

ICT and farm productivity: Evidence from the Chilean agricultural export sector

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Abstract: With the use of modern information and communication technologies (ICTs), farmers in developing and transition countries can overcome non-market information asymmetries and increase farm productivity. Which kind of ICT is most effective is still uncertain. This study aims at investigating the impact of different kinds of ICTs on farmer's performance by using survey data collected from raspberry, avocado and table grape farmers in Chile in 2012. The results of our analysis show that the use of ICTs for communicating with trading partners has a significant impact on farm productivity. This especially counts for the use of mobile phones by smallholder raspberry producers, whereas the use of various internet communication channels has controversial effects on avocado producers (mainly medium- sized farms) and table grape producers (mainly large farms).

1 Introduction

Until today, farm productivities in developing and transition countries are much lower than in industrialized countries. A lack of non-market information is considered one of the main reasons for farmers' low productivity in developing and transition countries. Within the production process, a multitude of different information is needed whose absence can decrease farmers' yield. While in the stage of planting information on high yield varieties and timing to plant are crucial, in the stages of planting and growing it is the information on fertilizer, pesticides and new techniques that can cause significant yield differences. Furthermore, information on appropriate harvesting time, climate and weather can enable farmers to gain better results [Ak11] [MT09]. Even though modern ICTs are associated with the so called "digital divide" due to high costs and the need of adequate infrastructure and capabilities to use them, they are also considered to be an effective tool to overcome non-market information asymmetries and, thus, can help to increase farm productivity [Ak11] [AA12] [OKN12]. The two most important ICTs for rural areas of developing and transition countries are the mobile phone and the internet. Whereas the mobile phone gives farmers the opportunity to quickly and flexibly connect with other people to share information, the internet provides access to a great amount of

agricultural data that can easily be stored and the possibility to connect with people across regions or even internationally per email or social networks [CMG13]. Until now, the effects of the different kinds of ICTs on farm productivity have not yet been quantified in a direct comparison. In this regard, the main research question of this study is: Does farmers' use of ICTs to exchange non-market information with trading partners influence farm productivity? Chile was chosen as the country of investigation, because it is highly involved in agricultural production and export [Pe05] and one of the pioneers of high-value food exports [OT12]. At the same time, Chile is the Latin American country with the greatest mobile phone penetration and has a great share of farmers in the export sector using computers (35.46%) and the internet (30.32%) [EMB12]. This indicates that ICT coverage is relatively high and Chilean farmers generally have access to ICTs [Ur08] [EMB12]. Furthermore, recent analyses showed a highly significant influence of mobile phone use on farm productivity in the Chilean fruit and vegetable export sector [OT13].

2 Study design, data collection and sample description

The data collection was conducted in Chile between September and November 2012 among farmers who grow raspberries, avocados and table grapes for export. A standardized questionnaire including several indicators for the frequency of the use of various kinds of ICTs and other channels for the exchange of information with trading partners (scale: 1=never 2=rarely 3=sometimes 4=often 5=always) and performance indicators such as farm yield were part of the questionnaire. The questionnaire was tested in discussion with Chilean researchers and through pre-test interviews with producers of the three farmer groups previous to its implementation for data collection. The total data set consists of 241 Chilean fruit and vegetable producer (81 raspberry, 81 avocado and 81 table grape producer). 70.4% of the raspberry farms have less than 2 ha (mainly small farms), 66.3% of the avocado producers have between 2 and 50 ha (mainly medium-sized farms) and 56.3% of the table grape producers have more than 50 ha of land (mainly large farms). Only 33.8% of the raspberry producers use a mobile phone for information exchange with trading partners (mostly export companies and traders) while 88% of the avocado producers and 100% of the table grape producers do so. This is equal to the frequency of mobile phone use: While avocado and table grape producer use it almost often (means: 3.74 and 3.81 on 5-point Likert scales), the raspberry producer use it much less frequently (mean: 2.03). The difference between the group of the raspberry farms and the other two farm groups is even greater regarding the frequency of using emails (raspberry farms mean: 1.03; avocado farms mean: 3.2; table grape farms mean: 3.38) but much lower regarding the frequency of using Facebook (raspberry mean: 1.03; avocado farms mean: 1.02; table grape farms mean: 1.11).

3 Results

To find out to which extent farmers' use of different kinds of ICTs influences farm productivity, a semi-logarithmic regression analysis with the logarithmized yield as the

dependent variable was conducted by using SPSS version 21. The data set was divided by product into three subgroups. The results show that especially the use of a mobile phone to communicate with trading partners has a great positive impact on the productivity of the smallholder raspberry farms, but an even larger negative impact on the productivity of the table grape producers.

	Raspberry producers n= 81	Table grape producers n= 80	Avocado producers n= 80
Farm age (years)	- 0.017***	0.001	0.001
Planted land (ha)	- 0.218***	- 0.001	0.000
Number of trading partners	0.032	- 0.005	- 0.053*
Frequency mobile phone	0.041 *	- 0.093 ***	0.020
Frequency webpage	0.055	- 0.013	0.007
Frequency facebook	No result ¹	- 0.005	- 0.344 *
Frequency email	No result ¹	0.041 *	- 0.019
Frequency journal	No result ¹	- 0.044	- 0.001

Table 1: The impact of ICT use on farm yield (dependent variable: log yield tons/ha; raspberry producer: $R^2= 0.284$, $F= 5.639***$; avocado producer: $R^2= 0.217$, $F= 2.078*$; table grape producer: $R^2= 0.186$, $F= 1.970*$, $***p \leq 0,01$; $**p \leq 0,05$; $*p \leq 0,1$, scale of „Frequency journal/ mobile phone/Facebook/ email/webpage“: 1=never 2=rarely 3=sometimes 4=often 5=always; ¹No result= variables were excluded, because they were constant or did not show any correlation)

The variables for the different opportunities of internet use do not have any significant influence on the yield of raspberry farms, but on the yield of avocado and table grape farms. In this regard the more frequent use of Facebook to exchange information with trading partners significantly decreases farm yield of avocado farms. The opposite is the case for table grape producers' frequent use of emails to exchange information with trading partners; it significantly increases their farm yield.

4 Conclusion and Discussion

In general the assumed positive impact of ICTs on farm productivity is supported by the results of this study. Especially the use of mobile phones can increase farm yield of smallholder raspberry farms significantly. This can be explained by the comparatively low share of raspberry producers using a mobile phone to exchange information with trading partners (33.8%) and the much lower frequency of mobile phone use by small producers for the same purpose, both most likely due to the high costs of mobile phone charges in Chile [Ur08]. Thus, the few farmers investing in the technology benefit from the advantages. Also for financial reasons and due to their limited penetration in rural areas, the different opportunities of internet use only have an influence on the productivity of avocado and table grape farms. The positive effect of email use on table grape

farms' productivity, in contrast to the negative effect of the frequency of mobile phone use, can be interpreted as the benefit of an even more innovative ICT for those large farmers adopting it, while mobile phones are used by all table grape farmers very frequently already. However, this is a contradiction to the finding that a more frequent use of Facebook to exchange information with trading partners significantly decreases farm yield of avocado farms. Most likely Facebook is not formal enough as an internet-based communication channel for high quality business information.

Overall, the results of this study indicate that NGOs and governmental offices should accelerate innovation adoption in rural areas by initiating measures to increase ICT penetration, capabilities to use various ICTs and decrease costs for charges especially for small producers to overcome the "digital divide". Future research should aim at understanding in more detail the link between the access to market and non-market information provided by various ICTs and farm productivity.

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