

Effectiveness of Information and Communication Technology Use in Flower Marketing as Perceived by Vietnamese Smallholders

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Abstract This study was conducted to analyse the current situation and assess smallholders' perspectives on the level of use and effectiveness of information and communication technology (ICT) in flower marketing. The survey sample consisted of 150 smallholders randomly selected from a total of 241 smallholders in the Duong No Ward, Hue City of Vietnam. Descriptive and inferential statistics were used to analyse the data. The research results revealed that a number of ICT tools were used by smallholders. Of which, televisions, mobile (smart) phones, and internet-connected computers were the most commonly used by smallholders. The study also indicated that mobile (smart) phones and internet-connected computers were the two types of ICT tools that had the highest effectiveness for flower marketing. The research found that there was a statistically significant relationship existing between the extent of ICT use (mobile phones) in flower marketing and the smallholders' educational level ($\chi^2 = 7.009$; $p = 0.002$), income ($\chi^2 = 6.341$; $p = 0.053$), distance from home to electricity base ($\chi^2 = 4.385$; $p = 0.044$), and participation in training programs ($\chi^2 = 7.748$; $p = 0.009$). The local government and authorities need to provide supportive policies, training courses, and technological infrastructure investment to improve access to and use of ICTs in flower production and marketing.

Keywords: ICTs, effectiveness, smallholder farmers, flower marketing, Vietnam

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1. Introduction

In the context of the vigorous Fourth Industrial Revolution (Industry 4.0), information and communication technologies (ICTs) have become important tools contributing to the modernization of agriculture and rural areas in developing countries, including Vietnam [1,2,3]. The use of ICTs in agricultural production not only helps farmers gain quicker access to market information, new production techniques, and weather and climate information, but also opens up opportunities for connecting supply and demand, enhancing product value chains, and increasing competitiveness in the context of deepening international economic integration [3,4,5]. According to the Ministry of Agriculture and Rural Development [6] (now called the Ministry of Agriculture and Environment), promoting digital transformation in agriculture through ICT adoption has been identified as one of the strategic orientations to increase productivity, reduce costs, and ensure sustainable development for Vietnam's rural areas. However, the

extent of ICT access and use across regions, household groups, and agricultural sectors still showed considerable disparities and faces many challenges [7]. While some concentrated production areas with higher educational levels and developed infrastructure have gradually adopted new technologies, including ICTs, many localities and rural regions still have limited ICT adoption. This led to farmers continuing to rely heavily on traditional information channels and personal experience, resulting in slow access to new knowledge, new technologies, and market information, thereby reducing production efficiency and income [8].

Phu Mau Commune, formerly part of Phu Vang District, Thua Thien Hue Province (now called Duong No Ward of Hue City), is one of the areas with a long-standing tradition of flower production and marketing in the central region of Vietnam. These flower farming activities not only bring high economic value but also contribute to job creation, income enhancement, and economic restructuring toward sustainability. In previous years, flower farming households in Duong No Ward mainly relied on traditional experience, information from acquaintances, traders, or wholesale markets. In recent

years, however, the use of ICT tools such as mobile phones, the Internet, and social networks has increasingly been used by local farmers to improve market access and enhance product value. To establish a scientific basis for proposing policies that encourage farmers to use ICTs in flower production and marketing, it is necessary to understand the current situation as well as farmers' perspectives on the extent of use and effectiveness of ICT in these activities. Based on this need, evaluating the current status and viewpoints regarding ICT adoption and effectiveness among flower farming smallholders in Duong No Ward is essential and scientifically meaningful. The objectives of this study were to (1) provide a scientific foundation for proposing appropriate solutions to encourage more effective use of ICT in flower production and marketing; (2) promote digital transformation in local agriculture, (3) improve production efficiency and income, and (4) contribute toward sustainable agricultural development in the era of integration and digital revolution.

2. Methodology

This research activity was conducted in Phu Mau Commune, Thua Thien Hue Province (now Duong No Ward of Hue City of Vietnam). The study employed a survey research design [9]. The household survey questionnaire was designed to collect data and it consists of two main sections: The first section collected information on: (1) types of ICTs used in flower production and marketing; (2) the extent of ICT use in flower production and marketing. The extent of ICT use was measured using a Likert scale [10] with five levels: "1 = never used, 2 = rarely used, 3 = occasionally used, 4 = frequently used, and 5 = very frequently used"; (3) the effectiveness of ICTs in flower production and marketing. The effectiveness level was measured using a five-point Likert scale: "1 = very ineffective, 2 = ineffective, 3 = slightly effective, 4 = effective, 5 = very effective"; and (4) difficulties/challenges encountered by smallholders in using ICTs. The second section collected demographic and socioeconomic information (including gender, age, educational level, household type, income level, landholding size, number of labourers, level of participation in community organizations, etc.). The study surveyed 150 households randomly selected from 241 households engaged in flower production and marketing in the study area. Slovin [11] sampling formula was used in this research:

$$n = \frac{N}{1 + N \times e^2}$$

Where:

- n: sample size;
- N: population = 241 households engaged in flower production and marketing;
- e: allowable error = 0.05.

The collected data were analysed using SPSS statistical software version 20.0. Descriptive and inferential statistical parameters were employed to analyse the smallholders' perspectives. The Chi-square test and T-test

were applied to examine the relationship between the level of ICT use (mobile phones) and the characteristics of the farmers.

3. Key Results and Discussion

3.1. Characteristics of Surveyed Smallholders

Table 1. Characteristics of surveyed smallholders

Characteristics of surveyed smallholders		Value ¹
Age	25–34 years old	1 (0.7)
	35–44 years old	21 (14.0)
	45–54 years old	49 (32.7)
	55–64 years old	44 (29.3)
	65 years old or higher	35 (23.3)
Gender	Male	94 (63.3)
	Female	56 (36.7)
Education level	Did not go to school	15 (10.0)
	Primary school	33 (22.0)
	Junior high school	82 (54.7)
	Senior high school	19 (12.7)
	Technical certificate/ university degree	1 (0.7)
Household type	middle-income household	87 (58.0)
	fairly well-off household	63 (42.0)
Income (VND ² /year)	1–10 VND	39 (26.0)
	11–15 VND	32 (21.3)
	16–20 VND	13 (8.7)
	21–25 VND	10 (6.7)
	Higher than 25 VND	56 (37.3)
Farm size (sao ³)	Total area of farmland	1,56 (17.9)

Source: household survey, 2023

Table 1 presents the demographic and socioeconomic characteristics of the respondents participating in this study. Most surveyed smallholders were the middle-aged and elderly groups, with the 45–54 age group accounting for the highest proportion (32.7%), followed by the 55–64 age group (29.3%) and those aged 65 and above (23.3%). This indicates that the labour force in flower production consists mainly of smallholders with many years of experience. Males accounted for 63.3%, significantly higher than females (36.7%). The majority of participants had a lower secondary education level (54.7%), followed by primary school (22.0%) and upper secondary education (12.7%). Only 0.7% of smallholders had vocational, college, or university qualifications. This suggests that the educational level of flower smallholders is generally limited, which may affect their ability to access and adopt new technical advancements in production. The average income households made up 58.0%, while fairly well-off households accounted for 42.0%, indicating a relatively stable standard of living among the smallholders. Annual income showed slight variation, with the group earning over 25 million VND

¹ : Values in parenthesis are percentages and without parenthesis are numbers

² : VND is Vietnamese Dong and 25,000 VND equals to 1 USD

³ 20 'sao' equals to one hectare.

per year representing the highest proportion (37.3%), followed by those earning 1 - 10 million VND (26.0%) and 11 - 15 million VND (21.3%). The average flower farming area is 1.56 sao per household (one "sao" equals 1/20 ha). These findings indicate that flower smallholders are predominantly middle-aged men with relatively low educational levels, slightly varied income levels, and relatively small production scales. Previous studies [12] are also shown that agricultural production scales among farmers in Central Vietnam are generally small, which is supported by the finding of this study.

3.2. Smallholders' Use of ICTs in Production and Marketing

Table 2 describes the current situation of ICT use among smallholders in the study area. Overall, smallholders used a fairly diverse range of ICT tools in flower production and marketing. Most respondents used television and mobile phones (smartphones), accounting for 100% and 94.6%, respectively. This indicates that modern and easily accessible ICT tools play a dominant role in receiving information and exchanging production experience. About 47% of smallholders used internet-connected computers, reflecting a gradual trend toward adopting modern ICT in production and business activities. Conversely, traditional ICT tools such as calculators (30.6%), newspapers/magazines (11.3%), landline phones (7.3%), and radios (2.0%) were used at relatively low levels. These findings show that people have a relatively high extent of access to and use of modern ICT tools. This contributes significantly to effective information exchange, learning new techniques, and expanding flower market opportunities. Previous studies on ICT adoption in the Vietnam farming context [13, 14] suggest that modern ICT tools are increasingly being used by farmers in agricultural production in some regions, which is corroborated by the result of this study.

Table 2. Type of ICT tools used by smallholders for flower marketing

No.	Type of ICTs	N	Percent (%)
1	Television	150	100.0
2	Mobile (smart) phone	142	94.6
3	Internet-connected computer	71	47.3
4	Calculator	46	30.6
5	Magazine/newspaper	17	11.3
6	Landline phone	8	7.3
7	Radio	3	2.0

Note: frequencies reflect multiple responses; N = 150.
Source: household survey, 2023

3.3. The Extent of Use of ICT Tools By Smallholders for Marketing

Table 3 describes the extent of ICT use in flower marketing among smallholders in the study area. Television is the most frequently used ICT tool ($M = 4.39$; $SD = 0.52$), indicating that it remains the most common and familiar source of information for flower growers. Mobile (smart) phones were also used frequently for information searching and exchanging production

experiences ($M = 3.90$; $SD = 0.72$). In contrast, other ICT tools such as internet-connected computers ($M = 2.28$, $SD = 0.85$), calculators ($M = 1.80$, $SD = 0.92$), newspapers/magazines ($M = 1.54$, $SD = 0.70$), radio ($M = 1.24$, $SD = 0.53$), and landline phones ($M = 1.10$, $SD = 0.43$) showed low levels of use. These findings indicate that smallholders tended to prioritize modern, simple, and easily accessible ICT tools such as television and mobile phones in flower production and marketing. Previous studies in developed countries revealed that mobile phones were among the most important ICT tools widely used by farmers for agricultural product marketing [15], weather and climate information [16] and agricultural information [17].

Table 3. The extent of ICT use by smallholders in flower production and marketing

STT	Type of ICTs	The extent of ICT use	
		Mean (M)	Standard deviation (SD)
1	Television	4.39	0.52
2	Mobile (smart) phone	3.90	0.72
3	Internet-connected computer	2.28	0.85
4	Calculator	1.80	0.92
5	Magazine/newspaper	1.54	0.70
6	Radio	1.24	0.53
7	Landline phone	1.10	0.43

Source: household survey, 2023

3.4. The Effectiveness of ICTs in Flower Production and Marketing

Table 4 describes the effectiveness of ICTs as perceived by smallholders in flower production and marketing in the study area. Overall, mobile (smart) phones, internet-connected computers, and television were considered the most effective ICT tools. Specifically, mobile (smart) phones were rated as having the highest level of effectiveness ($M = 4.33$; $SD = 0.43$). This indicates that mobile phones are the most commonly used and most effective tools in practical flower production and business. With multiple useful functions, mobile phones allow users to quickly communicate with customers, update market information, promote products via social media, and conveniently conduct online transactions. Internet-connected computers were also rated as highly effective ($M = 4.11$; $SD = 0.26$), highlighting the essential role of the Internet in supporting information searching, data management, communication, and implementing e-commerce activities. These two ICT tools reflect the strong trend of digital transformation in the flower production and marketing sector, as smallholders increasingly rely on digital tools to improve efficiency and competitiveness. Traditional media tools such as television ($M = 3.77$; $SD = 0.44$) and calculators ($M = 3.43$; $SD = 0.61$) were rated at moderately high levels of effectiveness, indicating that they still play a certain role in providing information and supporting product promotion. However, their effectiveness was no longer as high due to the rapid development of digital technologies. In contrast, newspapers/magazines ($M = 3.21$; $SD = 0.55$) and radio ($M = 2.67$; $SD = 0.61$) received lower ratings,

reflecting the declining influence of traditional media in the modern context. These findings suggest that modern ICT tools, especially mobile phones and the Internet are playing a central role in improving the efficiency of flower production and marketing. They clearly highlight the trend of digital technology adoption aimed at promoting sustainable development and enhancing competitiveness in the digital integration era. Although some studies [18,19] highlighted the effectiveness of mobile phones for marketing, the effectiveness of internet-connected computers in flower production and marketing has not been reported in any previous literature.

Table 4. The effectiveness of ICTs in flower production and marketing

No.	Type of ICTs	Mean (M)	Standard Deviation (SD)
1	Mobile (smart) phone	4.33	0.43
2	Internet-connected computer	4.11	0.26
3	TV	3.77	0.44
4	Calculator	3.43	0.61
5	Magazine/newspaper	3.21	0.55
6	Radio	2.67	0.61
7	Landline phone	2.24	0.57

Source: household survey, 2023

3.5. Challenges for Using ICTs As Perceived by Smallholders

Table 5. Challenges for using ICTs as perceived by smallholders

No.	Challenges/difficulties	N	Percent (%)
1	One-way information only	86	57.33
2	Underdeveloped infrastructure	77	51.33
3	Poorly developed interconnected network system	75	50.00
4	Lack of interaction in information transmission	73	48.67
5	Inability to control transmitted information	72	48.00
6	Limited time allocation for programs	65	43.33
7	High costs of purchasing and using technology	41	27.33
8	High cost of transmitting information	40	26.67
9	Underdeveloped electrical network system	22	14.67
10	High fees for using television programs	17	11.33
11	Old age	8	5.33

Note: frequencies reflect multiple responses; N = 150.

Source: household survey, 2023

Table 5 describes the difficulties/obstacles that smallholders encountered when using ICT in flower production and marketing in the study region. Overall, there were several challenges faced by smallholders in using ICTs. Specifically, the greatest obstacle was that the information received was one-way (57.3%). This indicates that smallholders find it difficult to obtain feedback or interact directly with information providers. Other common challenges included poorly developed infrastructure (51.3%), weak network connectivity (50.0%), limited interaction when communicating information (48.6%), and lack of control over transmitted information (48.0%). These constraints reflect technical

infrastructure limitations and insufficient information management capacity in the study areas. In addition, the high cost of purchasing and using advanced technology (27.3%), communication costs (26.6%), and underdeveloped electrical networks (14.6%) also were significant barriers. These findings show that the main obstacles stem from infrastructure limitations, costs, and limited ICT skills. A study on ICT adoption barriers by Nguyen, Hoang [7] also mentioned some of these challenges. The government and local authorities should develop support policies, provide training, and invest in technological infrastructure to enhance smallholders' access to and use of ICTs in flower production and marketing.

3.6. Relationship between Respondents' Characteristics and the Use of ICT Tools

Table 6 presents the relationship between demographic and socio-economic characteristics of the respondents and their level of mobile phone use in flower production and marketing. Overall, the extent of mobile phone use among the smallholders in flower production and marketing is closely associated with their demographic and socio-economic characteristics. Specifically, the extent of mobile phone use is significantly related to educational attainment ($p = 0.002$), income ($p = 0.053$), distance from home to electricity base ($p = 0.044$), and participation in training programs ($p = 0.009$). This suggests that those with better access to infrastructure, training in production and business skills, and higher educational levels tend to use mobile phones more frequently. The findings of Hoang [20] indicated that while there is a relationship between farmers' use of mobile phones in accessing agricultural information and their education and income levels, this relationship is not statistically significant, which is supported by the finding of this study. Therefore, human factors and infrastructure appear to play a more important role than financial or social factors in promoting the adoption of information technology among flower smallholders.

Table 6. Relationship between smallholders' characteristics and the use of mobile phones

STT	Variables	Correlation coefficient	p-value
1	Age	12.21	0,173 ^{NS}
2	Education level	7.09	0,002***
3	Income	6.34	0,053*
4	Farm size	19.53	0,214 ^{NS}
5	Distance from home to electricity base	4.38	0,044**
6	Participation in training programs	7.74	0,009***
7	Participation in credit programs	2.63	0,104 ^{NS}
8	Participation in CBO	1.82	0,177 ^{NS}

Note: *, ** and *** indicate statistically significant at the 90%, 95% and 99% levels respectively.

NS indicates not statistically significant.

4. Conclusion and Implications

The research findings show that most flower-growing

smallholders in the study region have begun to access and use ICTs in their production and marketing activities. The results showed that various types of ICT were used, among which television, mobile (smart) phones, and computers with internet access were the most commonly used by smallholders. The study also indicated that mobile phones and computers with internet access are the two types of ICT that have the highest effectiveness in flower production and marketing. It was found that a statistically significant relationship between the level of ICT use (mobile phones) in flower production and marketing and the smallholders' educational level ($\chi^2 = 7.009$; $p = 0.002$), income ($\chi^2 = 6.341$; $p = 0.053$), distance from home to electricity base ($\chi^2 = 4.385$; $p = 0.044$), and participation in training programs ($\chi^2 = 7.748$; $p = 0.009$) existed. Modern ICT tools such as social networks and e-commerce platforms have not been widely adopted, mainly due to constraints related to infrastructure, technological skills, and the financial capacity of farming households. This indicates that the digital transformation process in local agriculture is still at an early stage and requires coordinated support from multiple stakeholders to become effective. To promote ICT adoption in flower production and marketing, the study proposes several recommendations: (1) strengthen investment in rural digital infrastructure, ensuring stable Internet connectivity and electricity systems for production; (2) organize training programs to improve smallholders' digital skills, especially for middle-aged and older groups, to enhance their ability to access technology; (3) develop digital agricultural information channels and utilize social media and online platforms to provide information on prices, cultivation techniques, and market demand; (4) enhance the role of cooperatives and agricultural extension officers in disseminating knowledge and guiding the use of ICTs; (5) provide preferential credit support for farming households to invest in equipment and technologies for flower production and marketing, contributing to improved economic efficiency and promoting sustainable digital transformation.

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