



FACTORS INFLUENCING ADOPTION OF RECOMMENDED RICE PRODUCTION PRACTICES IN TWO SELECTED LOCAL GOVERNMENT AREAS OF KOGI STATE, NIGERIA

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ABSTRACT

The study analysed the factors influencing adoption of recommended rice production practices in two selected L.G.As of Kogi State, Nigeria. A Multistage sampling procedure was used to select 201 respondents. The study relied mainly on primary data which was achieved via a structured questionnaire. Descriptive statistics and inferential statistic were employed to achieve the stated objectives. Results on the socioeconomic and institutional characteristics revealed that, the rice farmers were in their active age with the mean age of 43 years and majority (87.6%) were married. In addition, results on factors influencing the adoption of recommended rice production practices by farmers shows that, sex ($p \leq 0.10$), farm size ($p \leq 0.05$), farming experience ($p \leq 0.10$), and number of visit ($p \leq 0.10$) influence the adoption of recommended rice production practices. Furthermore, high cost of agrochemicals (99%), scarcity of farm machinery (98%) and high cost of inputs (97.5%) were the major constraints faced by rice farmers in the study area. It was recommended that NCRI should endeavour to train rice farmers on how to turn house and farm waste product into manure to augment the use of agrochemical. Also, Rice farmers' cooperatives, government agencies and private enterprises through public-private partnership (PPP) should establish farm machineries leasing services to curtail the constraint on scarcity of machineries.

Keywords: Factors, Influencing, Adoption, Rice, Production, Practice.

INTRODUCTION

Rice (*Oryza sativa* L.) cultivation has been deeply influenced by the progress of human civilization. Asian cultivated rice has spread through migration and trade around the world, since its spread, rice has become a global staple crop important to food security and food cultures around the world. Local varieties of rice have resulted in over 40,000 cultivars of various type. More recent changes in agricultural practices and breeding methods as part of the Green Revolution and other transfers of agricultural technologies has led to increased production in recent decades (Qaim, 2020). Rice farming in Nigeria, is common in the Northern region (Kano, Gombe, Niger, Kebbi, Kogi, Nasarawa, and Zamfara among others). Rice varieties have been introduced within the last twenty years (Kamai *et al.*, 2020). Rice is grown in lowland or on upland fields, depending on a requirements of the particular variety. Recommended rice production practices are set of specified activities and processes designed to intensify rice production for a better yield. Recommended rice production practices was developed and disseminated by National Cereal Research Institute (NCRI) in Kogi State and across Nigeria for over five years through different agricultural programmes (NCRI, 2018). The practices which include: Nursery practices, Transplanting date (21-28 days), Plant spacing (20cm X 20cm), Weeding (2 weeks Days After Transplanting using herbicide



and/hoe), Fertilizer application (4bags of NPK and 2bags of Urea/ha), Method of fertilizer application (Basal), Water requirement (3mm-5mm of water/day), Diseases and pest control (Spray pesticides 30-40 days after transplanting) were best for lowland varieties such as FARO-67 was disseminated using demonstration farms in farming communities at different locations in Kogi State for its adoption (Mahmud, 2023). The adoption of these practices is inevitable because of its potentials in terms of yield. Julia *et al.* (2023), sees adoption as a mental decision process an individual or group encounter in an attempt to make full use of an innovation. In this vein, farmers' decision to integrate an innovation into their routine activities over an extended period of time is necessary for the much needed growth in the rice subsector (Taiwo, 2020).

One way of improving agricultural productivity in rural livelihood is through the introduction of improved agricultural production technologies to farmers. Most importantly, adoption of improved technologies remain the viable means to increase the productivity of small holder farmers thereby fostering economic growth and improved wellbeing for millions of the poor households. The adoption of recommended rice production practices is presumed to lead to increased yield, income and improve level of living of farmers. Therefore, this study attempts to find out the factors influencing the adoption of recommended rice production practices the two selected local government of Kogi State, Nigeria by addressing the following research objectives: (i) describe the socio-economic and institutional characteristics of the respondents in the study area, (ii) determine the factors influencing the adoption of recommended rice production practices and (iii) identify the constraints faced by rice farmers in the adoption of recommended rice production practices. For this study, the following hypothesis was tested, H_{01} : Socio-economic and institutional factors have no significant influence on the adoption of recommended rice production practices in the study area.

MATERIAL AND METHODS

Study Area

The study was carried out in two selected local government area of Kogi State, Nigeria. Kogi State lies on latitude 7° 49' North and longitude 6° 45' East with a geological feature depicting young sedimentary rocks and alluvium along the riverbeds, which promotes agricultural activities and has an average maximum temperature of 33.2°C and average minimum of 22.8°C (Nigerian Meteorological Agency, 2022). The State has two distinct weather; the dry season, which starts from November to February and rainy season that starts from March to October, with annual rainfall that ranges from 1016mm to 1524mm (Sunday and James, 2020). The two selected local government areas (Lokoja and Kogi-Koto Karfe) are in Kogi- West which lies on longitude 5° 30' to 7°15' East and latitude 7°15' to 3°45' North. The Zone has population 662,809 people in 2006 census (NPC, 2006) and a projected population of 910, 334 people (NPC, 2023). Economically, Kogi State is largely an agricultural area consisting of coffee, cashew, ground nut, cocoa, oil palm, rice and yam. Other key industries are crude oil extraction and livestock (cattle, goats and sheep and poultry).

Sampling Technique and Sample Size

Multi-stage sampling procedure was used to select respondents for the study. Kogi State consist of three senatorial district namely: Kogi-West, Kogi-East and Kogi-Central. In the first stage, two LGAs were purposively selected (Lokoja and Kogi/Koto Karfe) from the Kogi-West zone. This is because of their closeness to the confluence river which makes their farm land favorable for rice production in both raining and dry season. Most of them are also

smallholder farmers that depend mostly on rice production as source of their livelihood. In the second stage, simple random sampling was used to select five communities from each of selected LGAs, making a total number of ten communities for the study. Kogi State Agro Processing, Productivity Enhancement and Livelihood Improvement Support (APPEALS) project documented 405 rice farmers in the selected communities which are part of the APPEALS project adopted communities. This form the sample frame the respondents from which 201 rice farmers (49.6%) was selected as sample size using Slovin's formula (1960).

Method of Data Collection

Primary data was used for this study. Primary data were collected using structured questionnaire which was administered to the selected sample size in the study area using Kobocollect. Information collected include; socio-economic and institutional characteristics of rice farmers, recommended rice production practices adopted and the constraints faced in the adoption of recommended rice production practices. Two enumerators were used for this exercise which were supervised by the researcher.

Analytical Techniques

Descriptive statistics such as frequency, percentage and mean were used to summarize and achieve objective i and iii while Tobit regression analysis was used to achieve objective iii and also to test hypothesis 1 (H_{01}). The empirical model of specification is explicitly expressed as:

$$Y_i = 0 \text{ if } Y_i^* < 0$$

$$Y_i = Y_i^* \text{ if } Y_i^* \geq 0$$

$$Y_i^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{11} X_{11} + e$$

$$i = 1, 2, \dots, 11$$

Source: Tobin, (1958) cited by John *et al.* (2022).

Y_i = Recommended rice production practices index

Y_i^* = Unobserved recommended rice production practices

e_i = Truncated error term

β_0 = Intercept term

$\beta_1 \dots \beta_{11}$ = Slope coefficients

X_1 = Age (years)

X_2 = Sex (male/female)

X_3 = Marital Status (married, single, divorced and widow)

X_4 = Household size (number of people)

X_5 = Farm size (hectare)

X_6 = Farming Experience (years)

X_7 = Education level (years in school)

X_8 = Income (₦)

X_9 = Access to credit (amount of credit received in Naira)

X_{10} = Membership of cooperative (years of membership)

X_{11} = Extension visit (number of visit)

RESULTS AND DISCUSSION

Socioeconomic and Institutional Characteristics of Rice Farmers

Socioeconomic Characteristics of Rice Farmers

The results in Table 1 revealed that, significant proportion (45.3%) of the respondents were within the age range of 30-39 years with mean age of 34 years. The adopters of recommended rice production practices were averagely young. This implies that quite large number of the respondents were young and were in their productive age, they could be ready



to harness their potentials in rice farming. This findings is in line with the study of Olorunfemi *et al.* (2020), who reported that livestock farmers in Kogi State were in their active age which played major role in the adoption of livestock production technology in the State.

The results also revealed that majority (79.6%) of the respondents were males. The implication is that, the presence of more male rice farmers among the respondents could be as a result of the cultural believe in the study area where ownership of land favours men than women and this encourages men to go into farming than women. More males in the study area could also signifies that the role of women as wife in the family which could takes much of their time to engage in farming activities. This result agrees with the work of Onuche and Oladipo (2021), who found that males were more into farming than female in Kogi State.

The results presented in Table 1 revealed that, most (87.6%) of the respondents were married across the adopters of recommended rice production practices while only 9% were single. This implies that, large number of the adopters were saddled with family responsibilities and also have at their disposal family labour. This responsibilities could lead to a farmer to adopt high yielding rice production practices in other to have an improve level of living. This result is in conformity with the work of Muhammed *et al.* (2019), who found out that majority of the cassava farmers in Kogi State were married.

The result on household size of the respondents revealed that, majority (56.2%) of the respondents had household size ranging from 1-10 members with mean household size of 6 members. The implication here is that family labour which would be beneficial for the rice farmers in carrying out some farm operations could be high among the adopters of recommended rice production practices making available more hands to carryout rice farming activities. This is in consonance with the study of Olorunfemi *et al.* (2020), who revealed in their work that famers in Kogi State has considerably large household size.

Furthermore, the result revealed that majority (65.7%) of the adopters cultivate land area ranging from 3.00-4.99ha with mean farm size of 3.5ha. this implies that, the respondents operates small-scale farm, for adoption of new farming practices to yield high benefits, it needed to be used on a relatively large portion of land. This result disagreed with the work of Onuche and Oladipo (2021) who found that, farmers in Kogi State have relatively large farm size. The contrast could be because the study of Onuche and Oladipo generally focused on farm household in rural areas in Kogi State while this study was specific to rice farmers in two selected local government in Kogi State. The findings of this results agreed with the work of Adisa *et al.* (2019), who reported that majority of rice farmers in Kogi State operates in small-scale.

The respondents were quite experienced in rice farming, 35.3% of the respondents had rice farming experience ranging from 11-20year with mean rice farming experience of 15years. The implication of this finding is that the experience of the respondents in rice production is sufficiently many to bring about improvement and efficiency in the rice production practices. This findings is in line with the work of Adebayo *et al.* (2021), who found that improved rice varieties adopters in Ogun State had many years of experience in rice farming.

Education is an important factor in adoption of new farming practices as it makes human to be more flexible to changes around them. According to the result as seen in Table 1, a notable proportion (41.8%) of the respondents had secondary education and 31.3% had tertiary education. This implies that, large number of adopters of recommended rice production practices had at least secondary education which translate into their quick comprehension of the recommended rice production practices package and high level of



adoption of the practices as most of the respondent can read and write. The findings of the results is in correspondence with the work of Aliu *et al.* (2017), who reported that majority of the soya bean farmers in Kaduna State were literate with one form of education or another.

The results on income of farmers from rice production was also presented in Table 1. The result revealed that, most (90.5%) of the adopters had income within the range greater than ₦800,000 with mean income of ₦1,355,716. This implies that, with the amount of money gotten from rice farming, the adopters of recommended rice production practices can result to improve level of living. Such amount of income could enable them to navigate through the vast innovations available to improve their farming system. This is line with the work of Ogunremi *et al.* (2023), who reported that fishermen in Kogi State has make sustainable daily income from their fish farming.

Table 1: Distribution of Respondents according to Socio-economic Characteristics

Variables	(n=210)			
	Frequency	Percentage	Mean	Standard deviation
Age				
20-29	15	7.5		
30-39	91	45.3		
40-49	40	19.9	34	11.7
50-59	30	14.9		
≥ 60	25	12.4		
Sex				
Female	41	20.4		
Male	160	79.6		
Marital status				
Married	176	87.6		
Single	18	9		
Divorced	4	2		
Widow	3	1.5		
Household size				
1-10	113	56.2	6	5
11-20	73	36.3		
21-30	15	7.5		
31-40	-	-		
Farm size				
1.00-2.99	36	17.9		
3.00-4.99	132	65.7		
5.00-6.99	30	14.9	3.5	1.4
≥ 7.00	3	1.5		
Farming Experience				
1-10	63	31.3		
11-20	71	35.3		
21-30	30	14.9		
31-40	20	10	15	12.7
41-50	16	8		
51-60	1	0.5		
Educational level				
Non-formal Education	17	8.5		
Primary Education	37	18.4		
Secondary Education	84	41.8		
Tertiary Education	63	31.3		
Farm income				
< 200000	5	2.5		
200000-499000	6	3		
500000-799000	8	4	1355716	566421.9
≥ 800000	182	90.5		

Source: Field survey, 2024



Institutional Characteristics of Rice Farmers

Result on access to credit in Table 2 revealed that, majority (75.9%) of the adopters received credit within the range of ₦ 100,000- ₦ 499,000 with mean credit received of ₦ 255,172.4. This implies that, adopter of recommended rice production practices has access to financial support but may not be large enough to cover all their financial needs. Those farmers who could not access this support from financial institutions could be that the farming households were poor in assets that could have served as collateral to earn loan since financial institutions such as banks and other lending agencies appear either not accessible or have stringent condition attached to their services such as high interest rate thereby making it inaccessible. This is in agreement with the work of Silong and Gadanakis (2020), who found that most of the rural livestock farmers accessed credit for livestock production in Nigeria.

The results presented on Table 2 revealed that, majority (72.7%) of the adopters have been a member of cooperative for about 1-10years. The mean years of membership was 9years. This result implies that most of the adopter of recommended rice production practices were in cooperative societies for many years. Membership of cooperative societies could influence farmers to adopt new farming practices thereby increasing the level of adoption of recommended rice production practices. This is consonance with the study of Adisa *et al.* (2019) who reveals that, most of the rice farmers in Kogi State were members of cooperative society which contributed to their source of information.

Table 2 presented rice farmers access to extension agents, the result revealed that almost all (98%) of the adopters had access to extension agents with an average visit of 3times in a month. Since extension visit has strong correlation with farmers' access to information of modern production practices, this result is an indication that the adopters may be exposed to agricultural information many times which could lead to the adoption of recommended rice production practices. This is consistent with the study of Olarinde *et al.* (2020), who reported that adopters of crop production practices of FADAMA project in South West had 3times extension visit in a month.

Table 2: Distribution of Farmers based on Institutional Characteristics

n=201				
Variables	Frequency	Percentage	Mean	Standard deviation
Amount of credit received				
< 100000	5	5.7	255172.4	217078.2
100000-499000	66	75.9		
500000-899000	13	14.9		
≥ 900000	3	3.4		
Years of membership				
1-10	144	72.7	9	5.9
11-20	40	20.2		
21-30	14	7.1		
Access to extension agents				
No	4	2		
Yes	197	98		
Number of extension visits				
1-3	167	84.8	3	1.046
4-6	29	14.7		
7-9	1	0.5		

Source: Field survey, 2024



Factors Influencing the Adoption of Recommended Rice Production Practices

The Tobit regression model was used to estimate the parameters of the factors influencing the adoption of recommended rice production practices in Lokoja and Kogi/Koto Karfe local government area, Kogi State. The log likelihood ratio value represent the value that maximizes the joint densities in the estimated model. The Prob> χ^2 was (9.21) and statistically significant at $p < 0.003$ level of probability. This chi-square statistic revealed the effect of the predictor variables on specified alpha level. This implies that at least one of the regression coefficients in the model is not equal to zero. The Pseudo R-square was 0.603, implying that about 60.3% of the variation in the decision to adopt recommended rice production practices of the rice farmers was explained by the model. Eleven explanatory variables were used to predict the variation on the dependent variable. The result revealed that four independent variables significantly influenced the decision to adopt recommended rice production practices. They include sex ($p \leq 0.10$), farm size ($p \leq 0.05$), farming experience ($p \leq 0.10$), and number of visit ($p \leq 0.10$). The regression coefficient of the predictor variables was used to interpret the result, any positive or negative coefficient on these variables implies an increase or decrease in the probability to influence the adoption of recommended rice production practices.

The result revealed that sex was negative and significant at 10% level of probability to the decision to adopt recommended rice production practices. The implication of negative coefficient (-0.0218) of sex is that the predicted value of farmers decision to adopt recommended rice production practices is -0.0218 points lower for rice farmers who were female than rice farmers who were male. This result give credit to the fact that rice farming is more labour-intensive. This implies that being female farmers tends to abandon rice farming for less demanding cropping systems with low transaction cost associated with them in order to increase income. This is in consistent with the study of Nonvide (2020), who found that male-headed households' adoption is positively influenced because men in most societies are the ones who control productive resources such as land, labour and capital which are critical for the adoption of new technology In contrast, female farmers have a negative influence on technology adoption due to poor access of resources which are used in production (Oyetunde-Usman *et al.*, 2021).

Coefficient of Farm size (0.0285) was found to be positive and significant in influencing farmer's decision to adopt recommended rice production practices at 5% level of probability. This suggest that, every unit increase in the farm size of rice farmers, there is 0.0285 point increase in farmers' decision to adopt recommended rice production practices. This implies that farmers who have large farm size will definitely adopt recommended rice production practices as it is more economical in order to have a good return compared to when using traditional methods. Land holding size returned a positive and significant result in influencing adoption of new technology. Households with larger land holdings allocated more land to improved common bean varieties (Nonvide, 2020). This is in consonance with the findings of Thai *et al.* (2017), who found that farm size is often one of the first factors measured when modelling adoption processes. Farm size does not always have the same effect on adoption; rather the literature shows that the effects of farm size vary depending on the type of technology being introduced, and the institutional setting of the local community.

Experience is a driver of individual's understanding and in making viable economic decision and it is also an important factor influencing farmers' decision to adopt recommended rice production practices. The coefficient of faming experience (0.0496) was statistically significant and positively associated with the probability of adopting recommended rice production practices at 10% level of probability. The implication of this



result is that, every unit increase in farming experience of rice farmers, there is 0.0496 likelihood to adopt recommended rice production practices. The result give credence to the fact that, farmers with more years of farming experience would tend to utilize the opportunity of new farming practices to due to their better disposal to rice farming. This is in contrast with the work of Adebayo *et al.* (2021), who reported that farming experience is negative but significantly influenced adoption which indicates that the less experienced a farmers was, the higher the farmer adopt a technology. This differences could be due the fact that the study was conducted in different location, rice farmers in Ogun state may be more exposed to information on improved practices and may not necessary spent many years in farming before they adopt. On the other hands, experienced farmers are more likely to adopt improved crop production practices (Olarinde *et al.*, 2020).

Furthermore, the coefficient of numbers of extension visit (0.0199) was statistically significant and positively associated with the probability of adopting recommended rice production practices at 10% level of probability. This implies, for a unit increase in rice farmers extension visit, there is a 0.0199 point increase in the probability of rice farmers to adopt recommended rice production practices. This result was consistent with the *a priori* expectation which stated that, there is expected positive relationship between extension visit and adoption of recommended rice production practices. This result give credit to the fact that, farmers who have many visit with extension agents will have more information about recommended rice production practices than those who have less. Frequent information about recommended rice production practices may reduce their doubt about the practices therefore timely adoption will take place. This result is in conformity with the work of Abubakar *et al.* (2019), who found that extension contact has positive influence on the farmers' adoption decision by more willing to adopt the management practices of rice production, if numbers of extension contacts are increased. Farmers who are not contacted by frontline extension agents are expected to have lower probabilities of adoption and a lower level of use of improved technologies.

Table 3: Tobit Regression of the Factors Influencing the Adoption of Recommended Rice Production Practices

Variable	Coefficient	Standard error	T-value	Marginal effects
Constant	0.8610***	0.2791	3.0853	
Age	-0.0146	0.0227	-0.6432	-0.0022
Sex	-0.0218*	0.0118	-1.8571	0.0160
Marital status	0.0013	0.0111	0.1202	0.0045
Household size	-0.0117	0.0178	-0.6575	-0.0028
Farm size (ha)	0.0285**	0.0147	1.9937	0.0099
Farming experience	0.0496*	0.0275	1.8078	0.0014
Years of schooling	0.0059	0.0122	0.4824	0.0037
Farm income	-0.0032	0.0139	-0.2268	0.0247
Amount of credit	0.0223	0.0114	1.9595	0.0198
Years of membership	0.0014	0.0183	0.0749	0.0041
Number of extension visit	0.0199*	0.0111	1.7885	0.0284
Sigma	0.0214***	0.0022		
LR chi ² (11)	9.21			
Prob > chi ²	0.003			
Log likelihood	98.50			
Pseudo R ²	0.603			

***= Significant at 1%, **= significant at 5% and *= significant at 10% levels of probability.

Source: Field survey (2024)

Test of Hypothesis One

The hypothesis which says that socio-economic and institutional factors have no significant influence on the adoption of recommended rice production practices in the study area is presented in Table 3. The result revealed that five explanatory variables (sex, farm size, farming experience, years of membership in cooperative society and number of extension visit) significantly predicted the influence of the decision to adopt recommended rice production practices. The significance of $Pro > \chi^2$ (9.21) statistic implies that the model estimated provided a better fit to the data than a model with no predictors. Therefore, the socio-economic and institutional factors included in the model had significant influence on the adoption of the recommended rice production practices. However, the null hypothesis which says that socio-economic and institutional factors have no significant influence on the adoption of recommended rice production practices in the study area is rejected and the alternative accepted.

Constraints Faced by Rice Farmers in the Adoption of Recommended Rice Production Practices

Result in Table 4 revealed that almost all (99%) of adopters of recommended rice production practices faced a high cost of agro chemicals, respondents which was ranked 1st. it can be deduced from this result that reduction in the price of agro chemical could be an important factor in the adoption of recommended rice production practices. This implies that the cost of agro chemicals is one of the reasons why some farmers did not adopt the



recommended practices. Also, the respondents complained about scarcity of farm machineries (98%) and high cost of inputs (97.5%) which ranked 2nd and 3rd respectively. This implies that, farmers may not fully adopt the recommended rice production practices due to the lack of money to purchase inputs (such as fertilize and seed) and lack of tractors available for cultivating land for farmers with large scale of land. This is in line with the work of Adisa *et al.* (2019), who found that high cost of agro chemicals, high cost of inputs and lack of machineries were constraints to adoption of rice production technologies in Kogi State.

Furthermore, 90.5%, 85.6%, and 83.1% of the rice farmers reported that low market prices, increased labour demand, and incident of bird attack on rice crop were also the constraints faced in the adoption of recommended rice production practices. These were ranked 4th, 5th and 6th respectively. This is consistent with the study of Loko *et al.* (2022), who found that birds attack on rice fields, inadequate sales market were identified as constraint to rice farmers in Edo State. Rice farmers also lamented on lack of regular trainings (75.1%) and problems of religious beliefs (60.7%) were also additional constraints to farmers in adopting recommended rice production practices. These constraints ranked 7th and 8th respectively. This collaborated with the work of Adnan *et al.* (2019), who asserted that the major constraints to adoption of green fertilizer are complexity problems, economic problems and poor technical information

Table 4: Distribution of Farmers according to Constraints Faced in the Adoption of Recommended Rice Production Practices

Constraints	*Frequency	Percentage	Ranking
High cost of agro chemicals (pesticide & insecticide)	199	99.0	1 st
Scarcity of farm machineries (tractor hiring)	197	98.0	2 nd
High-cost of inputs e.g. seed, fertilizer	196	97.5	3 rd
low market prices	182	90.5	4 th
Insufficient labour demand	172	85.6	5 th
Incident of birds attack on rice crop	167	83.1	6 th
Lack of regular trainings	151	75.1	7 th
Religious beliefs	122	60.7	8 th

*Multiple choices

Source: Field survey (202)

CONCLUSION AND RECOMMENDATION

Base on the results of this findings, it was concluded that, high cost of agro-chemicals was the major constraints faced in the adoption of recommended rice production practices and also five independent variables (sex, farm size, farming experience and numbers of extension visit) significantly influenced the decision of respondents to adopt recommended rice production practices. Most of the respondents also identified lack of training as their constraints. Therefore, it is recommended that the National Cereal Research Institute and agricultural-oriented Non-Governmental Organizations in the State should organize regular trainings for the adopters of recommended rice production practices to increase their skills in rice farming. Also, constraints such as scarcity of machineries and high cost of agrochemicals were ranked high. It is therefore recommended that NCRI should endeavour to train rice farmers on how to turn house and farm waste product into manure to augment the use of agrochemical. Also, rice farmers' cooperatives, government agencies and private enterprises



through public-private partnership (PPP) should establish farm machineries on hiring basis to curtail the constraint of scarcity of machineries.

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