Extended Abstract
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Paper/Poster Title	Does Internet use improve eco-efficiency? Evidence from potato production in China

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Abstract	200 words max

Although numerous studies have explored various impacts of information and communication technologies (ICTs), few have investigated the relationship between Internet use and eco-efficiency in agricultural production. This paper fills the gap by analyzing the impact of Internet use on the eco-efficiency in potato production using a cross-sectional dataset covering 434 potato-producing farm households in China. The slacks-based measure (SBM) model approach is used to calculate eco-efficiency in potato production. The endogenous switching regression model is employed to examine the impact of Internet use on eco-efficiency, accounting for the self-selectivity bias arising from observable factors. The study reveals that 67.74% of the sample use the Internet to acquire information about potato production. Our findings show that the eco-efficiency of Internet users and nonusers are 0.70 and 0.61, respectively. After accounting for the self-selectivity bias, Internet users would reduce eco-efficiency by 0.15 (21.43%) if they had not used the Internet. Moreover, Internet nonusers would improve eco-efficiency by 0.21 (34.43%) if they had used the Internet to acquire information about agricultural production. The robustness check reconfirms that Internet use can improve eco-efficiency in potato production. Our findings have important implications for government to expand investment in ICTs infrastructure and promote Internet use in rural areas.

Keywords	internet use, eco-efficiency, endogenous switching regression model, robustness check
JEL Code	Q12 Q18 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	100 – 250 words

Agriculture has contributed a fundamental role to rapid development of Chinese economy. Especially for China, potato is an important staple and cash food for a great number of farm households in rural China. From 2000 to 2020, the total potato output and yield in China have increased with a "high input, high yield" production model. Meanwhile, it has brought huge environmental pressures, such as soil erosion, reduced potato quality, and reduced biodiversity. Sustainable agricultural production is essential to address the enormous challenges of resource and environmental constraints and food security. Eco-efficiency is an important index to measure the ability of sustainable development, implying that the maximum agricultural economic output can be achieved with the least amount of resource consumption and pollution for a given set of material factor inputs. The Internet, one of the most essential information and communication technologies (ICTs), is playing

an important role in agricultural technology extension, reducing information asymmetry and access cost in developing countries. The Internet becomes a popular way that farm households acquire technological information. Although more and more studies focus on the impact of Internet use on agricultural production and rural development, little is known about whether and to what extent Internet use could influence eco-efficiency in agricultural production. Hence, this study aims to explore the impact of Internet use on eco-efficiency in potato production in China using a cross-sectional dataset covering 434 potato-producing farm households.

Methodology	100 – 250 words

Two major approaches are used in this study, one is slacks-based measure method (SBM), which is employed to calculate the eco-efficiency in potato production, the other is the endogenous switching regression model (ESR) to self-selectivity bias.
(1) Slacks-based measure
As a non-radial and non-oriented Data envelopment analysis (DEA) model, the slacks-based measure (SBM) model has the advantage of settling the problem of input and output slacks, avoid radial and oriented deviation and solved the efficiency evaluation in the presence of the undesirable output.
(2) Endogenous switching regression
The self-selectivity problem may bias the estimation of the impact of Internet use on eco-efficiency. Generally, farm households' decision to be a Internet user (treated group) and non-user (untreated group) may not be random. Thus, a self-selectivity bias of Internet use arises. The endogenous switching regression has been widely used to address the self-selectivity bias. Note that this approach can only correct for the self-selectivity bias arising from observable. Theoretically, there are two steps in an endogenous switching regression model. First, a selection equation is developed to describe whether a farm household search, browse and acquire agricultural technological information about potato production though the Internet use. Second, a separate outcome equation is specified for Internet users and non-users.

Results	100 – 250 words

(1) Results of the SBM model
The average eco-efficiency for all 479 farm households is 0.67, ranging from 0.40 to 1.00. There exists a considerable difference in eco-efficiency between the Internet users and non-users. The average eco-efficiency of 294 Internet users is 0.70, while that of 140 non-users is 0.61.
(2) Results of the ESR model
About results of the endogenous switching regression model, the results of the LR test show that the selection and outcome equations are dependent, and the results of the validity of the instrumental variable show that the instrumental variable used in the endogenous switching regression model is valid. The results of selection equation show that several factors significantly influence whether a farm household uses the Internet, including age, gender, off-farm work, farm size and communication signal strength). The results of outcome equations show that the statistical significance of the coefficients for the independent variables greatly differs between the Internet users and non-users. For Internet users, age, gender, village leader and farm size have a significant impact on eco-efficiency. For Internet non-users, there is no such evidence, only specialization degree and technology training have a significant impact on eco-efficiency. The average treatment effect on the treated

(ATT) and the average treatment effect on the untreated (ATU) are calculated based on the endogenous switching regression model, which are equal to 0.15 and 0.21, respectively, and both of them are positive and significant. For robustness check, the results of treatment effects model confirm the robustness of the present study.

Discussion and Conclusion | *100 – 250 words*

(1) Discussion

Based on the results of estimation, we can find that gender, off-farm work, farm size,and communication signal strength have a positive impact on whether a farm household uses the Internet, only age have a negative impact. For Internet users, Age, gender and farm size have a negative impact on eco-efficiency, only village leader has a positive impact. However, there is no such evidence for the Internet non-users. The positive ATT and ATU reveal that Internet users would reduce eco-efficiency in potato production by 0.15 (21.43%) if they had not used the Internet to acquire technological information. For the Internet non-users, eco-efficiency would increase by 0.21 (34.43%) if they had used the Internet to acquire technological information.

(2) Conclusion

This study explores the impact of Internet use on eco-efficiency in potato production of 434 potato-producing farm households in China. Eco-efficiency is calculated based on the SBM model. An endogenous switching regression model is employed to examine the impact of Internet use on eco-efficiency, accounting for the self-selectivity bias arising from observable factors. The treatment effects model is employed to check the robustness. All these results once again provide evidence that Internet use can indeed improve eco-efficiency in potato production