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SUBJECT III
INNOVATIONS IN AGRI-INPUT AND SERVICES MARKET TOWARDS SUSTAINABLE AGRICULTURE

Input Use and Socio-Economic Status of Farmers: A Case of Paddy Cultivation in India

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ABSTRACT

Inadequate input use has been one of the biggest factors constraining productivity growth in Indian agriculture. There have been rich scholarly interventions relating input use to productivity growth in India. However, the level of input use depends on a complex set of factors, including the socio-economic profile of farmers. Though there has been a system of public provisioning of various inputs, the awareness, access, and affordability of desirable inputs depends heavily on the socio-economic status of the farmer. Most of the studies regarding input use are limited to the size of the farms. This study explores the determinants of input use in a relatively comprehensive way by incorporating a large set of factors reflecting the socio-economic condition of farmers in India. Along with the farm size of the farmer, it also includes social groups, gender, education level, access to Kisan Credit Card, membership of farmer's organisation, family size, awareness about minimum support price, access to public procurement, type of land holdings, access to bank account, access to crop insurance, and age group of farmers as determinants of input use in the farming process. To have a broader and more consistent analysis, rice cultivation is taken as a case study. The paper draws its conclusion based on NSSO 77th round unit level data by using OLS regression to show that the socio-economic profile influences input use in a substantial manner. Without considering such differentiation across farmers, no policies or programmes targeting input use would be fully effective in the Indian context.

Keywords: Input use, castes, class, exclusion, discrimination

JEL codes: Q12, Q13, Q14

I

INTRODUCTION:

Rice has been the most crucial crop in India in terms of gross cropped areas and the number of farmers dependent on it. As per data from the Directorate of Economics and Statistics, this crop alone constitutes nearly 23 per cent of the gross cropped areas of the country. While India ranked first in terms of total gross cropped areas under rice cultivation, in terms of productivity, its rank remains lower than that of leading rice-producing countries such as China, Indonesia, and Japan but also lower than that of its neighbour Bangladesh. One of the most critical factors explaining low productivity has been the lack of infrastructure supporting high-yield rice cultivation and the low level of input use, indicating large proportions of farmers' reliance on traditional cultivation methods. While there has hardly been any doubt about the positive relationship between quantity and quality of input use (Adams & Bumb, 1979) and crop yield, the persistent gap between the desired and actual level of input use becomes a paramount concern (Thakur, 2024). Though many studies have highlighted the issue of low and inadequate input use as one of the main factors responsible for low productivity growth

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in Indian agriculture, there has not been enough discussion on factors responsible for differential input use across farmers.

Input Selection and Socio-Economic Status of Farmers- Possible Linkage

At a high level of generality, major determinants of input use in the farming process can be explained through *firstly*, awareness and knowledge about the desired input use; *secondly*, access to adequate input in both quantity and quality; and *thirdly*, the affordability of farmers enabling them to spend adequately on the desired input for the maximisation of yield and production. While public provisioning of input and associated awareness about the optimal use has been instrumental, the access to input and awareness regarding their optimal use is primarily a function of the socio-economic conditions of the farmer. There are three broad channels through which the socio-economic conditions of farmers affect input selection. *Firstly*, farmers with small land holdings and a lack of irrigated land primarily lack sufficient surplus from their farming. Thus, they spend less on physical input. A rich literature debating the relationship between farm size and productivity is based mainly on input use dynamics. It was advocated that small farms are primarily family farms, and they not only use higher labour per unit of land in the cultivation process but also substitute a sizable part of capital input with labour input, thus producing more as compared to larger farms using hired labour (Sen, 1962). However, it is also argued that cropping intensity is higher in small farms, and both labour and capital input are used more efficiently in small farms compared to large farms (Bardhan, 1973; Chand et al., 2011).

Nevertheless, intensive cultivation, particularly for small and marginal farmers, largely depends on the availability of resources, which in turn is a function of farm income. In this context, the role of public provisioning in terms of availability of cheap credit, public procurement of farm produce at a reasonable price, access to low-cost irrigation facilities, etc., are of immense importance. While cheap institutional credit helps resource constraints farmers to optimise the input used for better yield (Abedin et al., 2019), public procurement at a reasonable price provides farmers with enough surplus to invest in the cultivation process(Gupta, 1980). Access to irrigation facilities helps farmers adopt a high-yielding variety of seeds, increases surplus, and remains instrumental in providing incentives for intensive cultivation (Narayanamoorthy et al., 2023). However, public provisioning is essential to bridge the gap between potential and actual input use, particularly for resource-constrained small and marginal farmers. The *second* channel through which socio-economic status affects input use is primarily due to the lack of such inclusivity in public provisions. Public procurement in India across states has been biased against small and marginal farmers (Thakur, 2023). Access to institutional credit has shown a clear bias against small and marginal farmers during the post-reform period (Chavan Pallavi & Ramakumar, 2022). Some factors, such as access to formal banking, institutional credit, crop insurance, and related factors, affect the liquidity status of farmers at the time of cultivation, which in turn are instrumental in the selection of input and their timely use in the production process (Abedin et al., 2019).

Further, rural societies in India are characterised by rigid caste division-induced deprivation, both on the social and economic front. A long history of caste base based exclusion in social relations often leads to other types of socio-economic deprivation (Sen, 2000). Caste-based social exclusion and discrimination lead to deprivation in terms of access to quality land, ingestible resources, basic education, formal credit, and access to basic public provisioning, which in turn limits farmers' ability to optimally use input in the farming process (Prasad 2015; Rao, 2017; Thorat & Newman, 2007). Further, the ownership of forces of production, such as pump sets, tractors, electricity connections, etc., is historically biased against socially deprived castes of farmers (Munshi, 2019; Sahay, 2002). Access to technical advice, training in agricultural operations, and various extension services are instrumental in helping farmers adopt best practices concerning agricultural operations. These are largely exclusionary for socially deprived castes of farmers (Rao, 2017). Thus, caste-based social exclusion leads to economic deprivation and remains instrumental in further exclusion from public provisioning; the role of the market in bridging such a gap has been minimal (Deshpandey, 2011; Thakur, 2023). Thus, social deprivation leads to economic deprivation, reflected in the differential use of input and limited adaption towards productivity-enhancing technology in farming. Further, due to the lack of inclusivity in various public provisioning and the inability of the market to address such discrimination, there has been limited success in bridging such gap across various socio-religious identities of farmers.

In this context, the paper explores to what extent differences in the socio-economic status of a farmer are responsible for differences in input use, particularly in the case of paddy cultivation.

II

DATA AND METHODS-

The paper's analysis is based on the unit-level data of the National Sample Survey (NSS) 77th round dealing with the situation assessment of farmers in India. The survey was held for the year 2018-19. In the paper, all rice farmers are taken into consideration. The sample size of the NSS 77th round for rice cultivators is representative and constitutes a pan-India level distribution of farmers. The paper takes the cost of labour and other physical inputs as separate independent variables. In labour cost, animal and human labour are combined, including hired and imputed costs. The non-labour cost primarily incorporates expenditure on various physical inputs such as seeds, chemical fertiliser, bio-fertiliser, manures, plant protection materials, diesel, electricity, irrigation, minor repair and maintenance of machinery and equipment used in crop production, and cost of hiring machinery and equipment for crop production as recorded in the NSS survey. It excludes interest on loans utilised for crop production (as both institutional and non-institutional loans are taken as separate variables in the models), cost of crop insurance (instead, Fasal Bima is included as an independent variable), lease rent for land used for crop production (ownership holding and tenancy holdings are taken as separate variables), and other costs which are not specified.

Table 1 reflects that not only does input expenditure differ substantially across caste, class, religion, gender, education level, access to KCC, public procurement, organisational membership, irrigated lands, etc., but the pattern of such differences is also not random.

TABLE1: DESCRIPTIVE STATISTICS

(1)	Whether having access to/belonging to (2)	Expenditure on physical input per acre of land in Rs. (3)	Expenditure on labour input per acre of land in Rs. (4)	Ratio of expenditure on physical and labour input (5)
KCC	Yes	10213	6440	1.59
	No	9198	6536	1.41
Non-institutional loans	Yes	11375	7732	1.47
	No	8845	6208	1.43
Regulated market (WREG)	Yes	9932	6383	1.56
	No	9302	6535	1.42
Irrigated land	Yes	10542	6558	1.61
	No	5814	6408	0.91
Farmer's Organisation	Yes	10246	7739	1.32
(WORG)	No	9328	6472	1.44
Ownership of land (WOWN)	Yes	9282	6339	1.46
	No	9635	7042	1.37
Agricultural Training	Yes	8354	6776	1.23
(Wtraing)	No	9377	6517	1.44
Aware about MSP	Yes	9706	7062	1.48
	No	9118	6161	1.37
Having Bank account	Yes	9411	6553	1.43
	No	7342	5134	1.44
Having crop insurance	Yes	10793	7399	1.46
	No	9275	6466	1.43
Organisational Membership	Yes	10246	7739	1.32
	No	9328	6472	1.44
Caste Groups	ST	6246	5605	1.11
	SC	9592	6412	1.50
	OBC	9568	6250	1.53
	Other	10532	7612	1.38
Education	Illiterate	9515	6341	1.50
	Primary	9254	6338	1.35
	High secondary	9322	6172	1.51
	High	9297	6499	1.43
Age groups	Young	9267	6305	1.47
	Middle	9415	6674	1.41
	Old	9340	6363	1.47
Gender	Male	9412	6551	1.43
	Female	8879	6215	1.44
Land size	Area_1	11056	7660	1.44
	Area_2	7409	5396	1.37
	Area_4	6768	5700	1.19
	Area_10	7757	4716	1.64
	Area_10A	7788	4528	1.72
Land Holding	Individual	9004	6775	1.44
	Joint	9387	6511	1.38
	Ownership	9282	6339	1.46
	tenant	9634	7042	1.37

The Models Description

A simple OLS is run to explore the determinants of physical and labour input and the relationship between them; the details are in Table 2. Many studies confirm that the extent of agricultural input use depends on a farmer's socio-economic profile. Thus, a set of variables reflecting farmers' social and economic status is also included in the models.

TABLE 2: MODELS EXPLAINING THE FACTORS AFFECTING INPUT USE IN PADDY CULTIVATION.

(1)	Model 1 (dependent variable -Log (Non-labour/capital Expenditure per acre of land) (2)	Model 2 (dependent variable -Log (Labour Expenditure per acre of land) (3)
log_lpa	0.435*** (0.011)	
log_kpa		0.632*** (0.015)
Wirrigtd	0.589*** (0.020)	-0.406*** (0.022)
Area_2	-0.229*** (0.017)	-0.117*** (0.022)
Area_4	-0.272*** (0.020)	-0.218*** (0.024)
Area_10	-0.233*** (0.027)	-0.310*** (0.034)
Area_10A	-0.405*** (0.072)	-0.373*** (0.116)
WST	-0.216*** (0.029)	-0.055 (0.038)
WSC	-0.043* (0.023)	-0.124*** (0.029)
WOBC	-0.005 (0.017)	-0.136*** (0.022)
Middle_A	-0.016 (0.017)	0.049*** (0.021)
Old_A	0.009 (0.022)	0.050** (0.027)
Wmale	0.017 (0.029)	0.054 (0.033)
WMSP_AW	0.029** (0.015)	0.130*** (0.018)
WREG	0.137*** (0.021)	-0.031 (0.029)
WBAC	0.152** (0.073)	0.079 (0.080)
WKCC	0.095*** (0.019)	-0.079*** (0.024)
WFBIMA	0.018 (0.027)	0.114*** (0.040)
Wnoninsti	0.142*** (0.016)	0.092*** (0.020)
WORG	0.061* (0.031)	0.077 (0.049)
Wuptoprim	-0.049** (0.017)	0.075*** (0.021)
Wuptohsec	0.0001 (0.021)	-0.019 (0.028)
Whigh	0.004 (0.026)	0.046 (0.036)
Wtraing	-0.185*** (0.061)	0.181*** (0.061)
Windi	-0.01 (0.035)	-0.052 (0.042)
Wown	-0.002 (0.016)	-0.082*** (0.020)
HHsize	0.006* (0.003)	-0.022*** (0.004)
Constant	4.698*** (0.143)	3.268*** (0.170)
R^2	0.4938	0.3765
Adjusted R^2	0.4931	0.3756
RSE	24.35 on 19538 DF	29.34 on 19538 DF
F Statistic	635.4***	393.3***

The model estimates two separate relationships

$$Log(lpa) = b1*Log(kpa) + \sum biSi + ei$$
$$Log(kpa) = b2 * Log(lpa) + \sum bjSj + ej$$

Where lpa is the labour cost per acre of land, kpa is the non-labour cost per acre of land, S is the various socio-economic indicators listed below, and e is the error term.

The details of binary socio-economic variables (S) included in the study are as follows – whether the land is irrigated (Wirrigtd), castes of a farmer - scheduled castes (WSC), scheduled Tribes (WST), Other Backward castes(WOBC) and Others, class of the farmers- possession of up to one acre of land (Area_1), possession of land between 1 and 2 acres (Area_2), possession of 2 to 4 acres of land (Area_4), possession of 4 to 10 acres of lands (Area_10), and possession of more than 10 acres of land (Area_10A), educational status-illiterate, primary (Wuptoprim), higher secondary (Wuptohsec) and higher education (Whigh), awareness about Minimum Support Price (WMSP_AW), whether received any agricultural training (Wtraing), factors instrumental in enhancing access to finance -bank account (WBAC), crop insurance WFBIMA), Kisan Credit Card (WKCC), and loans from non-institutional sources-(Wnoninsti), age groups- young, middle-aged (Middle_A), and old-aged (Old_A), gender -male (Wmale) or female head of the family, type of land - ownership (Wown) or under tenancy and joint or individual (Windi) ownership of land, whether a farmer is selling their produce to the regulated market (WREG), and whether a farmer is member of any farmer's organisation (WORG). The continuous variable, the size of the households (HHsize), was included in the model to understand the relationship between the socio-economic status of any farmer and input expenditure.

III

DISCUSSION

Model 1 and Model 2 confirm that labour and capital costs in determining productivity have been complementary. Higher expenditure on capital inputs is associated with higher spending on labour and vice versa. It indicates low factor substitutability between labour and capital use in production. However, in the case of irrigated land, the models show a sharp fall in the per acre labour expenditure (by nearly 42 per cent) and more than the commensurate rise in the per acre expenditure on capital costs (by roughly 63 per cent). So, the cultivation becomes capital intensive with the shifting from non-irrigated to irrigated land. This is intuitive as cultivating the High Yeilding Variety (HYV) will likely be carried out only on irrigated land. Such cultivation requires much higher use of physical input, such as fertiliser, manures, irrigation, etc., in the cultivation process. Nevertheless, a sharp fall in labour input indicates a higher use of labour displacing technology in the production process on irrigated land.

As far as the land size is concerned, excluding the land size between four to ten acres, falling per acre expenditure on capital is observed with the size of the holdings. In contrast to the capital, the trend regarding labour expenditure per acre of land is clear. There is a secular decline in the spending on labour input as the size of the farm increases, except for the smallest size of the farms (up to one acre of land). Thus, to some extent, a lowering of the average total cost per acre of land is observed with the rise in the size of the holdings.

The pattern of both input expenditures differs across different age categories of farmers. Young farmers (up to 40 years old) spend more on labour input than their older counterparts. This seems intuitive as access to credit or farm machinery or the effort required to cultivate HYV seeds makes relatively young farmers more suitable. Gender appears to have no significant impact on the status of input use. Further, awareness about MSP seems to positively impact both capital and labour used in production. Such effect might be because those who are aware of the MSP are, in general, more aware of the role of the input in the production process and partly because those who are aware of MSP are likely to sell their produce in the regulated market and to get relatively higher prices (Thakur, 2023) for their produce and therefore could be having access to more capital for investment. Such a trend is further substantiated by the fact that those farmers selling in the regulated market are spending much more on capital input and relatively less on labour input. Thus, getting a higher price for the product is likely to increase capital intensity in the production process.

Similarly, access to finance is also instrumental in increasing capital use compared to the use of labour. While having a bank account increases the expenditure on capital with no significant impact on labour use, access to KCC instead affects capital expenditure positively and labour expenditure negatively. Thus, having access to KCC significantly makes farming capital-intensive. Having access to crop insurance (*Fasal Bima)* affects expenditure on labour positively, while spending on capital remains largely unaffected. Since crop insurance does not increase liquidity (instead, payment is made against it) and it is expected that general awareness of the farmers taking crop insurance is higher, they primarily rely on putting higher labour in the production process to increase productivity. The role of non-institutional finance is complex in determining farmers' input level. It has two different effects on a farmer's liquidity status. In general, it provides farmers with some liquidity at the time of cultivation and, therefore, overcomes some financial constraints concerning short-term capital investment.

On the other hand, since the rate of interest on such loans is very high, it is unlikely to promote any long-term change regarding the adoption of modern techniques in agriculture. Therefore, the capital-labour ratio in the production process is not likely to change by much. However, a higher financial burden might cause farmers to optimise production and yield in the cultivation process. Thus, non-institutional loans increase labour and capital expenditure in the cultivation process. Membership in farmer's organisations shows a positive and significant relationship with capital cost

per acre of land, while it remains insignificant for labour input cost. The coefficient indicates that the farmer's organisation will likely make farmers more aware of input combinations or help them get higher quality input (at a higher price).

Education and training in agriculture positively influence labour use in the cultivation process. Farmers up to the primary and higher levels of education are spending more labour input than illiterate farmers. Surprisingly, however, farmers with higher secondary education do not show any significant difference in input use in agriculture compared to illiterate farmers. Farmers with agricultural training tended to spend more on labour input while spending less on capital input than those who did not receive any training in agriculture. This is likely because agricultural training in India does not guarantee access to institutional credit or other direct benefits helpful in agricultural operations. It is possible that given the limited incremental access to capital, those who are receiving some sort of training find increased labour expenditure as only the source of enhancing yield.

The type of holding has a minimal impact on the pattern of input use in the cultivation. While individual or joint ownership of land does not change the input use pattern significantly, the ownership holding role against the tenancy holdings shows some differential patterns. While the expenditure on capital input witnesses no significant differentiation across owned and land under tenancy, the spending on labour is significantly lower in the case of ownership holdings as compared to cultivation under the tenancy. It is, in fact, intuitive as the tenant farmers are required to pay rent on the land, and in all possibilities, their capacity to use more capital input is limited; they are likely to use more labour in the production process to optimise the net output or net revenue from their produce (excluding rented share of the output or value). Surprisingly, larger family sizes lead to higher use of capital expenditure and lower use of expenditure on labour. However, one expects that higher availability of labour might lead to higher use in production (as the NSS also includes imputed labour by family members). There might be a couple of explanations for such a pattern. *Firstly*, not all types of labour use can have imputed values. Some labour efforts might be in parts and not recorded by family members. So, they may substitute labour use with unrecorded family effort in the production process. *Secondly*, larger family size might, in many cases, lead to higher diversification of activity. Therefore, relatively few family members are available for cultivation in the same light. These households might be placed better in spending on capital input. In any case, any more profound analysis of reasons explaining such trends is beyond the range of NSS data.

Thus, physical and labour input plays a crucial role in determining productivity. However, the choice of input use in the Indian context is also significantly influenced by social conditions and economic capacity. So, any policy and programmes targeting the optimisation of input use cannot be fully effective unless the influence of the socio-economic status of farmers is taken into account.

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