and gender disparities in technology access and knowledge. Furthermore, the study emphasises the importance of financial resources, including borrowing loans for farming, in boosting ICT adoption. This highlights the need for policies and programs that increase farmers' access to agricultural loans and foster digital literacy.

References

Abdul-Wakeel Karakara, A., & Osabuohien, E. S. (2022). Threshold effects of ICT access and usage in Burkinabe and Ghanaian households. *Information Technology for Development*, *28*(3), 511-531.

Adhikari, J. (2000). *Decisions for farm survival: Farm management strategies in the Mid-hills of Nepal.* Adriot Publishers.

Armstrong, L., & Gandhi, N. (2012). Factors influencing the use of information and communication technology (ICT) tools by the rural famers in Ratnagiri District of Maharashtra, India. *Proceedings of the Third National Conference on Agro-Informatics and Precision Agriculture 2012, Hyderabad, India. Allied Publishers Private Ltd (APIA 2012*). pp. 58-63.

Balana, B., & Oyeyemi, M. (2020). Credit constraints and agricultural technology adoption: Evidence from Nigeria (Vol. 64). Intl Food Policy

Res Inst.

Bano, N. (2020). Perceptions of Teachers and Students about the Utilization Pattern of Information and Communication Technologies (ICTs). *Indian Journal of Pure Applied Biosciences, 8*(6), 535–540.

Vosough, A., & Eghtedari, N. (2015). Factors Affecting ICT Adoption in Rural Area: A Case Study. *Research Journal of Fisheries and Hydrobiology, 10*(10): 611–616.

Daum, T. (2020). ICT applications in agriculture. The Hans-Ruthenberg Institute of Agricultural Science in the Tropics. University of Hohenheim, Stuttgart, Germany.

Fernández-Gutiérrez, M., Gimenez, G., & Calero, J. (2020). Is the use of ICT in education leading to higher student outcomes? Analysis from the Spanish Autonomous Communities. *Computers & Education*, *157(2020)*, 103969.

Uematsu, H., & Mishra, A. K. (2010). Can education be a barrier to technology adoption?(No.320-2016-10090).

Vosough, A., Eghtedari, N., & Binaian, A. (2015). Factors affecting ICT adoption in rural area: a case study of rural users in Iran. *Research Journal of Fisheries and Hydrobiology, 10*(10), 611-616.

Ferroni, M., & Zhou, Y. (2012). Achievements and challenges in agricultural extension in India. *Global Journal of Emerging Market Economies*, *4*(3), 319-346.

Gautam, M. (2018). ICT and Agriculture Development A Farm Level Case of Nepal. *Asian Journal of Humanities and Social Studies*, *6*(4).129-137

Gujarati, D. N. (2003). *Basic Econometrics*. Tata McGraw-Hill Education, New York.

Hosmer, D. W., & Lemeshow, S. (2000). *Applied logistic regression* (2nd ed., pp. 373). John Wiley and Sons, Inc. https://doi.org/10.1016/j.agsy.2012.03.010

Khan, N. A., Qijie, G., Ali, S., Shahbaz, B., & Shah, A. A. (2019). Farmers' use of the mobile phone for accessing agricultural information in Pakistan: A case of Punjab province. *Ciencia Rural*, *49*(10), 1–12.https://doi.org/10.1590/0103-8478cr20181016

Kharel, S. (2018). Information and communication technology for the rural development in Nepal. *Tribhuvan University Journal*, *32*(2), 177-190.

Leng, C., Ma, W., Tang, J., & Zhu, Z. (2020). ICT adoption and income diversification among rural households in China. *Applied Economics*, *52*(33), 3614-3628.

MOALD. (2023). *Statistical information on Nepalese agriculture, 2021/2021*. Ministry of Agricultural and Livestock Dvelopment (MoALD), Agri-business Promotion and Statistics Division (ABPSD), Singhadurbar, Kathamandu, Nepal.

Ruzzante, S., Labarta, R., & Bilton, A. (2021). Adoption of agricultural technology in the developing world: A meta-analysis of the empirical literature. *World Development, 146*(2021), 105599. https://doi.org/10.1016/j. worlddev.2021.105599

Montfaucon, A. F. (2020). Increasing agricultural income and access to financial services through mobile technology in Africa: Evidence from Malawi. *The Palgrave Handbook of Agricultural and Rural Development in Africa edt by Osabuohein* , E S. Springer International Publishing; Palgrave Macmillan, ISBN: 9783030415129,9783030415136, 247.262

Naharki, K. (2017). ICT in Nepalese Agriculture. *Retrieved from TUNZA Eco Generation: https://tunza. eco-generation. org/ resourcesView. jsp*.

Nyaupane, N. P., & Gillespie, J. M. (2009). The influences of land tenancy and rotation selection on crawfish farmers' adoption of best management practices.

Paudel, R., Baral, P., Lamichhane, S., & Marahatta, B. P. (2018). ICT Based Agro-Advisory Services in Nepal. *Journal of the Institute of Agriculture and Animal Science*, *35*(1), 21-28.

Regmi, A., (2016). Application of ICT tools in agriculture sector in Nepal.

Subashini, K.K.P., & Fernando, S. (2017). Empowerment of farmers through ICT literacy.

Paper presented at the 2017 National Information Technology Conference (NITC) in Colombo, Sri Lanka.

Tonny, N.B.W., Palash, M.S. and Moniruzzaman, M. (2019). Use of ICT in decision making of agricultural marketing: Factors determining farmers' involvement. *Journal of Bangladesh Agricultural University, 17*(2): 226–231.

World Bank (2011). *E - Source Book ICT in Agriculture, Connecting Smallholders to Knowledge, Networks, and Institutions* (Report Number 64605).