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IMPACT OF ICTS ON AGRICULTURAL PRODUCTIVITY IN PERAMBALUR DISTRICT

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ABSTRACT

The study was conducted in Perambalur district of Tamil Nadu in India during June and August 2020. The study used multiple stage random sampling technique to select the sample farmers. The objectives of this study were to find out the impact of ICTs on agricultural productivity, net profit per acre and on sources of finance to the farmers. The study revealed that the impact of ICTs on agriculture productivity was positive. The impact of television on productivity was positive and statistically significant. The productivity of farmers in the age group of 25-40 years was higher due to use of more ICTs. Estimation ofthe factors influencing productivity and net profit involved the use of Ordinary Least Square Regression Techniques. The use of ICTs along with seed, fertiliser and amount borrowed on agricultural productivity was positive. The impact of ICTs along with seed, fertiliser, and amount borrowed and level of education on net profit per acre was also positive but statistically insignificant. The study recommended that the Government should create an integrated agricultural information system on agro-technologies and techniques, pricing and market information so that strategic information could be provided to farmers and other stakeholders at national, provincial and district levels. The study also suggested for development of ICT skills among agricultural extension workers and farmers.

Key words: ICT, Agricultural Productivity, Net Profit

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1. INTRODUCTION

Information and Communication Technologies (ICTs) are any devices, tools that permit the exchange or collection of data through interaction or transmission. ICT is an umbrella term that includes radio, television, mobile phone, internet, electronic money transfer, etc., The ICTs increase productivity, access to markets and adaptability to weather conditions inagriculture.

More effective interventions are needed in agriculture because rising food prices pushed over 40 million people in to poverty since 2010 (World Bank, 2011). The growing global population which is expected to reach 9 billion by 2050, has heightened the demand for food and placed pressure on already- resources. Feeding that population will require a 70 per cent increase in food production (FAO, 2009). Even after years of industrialization and growth in services, agriculture still accounts for one-third of the gross domestic product and three-quarter of employment in India. Over 60 per cent of the labour force in countries with per capita incomes in the US$ 400 to 1,800 range works in agriculture (World Bank, 2020).

Agricultural productivity rose around the world because more land was cultivated and more land was cultivated more intensively. Most of the gains were made through intensification. Agricultural land expanded by only 11 per cent between 1961 and 2007 (FAO 2009), but between 1960 and 2000, genetic improvement and agronomic practices contributed to 78 Per cent of the increase in production (Lal, 2010). Bringing more land in to production is infeasible, not only because of the growing number of competing uses for land but because of environmental and social costs involved. The drive for agricultural land has resulted in deforestation, reduced biodiversity and provoked other forms of environmental degradation (Balmford *et al.,* 2005; Gopinath, 2019 d). It has also removed livelihood opportunities for some communities and elevated greenhouse gas emissions (Millennium Ecosystem Assessment, 2005). Due to these reasons there is need to raise crop yields without using additional land. Raising yield per unit of land was observed during the Green Revolution of 1960s and 1970s in Latin America and Asia. A similar Green Revolution never arrived in sub-Saharan India but is needed, given that almost all of the arable land is being cultivated (Govereh *et al.,* 1999). Looking at the present global circumstances of productivity gap and demand, there is needed to increase the productivity through intensive agriculture. The ICTs can play an important role in increasing the productivity through intensive agriculture (Gopinath, 2019 a). Conducting impact studies and sharing pilot project information is critical to success with ICTs as more specific lessons and impacts are learned (IICD, 2006).

India's arable land makes up to 40% of arable land globally, while only 10% is being cultivated (EIU, 2012). The share of agriculture in GDP in many Indian countries is much smaller, of ten 30% or less indicating low productivity levels in the sector (AFDB, OECD, UNDP and UNECA, 2012). A critical force in transforming agriculture in countries such as China and Korea was the investment in transport and communications infrastructure especially information and communication technologies, apart from their emphasis on agricultural research and extension, irrigation systems and storage facilities which are essential factors for raising productivity and increasing income for the poor (UNECA, 2012). The strategic application of ICTs to the agricultural sector, which is the largest economic sector in most Indian countries, offers the best opportunity for economic growth and povertyalleviation on the continent (World Bank, AFDB and AUC, 2012). India is the fastestgrowing region in the global telecommunications market. The number of mobile subscribers has further room for growth as India is being seen to have world's largest working-age population by 2040, which reflects the economic potential with a younger demography, of which 38% of the working youth in India are in the agricultural sector (UNECA, 2012).

The National ICT Policy in India recognizes that Agriculture is the economic backbone especially in rural areas. It plays an important role in the social and economic development of the country. Agriculture sector accounts for a significantly high proportion of the GDP and acts as the main source of employment and income in sub-urban and rural areas where the majority of Tamil Nadu reside (Gopinath, 2019 b). The national ICT's policy goal is to improve productivity as well as competitiveness of the agricultural sector through the use of ICTs in the planning, implementation, monitoring and the information delivery process (ZNFU 2016).

Agriculture is the major earner of export revenue in Tamil Nadu. In 2015, the value of agric exports was 27% of Non-Traditional Exports (NTE) value and of the agro exports value 43% was maize (IAPRI, 2016).

In Tamil Nadu there are some studies concentrated on macro level on impact of ICTs on agriculture. There is need for empirical studies at micro level on this subject. This study fills the gap in the existing literature on the impact of ICTs on agricultural productivity selecting a district in the Central Province of Tamil Nadu.

2. LITERATURE REVIEW

Mahmud and Ahsan (2016) studied the role of ICTs in Agriculture/Rural development and Governance in Taiwan. The study revealed that use of ICTs resulted in highest benefits to the producers and saved them from middlemen. ICTs were used for enhancing both research findings among the stake-holders which ensured optimum coordination between research and extension for the welfare of farmers. Chavula (2014) using the 2000-2011 panel data for 34 Indian countries revealed that ICTs played a significant role in enhancing agricultural production, despite mobile phones had insignificant impact while telephone main lines a significant contributor to agricultural growth. The results also suggested that certain socio-economic characteristics such as higher education levels and skills are prerequisites foreffective improvements in agricultural production due to the adoption and utilisation of new technologies. The study by Halewood and Surya (2012) showed that the benefits of using ICTs in promoting access to price information in India have led to increase up to 36% of farmers' income, and up to 36% of traders' income in countries such as Kenya, Ghana, Uganda and Morocco. McKinsey (2013) revealed that the Ethiopian Commodity Exchange provided a virtual market place, accessible online, by phone or SMS, which provided transparency on supply, demand and prices and increased farmers' share of revenue. Study of Gopinath & Kalpana (2019) had found that people from agricultural background are not having positive opinion about consuming fast food; they still prefer to go by organic. Further, similar studies discussed on Online Shopping Consumer Behaviour (Gopinath, 2020 e), Consumer Perception on Brand Awareness of Household (Gopinath, 2020 f) and Gopinath (2011) customer perception in buying decisions.

Chhachhar *et al.* (2014) revealed that internet, mobile phones, radio and television were the most important tools of communication providing knowledge and information to farmers about agriculture. In remote areas radio was favorite tool of communication which broadcasts many agriculture programs while television also contributed much in disseminating information about agriculture in developing countries. Mobile phones reduced the gap among farmers and buyers. Farmers directly communicated with customers and got price of their products from market. Farmers got latest information from metrological department for weather conditions before using pesticides in their farms. Internet also disseminated information regarding price and marketing of goods and farmers received information within minutes from all over the world.

3. OBJECTIVES OF STUDY

The specific objectives of this study are to:

- Find out the different type of ICTs used by the farmers.
- Examine the usage of ICTs in agricultural activities
- Know the impact of ICTs, seed, fertilizer and the amount borrowed on production

- Investigate the impact of ICTs, education, seed, fertilizer and amount borrowed on net benefit per acre.
- Ascertain the distribution of production per acre according to gender, age and usage of ICTs.
- Research the sources of finance to the farmers.

4. METHODOLOGY

This study was carried out in Perambalur district of Tamil Nadu during June to August 2017 for the agricultural season 2015-16. The study used multiple stage random sampling technique. In the first stage Central Province was selected out of 10 Provinces in India. In the second stage Perambalur district was selected out of six districts of Central Province. In the third stage 30 villages were selected out of 286 villages in the district. In the fourth stage 117 farmers were selected randomly who were using ICTs in agriculture. The data were collected through serving questionnaire and interview method. Estimation of the factors influencing productivity and net profit involved the use of ordinary least square regression techniques.

The study collected the information on production of maize. Production per acre was calculated by dividing the total production with area cultivated. The net benefit per acre was measured by subtracting cost per acre from revenue per acre. The ICTs used by the farmers in the study were mobile, radio and television.

Model Specification

To know the impact on productivity, the following model was use

Where, Pi= Production of maize per acre in a given agricultural season

$\beta 0i$=Constant

β^1_{im}=Mobile Phones used in a given agricultural season

β^2_{ir}=Radio used in a given agricultural season

β^3_{itv}=Television used in a given agricultural season

β^4_{iseed}=Seed used in a given agricultural season

β^5_{ifer}=Fertiliser used in a given agricultural season

β^6_{iab}=Amount Borrowed in a given agricultural season

β^1 to β^6=Regression parameters that were estimated.

μ=Error term associated with data collection which was assumed to be normallydistributed with zero mean and constant variance.

Where, NB= Net Benefit per acre

α^0=Constant

α^1_{im}=Mobile Phones used in a given agricultural season

α^2_{ir}=Radio used in a given agricultural season

α^3_{itv}=Television used in a given agricultural season

α^4_{iseed}=Seed used in a given agricultural season

α^5_{ifert}=Fertilizers used in a given agricultural season

α^6_{iab}=Amount borrowed in a given agricultural season

α^7_{iedu}=Level of education in a given agricultural season

α^1 to α^7=Regression parameters that were estimated

μ= Error term associated with data collection which was assumed to be normally distributed with zero mean and constant variance.

5. FINDINGS AND RESULTS

Distribution of Production per Acre by Usage of ICTs

Table 1 Distribution of Production per Acre by Usage of ICTs in agriculture

Name of ICT used	Number of Farmers	Production Per Acre (No. of bags of 50 Kg)
Mobile Phone	102 (87.17)	28.57
Radio	84 (71.79)	27.39
Television	55 (47.00)	31.16

Source: Primary data. Figures in the parentheses are percentages

Out of 117 farmers, 87.17 percent were using mobile phone; 71.79 percent were using radio and 47 percent were using television. The production per acre of farmers using television had higher production per acre, i.e. 31.16 bags due to telecast of different programmes on use of seed, fertilizer and other techniques of production in agriculture. The production per acre of mobile phone users was 28.57 bags and for radio users it was 27.39 bags. Even these Medias have influence in decisions of the consumers (Gopinath, 2019 c).

Distribution of Production per Acre by Gender

Table 2 Distribution of Production per Acre by Gender

Gender of Farmers	Number	Production Per Acre (In 50 Kg bags)
Male	86 (73.5)	31.72 (53.80)
Female	31 (26.5)	27.24 (46.20)
Total	117 (100)	58.96 (100)

Source: Primary data. Figures in parentheses are the percentages

Out of 117 farmers, 73.5 percent were male and 26.5 percent were female. The average production per acre in the study area was 58.96 bags. The production per acre for male was 31.72 bags (53.8%) and for female it was 27.24 bags (46.2%).

Distribution of Production per Acre by Age of Farmers

Table 3 Distribution of Production per Acre by Age of Farmers

Age Group of Farmers	Number of Farmers	Production per Acre (In 50 Kg bags)
Youth (15-24 years)	0	0
Adults (25-40 years)	39 (33.34)	32.07 (54.40)
Above 40 years	78 (66.66)	26.89 (45.60)
Total	117 (100.00)	58.96 (100.00)

Source: Primary data. Figures in parentheses are the percentages

Out of 117 farmers, 33.34 percent were between the age group of 25-40 years, 66.66 percent were above 40 years of age and the farmers in the age group of 15-24 years were nil. Out of total production per acre of 58.96 bags, the production per acre for adult farmers was 32.07 (54.40%) bags and for above 40 years age farmers it was 26.89 bags (45.60%). The per acre production for adults was higher than above 40 years age farmers due to use of more ICTs in agriculture (Gopinath *et al*., 2016).

Impact of ICTs on Productivity

Table 4 Impact of ICTs on Productivity-**Model Summary**[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F-Change	
1	.338[a]	.114	.066	16.0519	.114	2.359	6	110	.035	1.650

a. Predictors: (Constant), Amount borrowed Seed, Mobile, Radio, Television and Fertilizers.b.Dependent Variable: Production per Acre.

Table 5 Coefficients [a]

Model	Un standardized Coefficients		Standardized Coefficients	t	Sig.	95.0 % Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	45.090	9.163		4.921	.000	26.931	63.248
Mobile	3.350	4.803	.068	.697	.487	-6.169	12.869
Radio	3.943	3.425	.106	1.151	.252	-2.844	10.730
TV	-3.797	3.282	-.115	-1.157	.250	-10.300	2.706
Seed	-4.989	5.978	-.092	-.835	.406	-16.835	6.858
Fertilizers	-12.164	5.591	-.239	-2.176	.032	-23.244	-1.083
Amount borrowed	-.001	.001	-.078	-.856	.394	-.003	.001

[a.] Dependent Variable: Production per Acre

The model was statistically significant as the F probability was 0.035, which was less than 5 percent. The model was explaining 11.4 percent of the variation in production per acre due to changes in the independent variables. Since Durbin Watson value was 1.650 which was close to 2, there was no auto correlation.

The regression coefficients were not significant, except the coefficient of fertilizers. The impact of fertilizer was significant, which was the value of coefficient fertilizer was negative 0.239 which means as farmers applied one more bag of fertilizer, the production per acre decreased by 0.239 in the absence of other factors. The impact of ICTs on production per acre was not significant because the farmers could not apply the information due to lack of finance. Further, similar studies discussed on Reasons for a Brand Preference of Consumer Durable Goods (Gopinath & Irismargaret, 2019) and Employer Branding (Gopinath & Meenakshi, 2019).

Impact of ICTs on Net Profit per Acre

Table 6 The Impact of ICTs on Net Profit per Acre - Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.515[a]	.265	.218	3211.1375	.265	5.609	7	109	.000	1.217

a. Predictors: (Constant), Level of Education, Fertilisers, Television, Amount borrowed, Radio, Mobile and Seed; b.Dependent Variable: Net Profit per Acre

Table 7 ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	404840968.075	7	57834424.011	5.609	.000[b]
Residual	1123943022.695	109	10311403.878		
Total	1528783990.769	116			

a. Dependent Variable: Net Profit per Acre

b. Predictors: (Constant), Level of Education, Fertilisers, Television, Amount borrowed, Radio,mobile and Seed.

Table 8 Coefficients[a]

Model	Un standardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	3819.526	1928.265		1.981	.050	-2.232	7641.283
MOBILE	.663	961.703	.000	.001	.999	-1905.400	1906.727
RADIO	141.657	708.159	.017	.200	.842	-1261.892	1545.206
TV	-1238.839	657.469	-.171	-1.884	.062	-2541.920	64.243
SEED	-311.283	1196.079	-.026	-.260	.795	-2681.873	2059.308
FERTILISERS	-693.471	1118.562	-.062	-.620	.537	-2910.424	1523.483
AMOUNT BORRROWED	1.036	.195	.444	5.315	.000	.650	1.422
LEVEL OF EDUCATION	394.815	412.268	.082	.958	.340	-422.287	1211.917

a. Dependent Variable: Net Profit per Acre

The model was significant at 5 percent level. The value of R^2 was 26.5, meaning that 26.5 percent of the variations in the net profit per acre were explained by the independent variables. The regression coefficients were not significant, except amount borrowed. The coefficient value of amount borrowed was 0.44, which means as the amount borrowed by one kwacha, the net profit per acre increased by 0.44 kwacha.

The impact of ICTs on net profit per acre was positive but statistically insignificant. The impact of seed and fertiliser on profit per acre was not significant because the farmers had to pay higher price for purchasing them which reduced the net profit per acre. The impact of level of education on net profit per acre was not significant due to the reason that though they were educated they could not have access to finance and they could not purchase seed, fertiliser, irrigation source, etc.(Bhawiya Roopa & Gopinath, 2020 a).

Sources of Finance to the Farmers

Table 9 Sources of Finance to the Farmers

Source of Finance	Number of Farmers Access to Finance	Percentage
Banks	0	0
Co-operatives	6	5.12
Micro Finance	4	3.42
Relatives	3	2.56
Friends	10	8.55
Total	23	19.65

Source: Primary data.

Out of 117 farmers only 23 (19.5%) had the access to finance. The major source of finance was relatives and friends which constituted of 56.52 percent. 43.47 percent of farmers received finance from co-operatives and micro finance institutions. The farmers could not getfinance from the banks (Gopinath, 2019 d).

6. DISCUSSIONS AND SUGGESTIONS

The results of this study showed that the impact of ICTs on agricultural production was positive. This study showed that per acre production for male farmers was higher than femalefarmers. There were no youth involved in agriculture. The production per acre of farmers in the age group of 25-40 years was more than the farmers above 40 years of age due to use of ICTs in agriculture. The effect of television on production per acre was higher than radio and mobile phones due to different programmes broadcasted on television about the weather conditions, seed, fertiliser use etc., through discussions with the experts and success stories offarmers. The results of this study confirmed the outcome of the study by Chavula (2014) that ICTs played important role in agricultural production but it did not confirm that telephone main lines contributed significantly to agricultural growth. This study also confirmed the results of research by Chhachhar *et al. (*2014) which revealed that television contributed much in disseminating information about agriculture. This study did not confirm the results of the studies by Hassan, et.al (2010) and Meera *et al.* (2004) which revealed that farmers used internet for the purpose of seeking agricultural information. Whereas, this study confirmed the results of Murty and Abhinov (2012) that television played a most vital role as a medium of diffusion information about agriculture. The farmers got information by watching the agriculture related programmes on television. This study also confirmed the results of study by Agnes (2010) that in Tanzania use of ICTs by farmers was related to the quantity produced and increase in income.

In this study the impact of ICTs along with the use of seed, fertiliser and amount borrowed onagricultural productivity was positive. The impact of ICTs along with seed, fertiliser, amount borrowed and level of education on net profit per acre was also positive but not statistically significant. The impact of ICTs on sources of finance was insignificant due to collateral issues. The main source of finance to the farmers was relatives and friends. The source of finance from banks was nil.

7. CONCLUSIONS

The conclusions that emerged from the foregoing analysis were as follows:

- The Government should create an integrated agricultural information system on agro-technologies and techniques, pricing and market information so that strategic information could be provided to farmers and other stakeholders at national, provincial and district levels (Usharani & Gopinath, 2020 a & b).
- There is need to intensify the use of radio and television programmes and integrates new technologies as a means to reach extension workers and farmers.
- ICT skills should be developed among agricultural extension workers and farmers.
- Government should increase access to ICTs by reducing Value Added Tax so that the small scale farmers also could use them.
- The Government and NGOs should sensitize the farmers on the benefits of using ICTs and ICT education in the schools and colleges/universities should be made compulsory to address the shortage of ICT skills.
- With Public-Private Partnership (PPP) ICT infrastructure should be developed across the country to ensure access to ICT technologies.

- Government should provide an enabling environment to encourage softwaredevelopers by reducing taxes to develop packages that are suitable for local market conditions (Bhawiya Roopaa & Gopinath**,** 2020 b)
- The existing communication tower infrastructures should be upgraded to ensure better cell phone and internet coverage. Fibre Optic Cable should be promoted to improve the quality of network connectivity.
- Accessible telecoms and power infrastructure in rural areas should be developed to use ICTs in agriculture.
- Lastly, since television contributed for higher agricultural productivity in the study area, the farmers should be provided televisions at affordable price by reducing VAT and Sales tax and more time should be allocated for broadcasting programmes on use of seed, fertiliser, irrigation management, success stories, etc.,

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