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Input Adoption among Smallholder Farmers of Northern Tamil Nadu: Evidence from primary survey

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Abstract

This paper is an attempt to assess the impact of modern technological input adoption and participation in Farmer Producer Organization by the smallholder farmers. Using primary survey from six non-contagious villages of Tiruvannamalai district of Tamil Nadu we have tried to analyze the impact of the same on the agricultural production of the smallholders. A multiple linear regression model has been used to analyze the effects of the same on their production. An input adoption index has been constructed based on the farmers' access to fertilizer, pesticide and herbicide. The findings revealed positive and significant impact of these on their production.

Keywords: *DFI, Smallholder, FPO, Input Adoption, ICT*

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Introduction:

Extensive agricultural cultivation has characterised Indian agriculture during the pre-green revolution era (1965), and intensive cultivation in the post-green revolution period. Significant increase in the use of modern inputs has been witnessed after the green revolution. Adoption of improved varieties and advanced technologies by smallholder farmers is critical to improve the productivity and income of farmers. Improved agricultural techniques and inputs, such as improved seeds that produce higher yields or fertilizers, are vital to increasing agricultural productivity, especially among subsistence farmers. (Scherr & Hazel, 1994). Yet, the adoption of improved agricultural inputs by smallholder farmers has been slow. Small and marginal farmers account for 86% of total farmers but they contribute only 47% of total cropping area (Agricultural census, 2015-16), while small and marginal farmers account for 93% of total farmers operating 62% of total cultivable land (GoTN 2022) which reveals the significant disparities that exist in agriculture sector. Small land sizes are associated with small marketable surpluses and limited access to agricultural inputs, and market access. Faced with limited production quantities, and lack of adequate access to input supplies, extension services, credit facilities and output markets, smallholders have lower rates of technology adoption and market efficiency, which in turn result in lower income (Verma et al., 2019).

With the announcement of the proposal of Doubling Farmers Income (DFI) by 2022 during the budget presentation by the finance minister, the government of India signalled a significant shift in policy in agriculture from production to farmers' welfare. Adequate access to extension services be it public or private is crucial for input adoption among the farmers; however, private extension services such as private input dealers are driven by the motive of maximizing the sale of their inputs and thus public extension services in this context may turn out to be more efficient (Goswami & Bezboruah, 2017). Provision of public extension services to a single farmer or a small group of farmers maybe economically inefficient as opposed to organizing training programs for a large number of farmers. To encounter such problems at the field level, organization of farmers into groups may be a viable option. Several schemes have already been adopted and implemented pursuing this objective; the promotion of Farmer Producer Organizations (FPOs) is one such prominent strategy. In support of FPOs GOI declared 2014 to be the 'Year of Farmer Producer Organization'. Farmer producer organisations have the potential to enhance smallholders' market outreach, improve their bargaining power, and also achieve higher food security standards by providing

them with access to agricultural inputs, credit facilities, post-harvest agricultural logistics, and a platform for aggregating their produce, as a collective (Verma et al., 2019). FPOs are considered as a strategy to improve the livelihoods of small farmers through economies of scale by providing collective strength to farmers for improved access to production technology, value addition services, high quality inputs and marketing services for improving their (Nikam et al., 2019). Under the 12th five-year plan of GOI, promotion and strengthening of FPOs has been one of the key strategies to achieve inclusive growth.

Against this backdrop, the paper with its focus on Tamil Nadu examines the input adoption and commercialization of FPO and Non-FPO paddy cultivating smallholder farmers. Using the data generated through a primary survey, the study further analyses the impact of smallholder FPO and Non-FPO farmers access to inputs like High Yielding Variety seeds, fertilizer, pesticides and herbicides, farm machineries, Information Communication Technology (ICT) on their agricultural production.

For the purpose of analysis, the study divides the smallholders into two groups, one participating in FPO and the other not participating in FPO. It is important to understand the adoption of inputs between FPO members and non-FPO members for the following reason. Smallholder farmers have limited land to produce the market needs where they suffer a lot to meet the market demand and compete with large farmers with quantity and quality produces. To meet this, smallholders require easy credit access for adopting new technologies in their field to produce marketable surplus (Penrose-Buckley, 2007). Collective action is an acclaimed strategy to deal with the challenges faced by smallholders. Small farmers' access to better machinery and optimal timing of operations, such as sowing, spraying and harvesting are expected to improve through participation in FPOs (Roy et al., 2020). Thus, understanding the implication of FPOs for the smallholders in accessing agricultural inputs is important.

Data and Methodology

To assess the impact of FPOs on agricultural production of smallholder farmers, the primary data has been collected from four non-contagious villages Chetput, Vandavasi, Polur, Cheyyar and Vembakkam under the district of Tiruvannamalai.

In order to understand the impact of input adoption and membership in FPOs more rigorously, a multiple regression analysis was carried out. The multiple regression models adopted is modelled as follows:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \varepsilon$ -----(1)

Where:

β_0=Intercept term

$\beta_1, \beta_2, \ldots\ldots\beta_9$ are the coefficients of the following independent variables respectively.

X_1=Input Adoption Index

X_2=Agricultural Machinery

X_3= Information and Communication Technology

X_4=Farm Experience

X_5=Household Size

X_6=Farm Size

X_7=Non-farm income

X_8=Access to Credit

X_9=FPO membership

The Technology Input adoption index has been constructed encompassing three inputs HYV seed, pesticide and herbicide. It has been constructed to quantify the adoption of modern technologies by the sample farmers following the formula-

$$\boldsymbol{A_i} = \frac{\boldsymbol{Number\ of\ Inputs\ adopted}}{\boldsymbol{Total\ number\ of\ inputs}} \text{-------(2)}$$

Where:

$$\boldsymbol{A_{i=Technology\ input\ adoption\ index}}$$

The sample farmers were classified as adopters if the adoption index was 50 or above and Non adopter is below 50. Studies like (Asfwa et al, 2012) has shown that in the absence of no option to increase area under production, adoption of new and advanced technologies and input varieties were found to be the key to increase production and for commercialization.

The independent variable that is the membership in FPO is a dummy variable, with two categories namely FPO =1 if the farmer is a member of FPO and FPO=0 if the farmer is not a member of FPO. The purpose of having such categorisation of the independent variable is to examine if being a member of FPO have any effect on the dependent variable. In order to isolate the effect of the independent variable, certain other variables which may also affect the dependent variable have been included in the regression analysis as control variables.

The control variables thus identified from relevant literature are Machinery, Access to Information and Communication Technology, household size, farm size, farm experience, non-farm income and access to credit. For the agricultural machinery variable, ownership of

at least one of the modern machines has been considered. Similarly, for the ICT variable, the farmers were asked regarding their use of ICT for information related to agriculture among different available options. Usage of any of the ICT method has been taken as a proxy for access to information and communication technology. Here, the access to credit variable implies access to both institutional and non-institutional source of credit.

Findings and Discussion

Impact of ICT adoption and FPO membership on Agriculture

Summary of the model

To test for the presence of heteroscedasticity and multicollinearity Breusch Pagan test and Variance Inflation Factor tests are employed respectively. It is found that the model has quite a good fit with the R2 value of 0.55. Also, significant value of F-statistics of the model depict that all the parameters of the models are non-zero and the model is overall significant. Since, none of the VIFs is exceeding the value of 10, we can say that the model is free from the problem of multicollinearity.

Table:1 Model summary

Variable	VIF	1/VIF
Machinery	1.37	0.727857
farm_exp_11	1.34	0.746495
ICT	1.34	0.746559
FPO	1.27	0.789769
Non_farm_i~e	1.20	0.832630
HouseholdS~e	1.09	0.921029
farm_size_11	1.08	0.923158
Index	1.07	0.938861
Credit_Acc~s	1.02	0.984873

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of ltp

chi2(1) = 0.68
Prob > chi2 = 0.4084

The null hypothesis (H0) of the Breusch Pagan test is that the variance of the error term is constant, i.e., homoscedastic, since the p value is greater than 0.05, H0 cannot be rejected. Hence, with a chi-squared statistic of 0.68 and a p value of 0.4084, the Breusch Pagan test indicates that there is no significant evidence of heteroscedasticity in the model.

Interpretation of the Coefficient Table

Among the independent variables, the input adoption index along with Machinery, ICT and FPO membership have been found to be significant. The coefficient of the input adoption index being statistically significant and positive implies that adoption of high yielding

varieties seeds, pesticides and herbicides contributes positively to the increase in agricultural output. The coefficient of machinery is significant and has been found to have a negative effect on agricultural production. Although use of modern agricultural machinery is linked to increased efficiency and production, however realization of these outcomes greatly depends on the management of agricultural machinery keeping in mind the regional uniqueness. Improper use of agricultural machinery may result in crop damage and thus reduction in agricultural production due to lack of adequate knowledge among the smallholder farmers on the usage of such machines. Additionally, the initial investment and maintenance cost of agricultural machinery may be exorbitantly high for smallholder farmers and in the regions with limited access to technical expertise, breakdown of machines may result in disruption in agricultural activities. Furthermore, soil degradation and soil erosion, especially the loss of fertile soil, contamination of soil and water through oil and other chemicals, loss of biodiversity, monoculture practices are other significant consequences of machinery use which adversely affects agricultural production.

Table: 2 Estimated coefficients of the model

Source	SS	df	MS	Number of obs	=	399
				F(9, 389)	=	53.58
Model	1.9729293	9	.219214367	Prob > F	=	0.0000
Residual	1.59141168	389	.004091033	R-squared	=	0.5535
				Adj R-squared	=	0.5432
Total	3.56434098	398	.008955631	Root MSE	=	.06396

ltp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Index	.1295795	.0494111	2.62	0.009	.0324334	.2267256
Machinery	-.0204861	.010293	-1.99	0.047	-.0407229	-.0002493
ICT	.0795799	.0080812	9.85	0.000	.0636916	.0954683
farm_exp_11	.0006813	.0034022	0.20	0.841	-.0060077	.0073702
HouseholdSize	-.0004506	.0025803	-0.17	0.861	-.0055237	.0046224
farm_size_11	.0042884	.0070187	0.61	0.542	-.0095108	.0180877
Non_farm_income	-1.07e-06	6.83e-07	-1.57	0.118	-2.41e-06	2.74e-07
Credit_Access	.0023042	.0065904	0.35	0.727	-.010653	.0152613
FPO	.1173968	.0072114	16.28	0.000	.1032187	.1315749
_cons	7.490361	.0522595	143.33	0.000	7.387614	7.593107

The coefficient of ICT variable has been found to be highly significant and has a positive effect on the agricultural output. This positive impact of ICT can be due to the increase in knowledge stock of the farmers regarding innovative methods of production which can be

through various channels of information and communication technology. The adoption of ICT has been revolutionary for the farmers as it significantly affects agricultural productivity, efficiency and overall livelihood of the farmers. ICT improves accessibility of information on market prices, demand trends, innovative farming practices, pest management practices, soil health management, etc. Additionally, ICT enables farmers to plan their production efficiently with access to accurate weather forecasts. ICT enables enhanced communication among the farmers and facilitates peer learning and extension support. Furthermore, ICT provides the farmers with various financial services which helps the farmers to deal with the issue of capital scarcity. It also aids to the improves supply chain efficiency and minimize post-harvest losses to a great extent.

The coefficient of FPO membership has been found to be statistically significant and has a positive impact on agricultural output. By being a part of the Farmer Producers Organization, smallholder farmers can overcome the various constraints they face in increasing agricultural output. FPOs ensures timely access to quality inputs such as seeds, fertilizer, pesticides etc. at discounted rates which contribute to better yield. Through FPOs farmers can also avail cheaper credit which can help the smallholder farmers to deal with credit constraint. FPOs also provide better market access and better market prices by eliminating the middleman to the smallholder farmers which encourages agricultural production. Another constraint faced by the smallholder farmers is in terms of access to modern machinery, storage facilities and processing facilities which can be overcome by the farmers through joining FPOs as the FPOs develop these facilities and allow farmers to use the same.

On the other hand, farming experience, farm size, household size, credit access, non-farm income are found to statistically insignificant in affecting agricultural production. The reason behind farming experience being statistically insignificant can be attributed to the fact that majority of the sample farmers surveyed were young and despite less experience has been successfully operating agricultural production. Since, the sampled farmers were mainly smallholder farmers with land size less than 2 hectare, this homogeneity in the farm size may have resulted in the insignificance of the variable. Similarly, for the household size variable, since there is lack of sampling variability in the data, i.e., the size of the household was more or less homogenous across the sample, this may have turned out to be insignificant. The variable access to credit has also been found to be statistically insignificant. The rationale behind such insignificance as observed in the field may be as the sampled farmers are mainly smallholders, due to the small size of their land they are not eligible for institutional credit

sometimes or they face various hurdles in availing credit and refrain from availing institutional financial support for lengthy paper work or lack of adequate knowledge. In addition to that, exorbitantly high rates of interest charged by the informal money lenders makes the cost of borrowing quite high. As a result, the farmers refrain from availing credit. The insignificance of the coefficient of non-farm income can be attributed to non-farm income being a risk diversification strategy rather than a direct contributor to agricultural production. Farmers may not decide on agricultural production based on changes in non-farm income.

Conclusion

Improving the production and productivity of the smallholder farmers in India has been at the heart of policy making. The announcement of the policy of doubling farmers income has necessitated serious understanding of the various constraints faced by the smallholder farmers as these farmers constitute majority of Indian farmers. The smallholder farmers due to small landholding are faced with the problem of lack of capital, lack of modern inputs and agricultural machinery, poor market access, low market prices etc. which result in low agricultural production for these farmers. Increasing the efficiency of the smallholder farmers depends on their accessibility to adequate extension services in order for them to make informed decision regarding production and sale. Accessibility to advanced technologies and inputs is sometimes difficult for a single smallholder farmer. Organization of the smallholder farmers as a group can be beneficial for the smallholder farmers. Farmers Producer Organization has emerged Findings of the paper revealed that smallholder farmers who are participating in FPO's have better access to modern inputs and technology and higher marketable surplus when compared to non- participating farmers. This shows that participating in FPO will increase the market participation which enhance the income of smallholders and therefore can be an appropriate strategy for doubling farmers income. Findings of the paper revealed that smallholder farmers who are participating in FPO's have better access to modern inputs and technology and higher marketable surplus when compared to non- participating farmers. This shows that participating in FPO will increase the market participation which enhance the income of smallholders and therefore can be an appropriate strategy for doubling farmers income.

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