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Is ICT Enabled Information Access Impacting the Productivity of selected Crops Uniformly? : A Case Study on North 24 Parganas of West Bengal

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Abstract

Context: Despite the green revolution measures in mid-sixties we can find asymmetry across the states in India to get the benefit of that Green revolution at the country level. The states in eastern region of India are characterised by alluvial soils, a humid climate, low levels of irrigation (except in case of West Bengal), relatively high rainfall, and a population density. Agricultural Productivity can be defined as a ratio of the volume measure of output to the volume measure of input use. Agricultural yield is not only dependent on conventional input factors but also dependent on several environmental and market-led factors therefore agriculture extension along with the ICT (Information & Communication Technology) can disseminate demand-driven information to the farmers for their diverse information need in a cost-effective and efficient manner.

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Aims: This study is an innovative empirical attempt to determine the impact of conventional inputs like seeds, fertilizers, pesticides, irrigation, and labour productivity as well as the impact of ICT-influenced information access through smartphone by the farmers for their various information need like weather forecast, information regarding seeds, fertilizers, pesticides and marketing on three crops viz. Rice, Jute and Mustard oilseed for North 24 Parganas.

Methodology: We applied Non-probability Convenient Sampling to select the sample households in North 24 Parganas. A total of 120 households are taken into consideration for the primary survey. The study tried to analyse the impact of independent variables on the dependent variables that is Rice yield per bigha, Jute yield per bigha and Mustard oilseed per bigha, through Regression Analysis with a two-fold measure, wherein the first fold (Model-1) we considered the conventional independent variables to identify the significance and in the second fold (Model-2) the ICT influence information access variables are also added to the Regression analysis to identify the impact of information access on dependent variables.

Results: From our analysis, it is evident that for several information need the farmers of the district rarely use their smart phone though they own them. But, interestingly the farmers who access the ICT-influenced information services through their smartphones have more rice yield per bigha, Jute yield per bigha and Mustard oilseed yield per bigha, than the farmers who don't use it. The increase in R^2 value after adding ICT-influenced information access variables depicts that information access through ICT mode can explain more variability in the dependent variable for all the crops.

Key Words: Smart Phone, ICT expenditure, Rice Yield, Jute Yield, Mustard oilseed Yield, Labour Productivity.

Introduction

The extreme drought in 1966 triggered the Green Revolution in India through the implementation of modern farming technologies, high yielding seed varieties, extensive use of fertilisers and pesticides, expansion of irrigation system, extension of credit and educational services to farmers. [**Khan, (2020)].** Despite the green revolution measures in mid-sixties we can find asymmetry across the states in India to get the benefit of that Green revolution at the country level. **[Rahim, Majumder & Biswas, (2011), DN (2001)].** Considerable heterogeneity has found in different parts of India in respect to crop composition and their performances. The

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states in eastern region of India are characterised by alluvial soils, a humid climate, low levels of irrigation (except in case of West Bengal), relatively high rainfall, and a population density. **[Joshi et. al. (2006)].** During mid-eighties West Bengal made a paradigm shift with the major land reforms in the state along with the adoption of high-yielding varieties of seeds, chemical fertilizers, heavy irrigation, technological improvement, and agricultural mechanization. [**Rahim, Majumder & Biswas, (2011)]**. Agricultural Productivity can be defined as a ratio of the volume measure of output to the volume measure of input use. [**OCED (2001b), Kakar et. al., (2016)**]. Therefore, Agricultural productivity or Yield is traditionally dependent on the input factors like seeds, fertilizers, pesticides, irrigation, labour productivity, etc. [**Kakar et. al., (2016), Baliyan, (2021)**]. As we all know, information and knowledge have the power influence anything in a positive way; therefore, the role of information and communication technology (ICTs) cannot be denied for agriculture's overall efficiency and development. As agricultural yield is dependent on several environmental and market-led factors therefore agriculture extension along with the ICT (Information & Communication Technology) can disseminate demand-driven information to the farmers in terms of the weather forecast, agriculture input-related information, price, and market-related information, post-harvest information, etc. cost-effectively and efficiently [**Ferroni & Zhou (2011)**]. The Government of India, different state governments as well as different private players have taken initiatives in the field of e-agriculture for benefiting the farmers. In this connection, different ICT modes like mobile phones, smart phones, television, radio, internet, newspaper, and different ICT Apps like Matir Katha, Agrisnet, E-Nam, Kisan Call Centre, etc. have a positive association with agricultural information access. Moreover, mobile phone is the most handy ICT mode for accessing the agriculture-related information by the farmers as they mostly use mobile phone-enabled services followed by extension workers, television, newspaper, etc. and they mostly rely on ICT sources of information [**John & Barclay, (2017); Das. B, (2014), Shalendra et al., (2011].** In India on the basis of seasons, main crops are classified as Kharif and Ravi. Karif crops are called Monsoon crops which need lot of water and hot weather to grow. On the other hand, Ravi are the winter crops which needs warm weather for germination but cold weather to grow. Moreover, on the basis of consumption crops can be divided as food crops and cash crops. Food crops are mainly the staple crop which are used for household consumption or livestock feed. On the other hand, cash crops are export crops. **[Achterbosch. et.al. (2014)]** West Bengal is the pioneer state in the production of Rice and Jute crops (Kharif crop) in the

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country, as well as major producer of mustard oilseed (Ravi crop). Moreover, the district North 24 Parganas is the pioneer in Jute production and major Rice and Mustard oilseed producer in the state of West Bengal. [**Parveen & Mondal, (2020), Department of Agriculture and Farmers Welfare, West Bengal].** Against this backdrop, our study will aim to determine whether the ICT enabled information access through smart phone has any impact on the productivity per bigha of selected crops viz. Rice, Jute and Mustard oilseed for North 24 Parganas of West Bengal. As well as the study will try to find out whether the ICT enabled information access impacting the productivity of selected crops uniformly?

Methods

This section elucidates the survey design, description of dependent and independent variables, and the empirical models employed in the study.

We applied Non-probability Convenient Sampling to select the sample households in the district North 24 Parganas. A total of 120 households are taken into consideration for the primary survey. The primary survey was conducted in the period from July 2021 to June 2022. The questionnaire has sections on Production and income, ICT cost, ICT awareness, and Information access through ICT modes regarding weather, seeds, fertilizers, pesticides, and marketing. The study has considered the productivity yield per bigha for three crops viz. Rice as Food crop as well as Kharif crop, Jute as Cash crop as well as Kharif crops and Mustard oilseed as Cash crop as well as Ravi crop independently as dependent variables. In our study, we have segregated the independent/ explanatory variables into two groups. The first group consists of the conventional inputs of production yield like labour productivity, fertilizers, seeds, pesticides, and irrigation. On the other hand, in the second group, we have considered the ICT-influenced information access through smart phone regarding weather, seeds, fertilizers, pesticides, marketing, and ICT expenditure by the farmers of the district.

To study the impact of ICT on production/bigha, first we use the conventional factors as independent variables. We use the following Regression equation:

$$Y_j = \alpha + \beta_i X_i \qquad i=1(1)3,\ j=1(1) \ldots\ldots\ldots\ldots\ldots (1)$$

Where, Y_1= Production of Rice/bigha

Y_2= Production of Jute/bigha

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Y_3= Production of Mustard oilseed/bigha

X_1=Seed usage/bigha,

X_2= Fertilisers usage/bigha,

X_3= Total Pesticides amount spent/bigha,

X_4= Cost of Irrigation/bigha,

X_5= Output per unit of labour/bigha

Next we add ICT information access related variables in the equation-(1) and solve the Regression equation-(2):

$Y_j = \alpha + \beta_i X_i + \Upsilon D_k$ k= 1(1)5 …….. (2)

Where, D_1= '1' if use ICT device to access Weather related information, '0' otherwise.

D_2= '1' if use ICT device to access Seeds related information, '0' otherwise.

D_3= '1' if use ICT device to access Fertiliser related information, '0' otherwise.

D_4= '1' if use ICT device to access Pesticides related information, '0' otherwise.

D_5= '1' if use ICT device to access Irrigation related information, '0' otherwise.

D_6 = ICT expenses which includes Expenses on Mobile phone, Smart Phone, Television and Internet.

The Y_j and X_i carries the same notation as above.

The positive change in the R^2 value signify the impact of ICT information on production.

The study tried to analyse the impact of independent variables on the dependent variables separately that is Rice yield per bigha, Jute yield per bigha and Mustard oilseed yield per bigha through Regression Analysis with a two-fold measure, wherein the first fold (Model-1) we considered the conventional independent variables to identify the significance and in the second fold (Model-2) the ICT influence information access variables are also added to the Regression analysis to identify the impact of information access on rice yield per bigha, Jute yield per bigha and Mustard oilseed yield per bigha separately.

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Results & Discussion

The present study is an attempt to analyze the impact of conventional inputs as well as ICT-influenced information access inputs on the dependent variables viz. Rice yield per bigha, Jute Yield per bigha and Mustard oilseed yield per bigha for North 24 Parganas. From the Descriptive Statistics in **Table 1** it is evident that the average Rice, Jute, Mustard yield per bigha are 18.6, 11.7 and 4.13 respectively with variability of 0.987, 1.17 and 0.279 respectively for Rice, Jute and Mustard oilseed. Now among the Independent variables, the Labour Productivity average for Rice, Jute and Mustard are 0.612, 1.16, 0.229 respectively with more deviation in case of Jute followed by Rice and Mustard. In the case of Seed usage the average for Rice, Jute and Mustard are 6.57, 1.03, and 0.937 respectively and for fertilisers the average spending per bigha for Rice, Jute and Mustard are 45.6, 34.2 and 111 respectively. For Pesticides the average cost per bigha for Rice, Jute and Mustard are 555.56, 205 and 589 respectively and Finally for Irrigation, cost per bigha for Rice, Jute and Mustard are 1340, 333 and 766 respectively.

Table 1: Descriptive Statistics

Variables		Rice	Jute	Mustard
Output yield per acre	Mean	18.6	11.7	4.13
	S.D	0.987	1.17	0.279
Labour Productivity	Mean	0.612	1.16	0.229
	S.D	0.0804	0.198	0.037
Seeds	Mean	6.57	1.03	0.937
	S.D	1.44	0.128	0.037
Fertilizers	Mean	45.6	34.2	111
	S.D	13.0	5.97	1.95
Pesticides	Mean	555.56	205	589
	S.D	146.70	21.2	24.2
Irrigation	Mean	1340	333	766
	S.D	255	43.7	26.8

Source: author's calculation

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In **Table 2** we have taken the responses from the farmers regarding their ICT-influenced information access usage through a smartphone for their different information needs for all the crops viz. Rice, Jute and Mustard oilseed.

Table 2: ICT influenced information access through Smart Phone

Variables	**Responses**	**Percentage**
Weather	Yes	24.1%
	No	75.9%
Seeds	Yes	52.6%
	No	47.4%
Fertilisers	Yes	61.2%
	No	38.8%
Pesticides	Yes	57.8%
	No	42.2%
Marketing	Yes	62.1%
	No	37.9%

Source: author's calculation

From **Table 2** we can find the information accessed by the farmers regarding their information needs through a smartphone, where 'yes' means farmers have accessed respective information through their smartphones and 'no' means they have not acted on the information. The survey depicts that the information access regarding Marketing is the highest (62.1%) by the farmers through their smart phones followed by fertilisers (61.2%), pesticides (57.8%), seeds (52.6%) and weather (24.1%).

Now to determine the impact of conventional variables as well as ICT-influenced variables on the rice yield per bigha, Jute yield per bigha and Mustard oilseed yield per bigha we opt for Regression Analysis separately. The Regression Analysis is done separately for each of the three crops to find out whether there is any disparity among the crops concerning the influence of conventional inputs (Model-1) and ICT-influenced information access input along with conventional inputs (Model-2) on the dependent variables i.e. Rice yield per bigha, Jute yield per bigha and Mustard oilseed yield per bigha. The $\mathbf{R^2}$ value of Model-1 and Model- 2 and the change in $\mathbf{R^2}$ for all the three crops are depicted in Table 3.

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Table 3: R^2 value of model 1 and model 2 for Rice, Jute and Mustard oilseed

Crops	Models	R^2	ΔR^2
Rice	Model-1	0.773	-
	Model-2	0.803	0.0308
Jute	Model-1	0.671	-
	Model-2	0.695	0.0241
Mustard	Model-1	0.867	-
	Model-2	0.879	0.0128

Source: author's calculation

For Rice crop the R^2 Value as per **Table 3** of Model-1 is 0.773 which signifies that the predictor variables can explain more than 77% variability in the dependent variable. The model depicts a significant relationship between conventional inputs and rice yield per bigha. As per Model-2, the value of R^2 is 0.803 signifying that the predictor variable explains more than 80% of the variability in the dependent variable. The R^2 increased by around 3% over the two models which are evident that information access through ICT mode can explain more variability in the dependent variable.

For Jute crop, the R^2 value as per **Table 3** of Model-1 is 0.671 signifying that the conventional inputs can explain more than 67% variability in the dependent variable. For Model 2 around 69% variability is explained by adding ICT-influenced information access variables along with conventional variables. Therefore, we find an increase of around 2% in the explaining capacity for the ICT-influenced information access variables, concerning the Jute crop.

For Mustard oilseed crop, the R^2 value as per **Table 3** of Model-1 is 0.867 signifying that the conventional inputs can explain more than 86% variability in the dependent variable. For Model 2 around 87% variability is explained by adding ICT-influenced information access variables along with conventional variables. Therefore, we find an increase of around 1% in the explaining capacity for the ICT-influenced information access variables for Mustard oilseed crop.

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Table 4: Model Coefficients for Rice, Jute and Mustard oilseed

Predictors		Rice			Jute			Mustard		
		Estimate	**t-value**	**p-value**	**Estimate**	**t-value**	**p-value**	**Estimate**	**t-value**	**p-value**
Conventional Variables	Seed	0.141	4.134	**0.001***	2.394	3.612	**0.001***	-	-	-
	Fertiliser	0.016	4.074	**0.001***	0.220	10.622	**0.001***	-0.010	-1.96	0.052
	Pesticides	5.450	7.077	**0.001***	0.00900	2.456	**0.016***	0.010	9.835	**0.001***
	Irrigation	0.001	3.196	**0.002***	-0.010	-3.362	**0.001***	0.006	14.98	**0.001***
	Labour Productivity	9.384	11.725	**0.001***	3.994	6.668	**0.001***	14.74	19.93	**0.001***
ICT Influenced Information Access Variables	Weather	0.416	3.497	**0.001***	-0.046	-0.275	0.784	0.0190	0.790	0.431
	Seeds	-0.163	-1.050	0.296	0.215	0.928	0.355	-0.057	-1.651	0.102
	Fertilisers	0.113	-0.621	0.536	-0.494	-1.789	0.077	-0.003	-0.092	0.927
	Pesticides	0.099	0.661	0.510	0.555	2.526	**0.013***	-0.049	-1.537	0.127
	Marketing	0.376	2.171	0**.032***	-0.357	-1.350	0.180	0.102	2.712	**0.008***
	ICT expenditure	3.700	1.879	0.063	-1.48	-0.45	0.653	6.55	1.59	0.113
F-Value		38.7		**0.001***	21.3		**0.001***	81.0		**0.001***

Source: author's calculation

*Significant at 1% & 5% levels **Seed is dropped for multicollinearity problem in case of Mustard oilseed.

The model coefficients for all the three crops are shown in **Table 4**. The model for all the three crops are generally accepted because the p-value of the F statistics is less than 0.05. All conventional variables are a significant predictor of Rice yield per bigha. Weather and marketing information access via ICT has a significant impact on the dependent variable, i.e., the above two information access can affect the Rice yield per bigha for the farmers who use their smartphone for weather and marketing information access than the farmers who don't use by 41% and 37% respectively.

Traditional factors like seeds, pesticide use and labour productivity are excellent predictors of productivity output for Jute. Though irrigation has a detrimentally significant impact on production yield for Jute, increasing irrigation will result in lower production yields per bigha. The dependent variable i.e. Jute yield per bigha, is not significantly impacted by any of the ICT-influenced information access factors except pesticides. This shows that farmers who

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utilize their smartphones for pesticides information access had a 55% higher Jute production per bigha than farmers who don't.

For Mustard oilseed the conventional variables like pesticides, irrigation and labour productivity are the significant predictors of Mustard oilseed yield per bigha. Marketing information access via ICT has a significant impact on the dependent variable, i.e., the marketing information access through smart phone can affect the Mustard oilseed yield per bigha for the farmers who use their smartphone for marketing information access than the farmers who don't use by 10%.

Conclusion

The overarching conclusion from the foregoing analysis signifies lower level of information access through ICT enabled devices by the farmers, though the study confirms that the ICT has significant positive effect on the productivity yield for the selected crops. The farmers who use ICT influenced information access through their smart phones have more crop productivity for all the three crops i.e. Rice, Jute and Mustard oilseed, than the farmers who don't use it. Though the crops are of different seasons and require different climate conditions, but ICT information access positively impacting their productivity. The inclusion of ICT influenced information access variable in the Regression Analysis, the capacity of dependent variable to be explained has been increased around 3% for Rice, 2% for Jute and 1% for Mustard oilseed. Therefore, the Digital India campaign by the Government of India can proves to be extremely helpful if the prospective farmers became aware about the ICT benefits and Government should take proper initiative for implementation of various ICT enables services to the farmers through panchayets and block levels.

References

1. Achterbosch, T. J., van Berkum, S., Meijerink, G. W., Asbreuk, H., & Oudendag, D. A. (2014). *Cash crops and food security: Contributions to income, livelihood risk and agricultural innovation* (No. 2014-15). LEI Wageningen UR.
2. Baliyan, K. (2021). Input Output Relationship and Economics of scale in Agriculture: Empirical evidence from eastern UP. *Research in Agricultural & Applied Economics. August 2021.*

ISSN PRINT 2319 1775 Online 2320 7876

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3. Das, B. (2014). ICT's adoption for assessing Agricultural Information: Evidence from Indian Agriculture. *Agricultural Economics Research Review. 27 (2), 199-208.*
4. D.N (2001). *'ICT's in rural poverty alleviation*. Economic and Political Weekly, Vol. 36, No. 11 (Mar. 11-23, 2001), pp-917-920.
5. Ferroni, M., & Zhou, Y. (2011). Review of agricultural extension in India. *Syngenta Foundation for Sustainable Agriculture, 1-49.*
6. John, A., & Barclay, F. P. (2017). ICT Usage and Effects on Rural Farming Communities. *Journal of Media and Communication, 1*(1), 100–136.
7. Joshi, P. K., Birthal, P. S., & Minot, N. (2006). *Sources of agricultural growth in India: Role of diversification towards high-value crops* (No. 596-2016-40010).
8. Kakar, M., Kiani, A., & Baig, A. (2016). Determinants of agricultural productivity: Empirical evidence from Pakistan's economy. *Global Economics Review, 1(1), 1-12.*
9. Khan. M.S.A (2020). Green Revolution and its influence in the Indian Scenario. *Open Access International Journal of Science & Engineering, Vol-5, Issue-2. ISSN: 2456-3293.*
10. Parveen, U., & Mondal, P. (2020). Impact of Green Revolution on the Sustainability of rice-wheat Cropping Pattern and Crop Productivity in Ganga Basin. *Maharashtra Bhugoshastra Sanshodhan Patrika, 37(2), 26-37.*
11. Rahim.K.M.B, Majumder.D & Biswas.R.K (2011). Determinants of Stagnation in Productivity of Important Crops in West Bengal. *Agro Economic Research Centre, Viswa Bharati, Santiniketan, 2011. Study No. 162*
12. Shalendra, Gummagolmath, K.C., & Sharma, P. (2011). Role of ICT in Dissemination of Knowledge in Agriculture Sector: Its Efficiency and Scope. *Indian Journal of Agriculture Economics, 66(3), 489-497.*
13. Department of Agriculture and Farmers Welfare, West Bengal https://agricoop.nic.in/sites/default/files/WestBengal%2013-North%2024%20Parganas-31-12-2011_0.pdf

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Appendix-1: Collinearity Statistics

Predictors		Rice	Jute	Mustard oilseed
		VIF	VIF	VIF
Conventional Variables	Seed	1.32	1.78	**
	Fertiliser	1.49	3.78	1.17
	Pesticides	2.21	1.48	7.39
	Irrigation	3.46	4.18	1.83
	Labour Productivity	2.25	3.46	8.82
ICT Influenced Information Access Variables	Weather	1.42	1.29	1.40
	Seeds	3.30	3.32	3.55
	Fertilizers	4.37	4.43	4.53
	Pesticides	3.02	2.92	2.96
	Marketing	3.88	4.02	3.91
	ICT expenditure	1.36	1.49	1.24

**Seed is dropped for multicollinearity problem in case of Mustard oilseed