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Adoption of fertilizer technology for rice cultivation in Kalahandi District, Odisha

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Abstract The management of nutrients presents a significant challenge for farmers and is a matter of concern for environmentalists. The key issue doesn't lie in innovation but in the diffusion of technology among agricultural practitioners. Developed by international fertilizer development corporations, Urea Deep Placement (UDP) technology represents an innovative approach to rice cultivation. Its primary objective is to address the issue of nitrogen loss and enhance the utilization efficiency of urea. UDP modifies the method and placement of urea to optimize its effectiveness and minimize environmental impacts. This study employs a two-stage treatment effect model to investigate the following questions: which are the aspects that influence the adoption of UDP technology in rice cultivation? and how does the implementation of this technology impact rice yield? Critical factors influencing adoption include land tenure, gender, extension services, non-agricultural income, affiliation with farming groups and participation in training, guaranteed risk mitigation, and access to irrigation. Furthermore, farm size and the adoption of UDP significantly affect rice production. Beyond the economic advantages of adopting this technology, it also generates job opportunities in the manufacture of urea briquettes and their application. The use of urea briquettes curtails chemical runoff and water pollution. The embrace of UDP technology has concurrently spurred farmers to adopt mechanization and improve water management and distribution in rice fields.

Keywords: agriculture, nitrogen, technology, paddy, urea deep placement

1. Introduction

In global agriculture, rice production holds significant importance, with the majority of rice production occurring in Asia (Kencana et al., 2021). The largest rice-producing countries in Asia are India and China, and rice constitutes the main staple food for approximately half of the world's population (Pandit et al., 2023). It is cultivated over vast areas due to its crucial nutritional value, as it contains essential components vital to the human body such as vitamins and carbohydrates. Despite India's high rice productivity, there are several challenges that continue to be explored for innovative solutions to enhance productivity (Parida et al., 2021).

India ranks as the second-largest rice producer in the world and plays a crucial role in both the agricultural and economic landscapes (Janaiah et al., 2020). It serves as a primary food source for a large segment of the rural population (Laitonjam et al., 2018), particularly in the eastern, northeastern, and southern states (Janaiah et al., 2020). The mechanisms employed to sustain its productivity vary depending on different agricultural practices (Shrine & Umadevi, 2020).

The application of fertilizers in agricultural practices presents a multifaceted predicament, entailing significant ecological and human health ramifications. Researchers, such as Mohankumar et al. have conducted a comprehensive analysis of the excessive utilization of synthetic fertilizers among rice farmers in Tamil Nadu, shedding light on its adverse effects on the environment and human well-being. Furthermore, Mykhailova et al. (2021) have emphasized the imperative of responsible management and prudent utilization of both organic and inorganic fertilizers to mitigate their detrimental ecological and health implications. In a global perspective, Isherwood (1996) has elucidated the escalating fertilizer consumption in developing nations, underscoring the urgent need for the adoption of sustainable agricultural practices. Correspondingly, Umesha (2017) has underscored the significance of enhancing fertilizer efficiency and minimizing environmental impacts through the development of innovative and more efficient fertilizer formulations. Collectively, these studies underscore the criticality of judicious fertilizer use to ensure sustainable agricultural systems.

Within the Indian context, the excessive use of nitrogen-based fertilizers has engendered formidable environmental challenges. However, potential solutions exist to enhance nitrogen utilization efficiency, including the integration of legumes

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in crop rotations, the utilization of leaf color sensing techniques, and the exploration of disruptive technologies (Móring et al., 2021). Moreover, researchers, such as Sharma et al. (2021), have conducted in-depth investigations into the long-term effects of incorporating rice straw and nitrogen fertilizer application on soil health and crop productivity. Additionally, imbalanced fertilizer usage, particularly the unwarranted overapplication of nitrogen, has resulted in a plethora of issues, ranging from soil degradation to compromised fertilizer efficacy (Sahu et al., 2020). It is evident that the adoption of sustainable fertilizer practices and the optimization of their utilization is paramount to mitigate environmental risks and ensure long-term agricultural sustainability.

Aiming to enhance the safe utilization of nitrogen fertilizers, a range of technological innovations has been proposed. Tiwari et al. (2022) put forward the utilization of nano fertilizers as a means to enhance nutrient utilization efficiency and mitigate environmental pollution and Okegbade et al. (2021) recommended the nitrogen application, highlighting a specific strategy for optimizing crop yield while minimizing environmental impact. Exploring precision agriculture techniques, including GPS tools and N-sensing devices, Lekomtsev and Komarov (2023) investigate their potential for improving nitrogen fertilizer utilization and preserving soil fertility. Miron et al. (2022) focus on the safe application of nitrogen-based chemical fertilizers, presenting a method for evaluating their explosive characteristics. Lastly, Devianti et al. (2022) propose the application of near-infrared spectroscopy as a rapid and effective technique for determining nitrogen content in organic fertilizers, potentially reducing the need for chemical inputs and Rajurkar (2021) has also stated Biofertilizers prevent soil degradation, enhance production, and save costs. Together, these innovations offer promising approaches to enhance the safe utilization of nitrogen fertilizers in agricultural practices (Mishra et al., 2024).

Research findings indicate significant benefits associated with the deep placement of urea [DPU] concerning nitrogen loss reduction and improved nitrogen extraction from fertilizers in rice fields (Yao et al., 2018). Moreover, the effectiveness of DPU has been observed in reducing ammonia (NH3) loss and increasing nitrogen use efficiency in intensive rice cultivation systems. Additionally, the implementation of DPU has been linked to the reduction of greenhouse gas emissions, particularly methane (CH4) and nitrous oxide (N2O), in rice production systems (Yao et al., 2018).

In light of the challenges posed by excessive and inefficient nitrogenous fertilizer usage, as well as the subsequent limitations on yield potential, it becomes imperative to explore agricultural practices that can simultaneously enhance economic viability and environmental sustainability in rice production. Consequently, this research embarks on an exploration of two pivotal research questions: which are the aspects that influence the adoption of UDP technology in rice cultivation? and how does the implementation of this technology impact rice yield? By delving into these research inquiries, this study endeavors to unravel novel insights that can foster the widespread implementation of UDP, revolutionizing the landscape of rice farming practices while addressing the challenges of nitrogen management and productivity enhancement.

The International Fertilizer Development Center (IFDC) has innovated the Urea Deep Placement (UDP) technique in collaboration with rice farmers in Bangladesh, aiming to enhance nitrogen application efficiency and rice productivity. This method involves compressing prilled urea into briquettes, which are then transformed into urea super granules. These granules are strategically placed beneath the soil surface, positioned equidistantly among four plants with a spacing of 20cm x 20cm. The application of UDP is timed within 7 to 10 days post-transplantation and is carried out either manually or mechanically. Notably, UDP requires only a single application for the entire crop cycle. Research indicates that UDP adoption has led to substantial improvements in various regions, including Bangladesh and Africa, where yields have increased by 20 to 30%, nitrogen use efficiency has risen by 40%, and the cost of urea has been offset by labor costs (Tarfa & Kiger, 2013).

While there have been studies on farmers' decision-making regarding the adoption of such technologies and their effect on production in certain countries in Africa, there is a lack of comprehensive literature addressing these issues within India's rainfed areas, particularly among marginal and small-scale farmers. This gap includes understanding the technology's adoption, its effects on crop production, and farmers' perceptions of the environmental impacts. This study aims to empirically investigate the factors that influence farmers' decisions to adopt UDP in agriculture and to determine the effects of UDP on rice production.

Considering the aforementioned background, this article aims to address the following two key objectives: which are the aspects that influence the adoption of UDP technology in rice cultivation? and how does the implementation of this technology impact rice yield?

2. Research Method

2.1. Context

Kalahandi, situated in the southwestern part of Odisha, is considered one of the most underdeveloped districts in the state. Covering an area of 7920 sq. km, which accounts for approximately 7.56 percent of the state's total area, it ranks seventh in size among the thirty districts in Odisha. This district lies between latitudes 19°8'N to 20°25'N and longitudes 82°32'E to 83°47'E (Figure 1) (Behuria, 2018).

When reviewing the data of the Agriculture Directorate in Odisha for the 2018-19 season, it was revealed that the cultivated area of rice in Kalahandi district reached 378,000 hectares, while in the autumn season, it reached 172 hectares.

This means that the area planted with rice amounted to 49.84% of the total cultivated area of crops (Agricultural statistics, 2019). This confirms the economic and social importance of rice in the studied region, where it provides job opportunities for residents and ensures income for farmers.

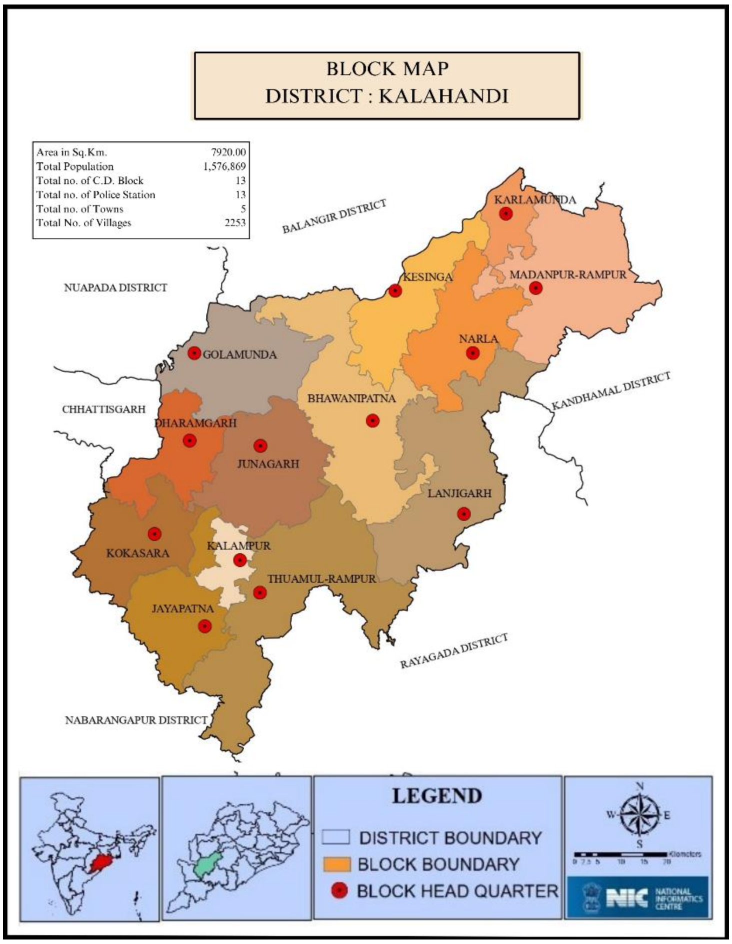

Figure 1 Study Area (Block Map of Kalahandi District).

2.2. Sampling

After consulting with 5 agricultural experts from the Department of Agriculture in Odisha, and 3 academicians with agricultural interests in the Odisha region. A purposive sampling technique was employed to selectively identify villages with significant catchment areas falling under the right canal of the Indravati irrigation project. This particular canal serves a crucial role in facilitating bi-seasonal irrigation for crop cultivation. Subsequently, to ensure a representative sample, a stratified sampling technique was employed. This method aimed to ensure a proportional inclusion of two distinct groups of farmers, namely adopters and non-adopters of the technology under investigation, within the sampled villages. This approach was designed to capture the inherent diversity among farmers prevalent in the study area. A total of 162 farmers were ultimately selected for participation in the study. These farmers were divided into two categories, with 85 identified as adopters of the UDP methodology of rice fertilization and 77 as non-adopters. The selection process was carried out using a simple random sampling method. Originally, the plan was to collect data from 90 farmers in each category. However, due to incomplete data obtained from 5 adopter interviews and 8 non-adopter interviews, the final analysis was conducted on a reduced sample of 85 adopters and 77 non-adopters. Primary data collection was conducted through structured individual interviews with the participating farmers, ensuring a rigorous and systematic approach to gathering pertinent information for the study.

2.3. Framework

The study used a treatment-effect model to conduct a two-stage analysis. The first step was to uncover significant characteristics that influence rice farmers' acceptance of urea deep placement (UDP) technology. The second stage sought to assess the effect of UDP on rice yield for adopters of the UDP methodology of rice fertilization. The variables studied were the farmer's gender, age, cultivation experience, land ownership, off-farm income, frequency of extension services received, agricultural credit amount, membership in farming associations or cooperatives, training frequency, farm size, labor force number, synthetic chemical usage, raw urea quantity, seed quantity, UDP adoption status, and rice output in quintals per acre.

These independent variables were considered potential influences on the farmer's decision to use UDP and the subsequent rice production yield.

To address selectivity bias, the Heckman two-stage method was applied within the treatment effect model framework (Azumah, 2017; Azumah, 2017). This model is widely used for program evaluation. The study's objective was to assess the effect of UDP on rice yield and to measure the actual impact of technology adoption while correcting for selectivity bias. Initially, the model estimates a selection equation to obtain predicted values for UDP adoption. These predicted values are then utilized to calculate the lambda value or IMR (Inverse Mills Ratio). In the second stage, the lambda value and the predicted values of the selected variables are incorporated to derive an additional variable for analysis.

$$Y = X_i'\beta + \delta A_i + u_{1i} \quad \text{(I)}$$

In the specified equation, Y represents the output of rice, Xi' signifies the exogenous variables that influence rice output, and Ai denotes the adoption of UDP technology, with a value of 1 indicating adoption and 0 indicating non-. The term ui represents the double-sided error with a normal distribution $N(0,)$. The parameters β and δ are to be estimated. As suggested by Maddala (1983), since Ai is an endogenous variable, it may not yield accurate results. Consequently, the selection equation Ai is estimated as follows:

$$A_i^* = Z_i'\gamma + u_{2i} \quad \text{(II)}$$

The selection variable, Cap(V), is influenced by exogenous variables denoted as 〖Zis〗 _i^'. The parameter to be estimated is represented by γ, and the double-sided error term u_2 follows a normal distribution N (0,σ_v^2). Accurate estimation of the functional equation necessitates prior estimation of the selection equation. This is because the decision to adopt new technology can be influenced by unobservable variables, such as innovations in rice production, which may also impact production outcomes. This correlation between the substantive equations and selection equations implies that estimates of the parameter β and other relevant variables may be biased if this correlation is not taken into account during estimation. Therefore, it is crucial to consider the interplay between the substantive and selection equations to obtain unbiased estimates and ensure a comprehensive analysis of the relationship between the variables under investigation.

$$\begin{bmatrix} u_{1i} \\ u_{2i} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & \sigma^2 \end{bmatrix}\right)$$

Urea deep placement adopted farmers' expected output is given as:

$$E[X_i, C_i = 1] = Z_i\beta + \delta + E[u_{2i}, C_i = 1] = Z_i\beta + \delta + \rho\sigma\lambda_i$$

Where

$$\lambda_i = \frac{\emptyset(-Z_i'\gamma)}{1-\phi(Z_i'\gamma)} \text{is the inverse mill ratio (IMR) (V)}$$

The equation (IV) implies that not incorporating the Inverse Mills Ratio (IMR) while estimating the selection equation (II) leads to biased coefficients β and δ. To achieve unbiased estimation, it is crucial to consider both adopters and non-adopters in the analysis. The formulation of the outcome equation (I) is as follows:

$$Y_i = \beta^i(\emptyset_i X_i) + \delta^i(\emptyset_i C_i) + \sigma\emptyset_i + e_{2i}$$

Where

$$\emptyset_i \equiv \emptyset(Z_i'\gamma)$$

Utilizing the aforementioned equations, empirical models were constructed and estimated to determine the outcomes pertinent to the research objectives delineated in the study.

$$Adaption = \delta_0 + \delta_1 GE + \delta_2 AE + \delta_3 LO + \delta_4 OFF + \delta_5 EXS + \delta_6 FGM + \delta_7 BC + \delta_8\, TA + \delta_9 AG + \delta_{10} RC + \delta_{11}\text{IRR} + u_2$$
$$Output\ (rice) = \beta_0 + \beta_1 FS + \beta_2 NOL + \beta_3\, WC + \beta_4 UP + \beta_5\, SD + \beta_6 UDP + u_1$$

3. Results and Discussions

The estimation process for the model involved two stages. In the initial stage, the focus was on examining the adoption of UDP technology (Table 1) among rice farmers as the dependent variable. The results, presented in Table 2, revealed a highly significant likelihood ratio test value of 64.51 at a significance level of 0.01. This finding supports the acceptance of the alternative hypothesis, indicating a correlation between the error associated with the outcome and the error associated with the treatment. Among the influential factors that significantly affected rice farmers' decision to adopt UDP technology (Table

1), several variables stood out. Notably, land ownership, access to extension services, off-farm income, the gender of the farmer, membership in farmer groups, and participation in training programs emerged as influential ones.

Table 1 Explanations regarding the variables employed.

Variables	Explanations of the variables and expected sign	Symbol
The farmer's gender	1= male, 0 =female expected sign is positive.	GE
The farmer's age	by years expected sign is positive.	AG
Agricultural expertise gained by farmers.	refers to the knowledge, skills, and experience that farmers acquire through practical involvement in agricultural practices. expected sign is positive.	AE
Land ownership	refers to the legal right, control and cultivate a farmer or entity possesses over a specific piece of land. expected sign is positive.	LO
Off-farm income	Income earned outside of agriculture or farming activities. expected sign is positive.	OFF
Extension services	refer to the additional support and assistance provided to farmers or organizations beyond their initial requirements or expectations. expected sign is positive.	EXS
Bank credit	refers to a specialized type of loan or credit facility provided by banks specifically designed to meet the financial needs of farmers and individuals engaged in agricultural activities (in Rs) expected sign is positive.	BC
Farmer group membership	refers to the participation or affiliation of farmers with a specific collective or association, taken to adopt the new technology. expected sign is positive.	FGM
Training attendance	Did the person participate in a training session focused on UDP technology? expected sign is positive.	TA
Farm size	Total farm size under irrigation (in acreage) expected sign is positive.	FS
No. of Labors	Total farm hand involved in cultivation expected sign is positive.	NOL
Weedicides	Refers to chemical substances formulated which are used to control or eliminate unwanted plants, commonly referred to as weeds (liter per acre) the expected sign is positive.	WC
Urea (Prilled)	Farmer may used (kg) the expected sign is positive or negative	UP
Seeds	Seeds used (kg) the expected sign is positive or negative	SD
Urea deep placement technology	Technology for the effective application of urea in the soil's deeper layers expected sign is positive.	UDP
Output of paddy	refers to the quantity of rice that is harvested from paddy fields or rice paddies. the expected sign is positive.	OP
Risk coverage	refers to various insurance and financial products designed to protect farmers against unforeseen events that may negatively impact their agricultural operations or income the expected sign is positive or negative	RC
Irrigation	refers to the process of supplying water to agricultural lands to support the growth of crops the expected sign is positive or negative	IRR

Table 2 Factors influencing the acceptance and implementation of Urea Deep Placement Technology by drivers.

Variables	Coefficient	Marginal effect	Standard Error	z	P>|z|	[95%Conf.	Interval.]
GE	0.6623	0.6320**	0.6462	1.02	0.017	1.9289	0.6042
AE	-0.0016	-0.0034	0.0236	0.07	0.944	-0.0480	0.0447
LO	1.2525	0.5762***	0.2868	4.37	0.000	0.6903	1.8148
EXT	-0.5671	-0.4321**	0.2855	1.99	0.047	-0.0074	1.1268
OFF	0.2415	0.2138***	0.1604	1.48	0.001	-0.1586	0.4703
BC	0.1214	0.0021	0.0086	1.41	0.158	-0.0047	0.0290
FGM	0.0211	0.0041	0.1322	1.31	0.512	0.5946	1.7643
TA	0.8693	0.673***	0.2891	3.01	0.003	0.30252	1.4361
AG	-0.0120	-0.0044	0.0148	-0.81	0.416	-0.0411	0.0170
RC	0.8818	0.0123	0.5698	1.55	0.122	-0.2350	1.9987
IRR	0.7990	0.5712***	0.3744	2.13	0.033	0.0650	1.5330
Cons	-2.711***		0.9871	-2.82	0.005	-4.5111	-0.7471

Observation count =162

significant at 0.05, and * significant at 0.01, Pseudo R2=0.612, Prob> chi2=0.0000, LR chi2(9) =154.144, , Log likelihood = 64.51.

3.1. Key factors influencing the adoption of UDP technology

The analysis revealed that land ownership was a significant factor at the 0.01 level, indicating that farmers owning their land were more likely to adopt Urea Deep Placement (UDP) technology, with a marginal effect of 0.576, compared to those farming on leased land. Landowners can invest in land improvements, whereas lessees may hesitate due to the uncertainty of tenure. Conversely, Doss & Morris (2018) support the notion that landowners are more inclined to adopt new technologies when investments are enduring.

Gender emerged as another noteworthy variable at the significance level of 0.05, wherein female farmers displayed a lesser propensity to embrace technology as compared to their male counterparts. This incongruity can be attributed to the prevailing socio-cultural milieu in India, wherein land ownership rights predominantly lie with males (Das and Mahanta, 2023). Despite the significant contributions of females in production and post-production processes, decision-making power remains predominantly concentrated in the hands of males. This observation aligns with the findings of Abdul (2014), which revealed that male farmers are more proactive in the adoption of water and soil conservation technologies due to their access to physical strength and resources.

The existence of supplementary sources of income proved to be significant at the level of 0.01, indicating that farmers with additional income sources display a greater inclination towards investing in novel technologies. The financial capability augments the propensity to invest (Abdul, 2014; Jena et al., 2021), albeit with certain ramifications.

The impact of extension services was found to be minimal, with a value of 0.43. This indicates that farmers who receive regular extension services are more inclined to adopt new technologies. Extension providers play a crucial role in offering technical expertise. Although the usage of UDP technology was relatively new in the context of the study, previous research conducted by (Donkoh, 2011; Doss & Morris, 2018), and Ransom et al (2003) has demonstrated the positive and significant effects of extension services. These studies highlight the importance of timely and accurate information dissemination to farmers.

Membership in farmer groups was observed to have a positive but non-significant influence on the adoption of UDP technology. Group dynamics often facilitate the adoption of new technologies, inputs, and materials, as they provide economic benefits and shared risk among members.

Training and exposure visits were highly significant at the 0.01 level, with a marginal effect of 0.673 for farmers who attended training. Given the novelty of the technology, training is essential for its effective and efficient application. Studies by Adesina & Baidu-Forson (1995) and Borges et al. (2015) found that training participation enhances farmers' knowledge, skills, and attitudes, thereby positively influencing their adoption decisions.

Lastly, risk coverage and the availability of irrigation facilities were identified as significant drivers for the adoption of UDP in agricultural practices, as indicated in Table 2. These factors contribute to the farmers' willingness to implement UDP, recognizing the economic and environmental benefits it offers.

3.2. UDP technology and paddy output

The analysis, in this section, proceeds to the second stage of the model, where the focus shifts. Table 2 presents the results, revealing a highly significant Wald test at the 0.01 level. This substantial result indicates a notable correlation between the error associated with the outcome and the error associated with the treatment. The findings suggest that the observed increase in rice output is relatively smaller compared to the unobserved adoption of technology, resulting in an estimated correlation coefficient of -0.0741 between the error in the outcome and the error in the treatment. This correlation signifies a relationship between the unobserved factors influencing technology adoption and the observed rice output (Table 3).

Table 3 shows that, at a significance level of 0.01, the study identifies farm size as a statistically positive variable, displaying a positive relationship with rice output. The findings indicate that a 100% increase in farm size leads to an approximate 61% increase in rice output. This result suggests that larger farms tend to achieve higher yields in rice production. The positive correlation between farm size and rice output can be attributed to several factors, including the farmers' improved knowledge acquired through training programs and extension services, as well as the benefits derived from economies of scale. Previous studies conducted by Mohanty et al. (1998), Nwaobiala (2016), and Prakash et al. (2021) align with these findings, illustrating the positive impact of effective nutrient management through the adoption of agricultural technologies on rice yield. This suggests that farmers who implement sound nutrient management practices, facilitated by the adoption of appropriate technologies, are more likely to experience increased rice yields. Interestingly, despite the acknowledged importance of seed usage in determining agricultural output, the study finds it to be statistically insignificant in this particular context. The insignificance of seed usage can be attributed (as the researcher's view) to two primary reasons. Firstly, farmers face limited access to improved seed varieties promptly, which hinders their ability to utilize high-quality seeds. Secondly, the poor germination rate of certified seeds distributed by the government further diminishes their effectiveness. Consequently, farmers often resort to using saved seeds from previous harvests or purchasing improved seeds from private vendors as alternatives.

Table 3 Factors influencing the paddy production.

Factors	Coefficient	Standard Error	*P*>|z|
FS	0.6142***	0.0541	0
NOL	0.0351	0.0475	0.601
WC	0.0754	0.0926	0.213
UP	0.037	0.0818	0.761
SD	0.0213	0.0279	0.131
UDP	0.2371**	0.086	0.012
_cons	2.5110	0.1872	0
Hazard lambda Wald Chi2=196.85, Prob>Ch2=0.0000	-0.0122	0.0731	0.974
Rho	-0.0741		
Sigma	0.5072		

significant at 0.05, * significant at 0.01

The study's findings reveal a significant and positive relationship between the implementation of urea deep placement (UDP) technology and rice output, with a significance level of 0.05. Farmers who embraced this technology witnessed an approximate 23.7% increase in output compared to their non-adopting counterparts, as evidenced by the coefficient value. These results are consistent with the research conducted by Bandaogo et al. 92015) and Mohanty et al. (1998), which similarly highlighted the efficacy of deep placement technology in enhancing nitrogen fertilizer efficiency and driving rice yield growth, particularly in irrigated conditions. The impact of UDP technology on rice production has been observed in studies conducted in Bangladesh, where the utilization of urea briquettes resulted in a significant 15-25% increase in rice yield and a noteworthy 24-32% reduction in commercial fertilizer expenses (Tarfa & Kiger, 2013).

4. Conclusions

This study has successfully identified and analyzed the principal factors that influence farmers' choices to embrace Urea Deep Placement (UDP) technology and has illuminated the notable influence it has on the production of rice. The discoveries emphasize the importance of a variety of elements such as land ownership, supplementary income derived from activities outside of farming, the gender of the farmer, access to services that extend knowledge and resources, membership in farmer groups, educational programs, protection against risks, and availability of irrigation in shaping the adoption trends of UDP technology among farmers. Furthermore, the study has established a robust association between the accessibility of advanced agricultural technologies, including UDP, and the appropriate utilization of inputs by farmers. The statistical analysis has confirmed that the implementation of UDP technology, in conjunction with farm size as a moderating factor, exerts a significant and positive influence on rice yield within the specific context of the study. These findings offer compelling evidence of the potential of UDP technology to enhance agricultural productivity. In addition to its direct impact on rice production.

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Ethical considerations

We confirm that we have correctly followed the ethical policies for this study which includes human subjects, in addition to confirming the consent of all the respondents involved.

Conflict of interest

The authors declare no conflicts of interest.

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