Original Research Article

Impact of on Custom Hiring Centers on Cost, Profitability, and Efficiency in Crop Production in Anantapur District of Andhra Pradesh

ABSTRACT

This study examines the impact of custom hiring centers (CHCs) on agricultural mechanization and productivity of groundnut of cultivation in Anantapur District of Andhra Pradeshin 2021. CHCs, established under the Submission on Agricultural Mechanization (SMAM) scheme, aim to address challenges faced by small-scale farmers in accessing improved machinery. Through farm business analysis, data envelopment analysis (DEA), and binary logistic regression, the study evaluates the adoption of improved farm machinery, changes in costs, profitability, and efficiency in crop production due to CHCs. Utilizing purposive sampling, data was collected from 160 beneficiary and non-beneficiary farmers in villages. Cost concepts were used to compare costs and returns in groundnut cultivation among CHC beneficiaries and non-beneficiaries. Findings indicate that CHC beneficiaries demonstrate lower input costs and higher net returns, signaling improved efficiency and profitability. DEA analysis reveals higher technical, allocative and cost efficiency among beneficiary farms compared to non-beneficiary ones. Additionally, binary logistic regression identifies significant factors influencing farmers' decisions to hire machinery from CHCs, including machine labor, net income, hired human labor, irrigation, and yield. Overall, the study underscores the pivotal role of CHCs in enhancing agricultural productivity and efficiency, particularly among small-scale farmers. It suggests that policymakers prioritize expanding CHCs and promoting mechanization to further improve agricultural outcomes and address challenges faced by marginalized farmers.

Keywords: Custom Hiring Centers, Data Envelopment Analysis, Binary logistic Regression, Submission on Agricultural Mechanization, Technical efficiency, Allocative efficiency and Cost efficiency

1. INTRODUCTION

Mechanization has been acknowledged as a pivotal factor in augmenting land productivity by facilitating timely execution of agricultural tasks, enhancing labor efficiency ~~per unit of time~~ through reduced exertion, and upgrading the overall quality of farm activities [14]. It leads to savings of approximately 15–20 percent on inputs such as seeds and fertilizers, 20–30 percent on labor and operational time, 5–20 percent on cropping intensity, and 10–15 percent on crop productivity [4].Numerous challenges accompany the adoption of farm mechanization, including economic hurdles like high initial and maintenance costs, inadequate access to institutional credit, exorbitant custom hire charges, escalating production costs, limited availability of service centers, situational constraints such as small and fragmented land holdings, unsuitability of certain machines for various soil types, and technological limitations such as a lack of proficiency in operating machinery and implements [7].

Comment [A1]: The fact that it is any "efficiency" pre-empts the need to write "per unit time".

Comment [A2]: "percent" is a single word.

Custom hiring centers (CHCs) serve as crucial facilitators in introducing advanced agricultural machinery to small-scale and marginalized farmers in India, thereby addressing the hurdles associated with mechanization and fostering increased productivity[9]. To promote agricultural mechanization, the Indian government has initiated various schemes and programs such as the RashtriyaKrishiVikasYojana (RKVY), the National Food Security Mission (NFSM), and the National Horticulture Mission (NHM). Notably, prior to 2014, the Government of India did not introduce specific schemes or programs for the promotion of agricultural mechanization. However, in the fiscal year 2014-15, the Submission on Agricultural Mechanization (SMAM) was launched to assist small-scale and marginalized farmers by establishing custom hiring centers (CHCs), farm machinery banks (FMBs), and high-tech hubs to facilitate access to farm machinery. The proliferation of CHCs, high-tech hubs, and FMBs at the grassroots level has ensured that small-scale and marginalized farmers have access to modern agricultural machinery for various field operations[8].

The state of Andhra Pradesh has emerged as a frontrunner in establishing CHCs under the SMAM scheme, with Anantapur district being one of its largest districts dominated by small-scale and marginalized farmers. In light of this backdrop, this study was undertaken to assess thechanges in cost of operations, profitability and efficiency in crop production due to adoption of improved farm machinery owing to CHCs in the Anantapur District of Andhra Pradesh.

Comment [A3]: I think there is need for hard figures to back these claims like, for example the percentage of CHCs established in the district in relation to the regional/national total and the proportion of farmers in the district who are small-scale and marginalised in comparison to the national/regional average.

2. MATERIALS AND METHODS

2.1 Data

Andhra Pradesh state was chosen purposively to study the performance of custom hiring centers established with government support. It is because Andhra Pradesh is the leader in the establishment of CHCs with the highest number of CHCs established under the SMAM scheme. Rayalseema region was selected purposively because most of the farmers belong to small and marginal categories in this region and the objective of the government scheme is to cover small and marginal farmers. Anantpur district from the Rayalseema region was intentionally selected as it is one of the largest districts and most of the

Comment [A4]: This somewhat unscientific, state the proportion/percentage of farmers belonging to the small and marginal categories in the region.

farmers are small and marginal farmers. Government subsidy support in e~~E~~stablishing CHCs plays an important role in such areas. In the district, 2 taluks were selected randomly namely Anantapur and Dharmavaram and from each of the selected taluks, 2 clusters of villages, one having formal CHCs established with government support and another without formal CHC and away from the first one so that custom hire services are not available in the villages from the formal CHC, ~~was~~ were selected. From each of the selected ~~clusters~~ villages~~of villages~~, 40 farmers were selected randomly. Thus a total sample of 160 ~~farmers which~~ constituting of~~includes~~ 80 CHC farmers and 80 ~~N~~non-~~B~~beneficiariesfarmers were selected~~ randomly from the study area~~. ~~The p~~Primary data was collected using~~a~~ personal interviews~~method~~ with the ~~help~~ aidof a pre-tested ~~specially designed~~ schedule designed for the study. The data was also collected from different stakeholders and officials involved in the implementation of the scheme.

2.2 Farm Business Analysis

Farm business analysis was performed to estimate different costs and returns in crop cultivation on sample farms. For this purpose cost concepts used by the Commission on Agricultural Costs and Prices (CACP), were used to estimate profitability and different costs to compare across farm size categories for both the beneficiaries and non-beneficiaries of CHCs to assess the changes due to mechanization through CHCs. ~~The sample farmers were classified into two groups i.e. beneficiaries and non-beneficiaries of CHC.~~The various cost concepts used to analyze the costs and profitability of Groundnut production are discussed below:

Cost Concepts:

- Cost A_1 = Wages of hired labor, cost of input, hired machinery charges, Imputed value of owned machine power, depreciation on implements and farm buildings, land revenue, and interest on working capital.
- Cost A_2 = Cost A_1 + Rent paid for leased in land
- Cost B_1 = Cost A_1 + interest on the value of owned fixed capital (excluding land).
- Cost B_2 = Cost B_1 + rental value of owned land.
- Cost C_1 = Cost B_1 + imputed value of family labour.
- Cost C_2 = Cost B_2 + imputed value of family labour.
- Cost C_3 = Cost C_2 + 10 percent of Cost C_2 accounting for managerial input

Farm Returns

- Farm business income = Gross income – Cost A_1
- Family labour income = Gross income – Cost B_2
- Net income over Cost C_1 = Gross income – Cost C_1
- Net income over Cost C_2 = Gross income – Cost C_2
- Net income over Cost C_3 = Gross income – Cost C_3

Comment [A5]: The is need for consistence in the use of Upper or Lower case in naming this group and the author changed between upper and lower case throughout the document

Comment [A6]: Was this data collected using a different technique or instrument from that indicated as" primary data"? If so, what technique and/or instruments were used?

Comment [A7]: Are these "sample farms" owned by the farmers selected as the sample for the study? In other words, what is the relationship between "selected farmers" and "sample farms"? If they are referring to the same subject of analysis, then it would be more efficient and clearer to use the same name to refer to them. As it is, it is not clear which is which.

Comment [A8]: I think a citation is needed to indicate which version of these standard/concepts are being referred to.

Comment [A9]: This has already been mentioned.

2.3 Dataenvelopment analysis approach(DEA):

DEA is anon-parametriclinearprogrammingmethod forevaluatingtheperformanceofasetofpeerentitiescalleddecision-makingunits(DMUs). In this case, the individual farm was considered as a decision-making unit.It measuresthetechnicalefficiencybased onestimatedbest-practiceorefficientfrontierorenvelopmentsurfacemadeupofasetofPareto-efficientDMUs(efficiencyscore=1).Theefficiencyofthefarmswascalculatedaboutthisandtheefficiencyscorew a s between0and1.Technicalefficiencycorrespondingtoconstantreturnstoscale(CRS)assumptionisknownasOverallTechnicalEfficiency(OTE)whichcapturesefficiencyduetobothmanagerialandscaleeffects.

ConsideringNDMUs,i=1,…, NandassumingthatthereareM outputs andN inputs.Letyiandxi denote,respectively,theoutputandinputvectorsforthei-thDMU.TheK*NinputmatrixXandtheM*NoutputmatrixY,representthedataofallNDMU"s.

Toestimatethetechnicalefficiency,theenvelopmentformofthelinearprogrammingproblem usingthe dualitywasused as

$$\min_{\theta,\lambda} \theta,$$

$$st - y_i + Y\lambda \geq 0,$$

$$\theta x_i - X\lambda \geq 0,$$

$$\lambda \geq 0,$$

Where θ is a scalar and λ is an N$\times$ 1 vector of constants. The value of θ is the efficiency score for the ith firm[2]. Table 1 shows the description of variables along with their unit of measurement which were used to perform DEA analysis.

Table 1. Description of the input and output variables used in the DEA analysis

S. No.	Variables	Units (per acre)
I	Output variable	
1	Profit	Rupees
II	Input variables	
1	Seed material cost	Rupees
2	Fertilizer cost	Rupees
3	Human labour	Total hours
4	Machine labour	Total hours

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Comment [A10]: What is the meaning of this abbreviation? It is not defined anywhere in the document.

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Comment [A11]: I think by adjusting the alignment of the table contents it becomes easier to distinguish the categories of the variables from the variables themselves.

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2.4Binary Logistic Regression Model

A logit model was used to identify the factors influencing farmers to hire machinery from CHCs. Using the maximum likelihood estimation method, the model predicts the probability of a binary outcome. It deals with situations in which the outcome for a target variable can have only two possible ways. Logistic regression model output helps identify important factors (Xi) impacting the target variable (Y) and also the nature of relationship between each of these factors and dependent variable

It helps to identify the factors (Xi) impacting the dependent variable (Y) and also shows the nature of relationship between dependent variable and explanatory variables.

The logistic function can be represented as,

$$Y=\ln (P_i/1-P_i) = \alpha + \beta_1 X_1 + \ldots + \beta_n X_n + U_i$$

Where, Y is the dependent variable that takes value 1 if a farmer hired machinery from CHC and otherwise it takes 0.

α= the constant of the equation;
β= the coefficient of predictor variables
Xi= the predictor variables
U_i =error term

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In this particular case nine (9) independent variables were used as mentioned belowshown in Table 2.: The logistic function for this study was thus rendered as:

$Y=\ln (P_i/1-P_i) = \alpha + \beta_1 Age + \beta_2$ Education+ β_3 machine labour hours+ β_4Net income + β_5Animal labour hours+ β_6 Human labour hours+β_7 Irrigation+β_8 yield+β_9 total seed cost +U_i

Marginal effects (dy/dx): Which reflect the change in probability of Y=1 given a unit change in the independent variable X.

Table 2 gives the outlook or description of dependent and independent variables taken in the binary logit model and also their unit of measurement

Table2. Description and units of variables used in the models

Comment [A12]: Made minor changes to the table columns.

Variables		Units of measurement
Dependent variable		
Yi	Whether Farmer is hiring machineries from CHC or not	1=yes,0=no
Independent variable		
X_1	Age	years

X2	Education	Illiterate=1, Primary=2, Secondary=3, PUC=4, Degree=5
X_3	Machine labour	Hours
X_4	Net income	Rupees
X_5	Animal labour	Hours
X_6	Human labour	Hours
X_7	Irrigation	Yes=1,No=0
X_8	Yield	q/ha
X_9	Seed cost	Total cost

3. RESULTS AND DISCUSSION

3.1 Costs and return in groundnut cultivation on sample farms

Farm business analysis was performed to understand the economics of groundnut production in both the CHC adopted villages and non-adopted villages. The costs and returns over different costs have been estimated and presented in the Table 3 for both the CHC and n~~N~~on-b~~B~~eneficiaries farmers across farm size categories. Perusal of the table indicates that all the input cost excepting irrigation and plant protection cost was higher on non-beneficiary farmers in comparison to beneficiary farmers. However, yield was marginally higher by 0.51 percent on beneficiary farms in comparison to Non-Beneficiary farmers.Singh (2005) also found that state having highest mechanization index incurred lower cost of cultivation per quintal of the wheat crop due to increased yield.

The Cost C_2 was 4.8 percent lower on CHC farms as compared to ~~Non~~non-~~Beneficiaries~~ beneficiaries farms on overall basis.Similar finding was reported by (Lokesh*et al,* 2018, Masayuki, 2009). The pattern was similar across farm size categories. The net returns over Cost C_2 of CHC beneficiaries was 20.8 percent more in comparison to non-beneficiaries and net return over Cost $C_1$of CHC beneficiarieswas 14.73 percent higher than n~~N~~on-b~~B~~eneficiaries. This indicates that the increased use of farm machinery on beneficiary farms has led to ~~increase in~~ better use of inputs and hence reduction in cost of cultivation. ~~The better use of inputs led to increase in crop yield and hence the increase in gross returns, net returns and returns over cost C2~~.Verma (2005) concluded that farm mechanization enhances the production and productivity of different crops due to timeliness of operations, better quality of operations and precision in the application of the inputs

Table 3. Costs and returns in groundnut cultivation at beneficiaries and non-beneficiaries of CHC farms (Rs/ha)

Particulars	Beneficiary farmers			Non-b~~B~~eneficiaries farmers			Change over Non-b~~B~~eneficiaries farms (%)
	Marginal	Small	Overall	Marginal	Small	Overall	

Comment [A13]: This reference is not in the reference list. Also, its style of citation differs from others in the document.

Comment [A14]: In improve the sentence construction for clarity. I could not understand the point the author was trying to make.

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Comment [A15]: Exactly what was similar? A lower C_2 or that C_2 was lower than 4.8 %?

Comment [A16]: This citation is not in the reference list and also the style of citing is different of that used in most of the document.

Comment [A17]: Which pattern is being referred to as no pattern has been identified by the author?

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Comment [A18]: I think this is too simplistic an explanation in light of the multiple factors/variables at play. I think this statement can be deleted without reducing the value of the study findings but it does an injustice in explaining the interplay of variables responsible for the outcome.

Comment [A19]: These terms are not defined anywhere in the document. This makes it hard to relate the results to the previous discourse.

Human labour	16720	16480	16600	17507	18327	17917	-6.68
Animal labour	6856	6644	6750	8015	7835	7925	-13.49
Machine labour	15123	17172	16148	20146	21152	21152.5	-28.50
Seed	14800	14450	14625	14910	14790	14850	-0.34
Manures & Fertilizers	5682	5777	5715	5815	6010	5955	-4.58
Irrigation charges	542.5	543.5	543	496	498.5	497.5	9.05
Plant Protection Chemicals	1455.5	1544.5	1500	1411.5	1489.5	1450.5	0.34
Miscellaneous	1435	1621	1528	1538	1553.5	1557.5	-7.87
Cost A_1	60633	59900	60267	65900	65200	65550	-7.50
Cost A_2	61591	60859	61225	66783	66083	66433	-7.29
Cost C_1	67886	67155	67521	73078	72268	72673	-6.59
Cost C_2	82883	80905	81894	88075	86048	87061.5	-4.80
Yield (q)	19.6	19.8	19.7	19.2	19.7	19.5	0.51
Price (Rs/q)	5600	5620	5610	5560	5580	5580	0.36
Gross return	112958	114459	113709	110958	112957	111958	0.89
Farm Business Income	51367	53600	52484	44175	46874	45525	12.83
Family labour Income	34164	38054	36109	28630	31309	29969.5	14.00
Net Returns over C_1	45072	47304	46188	37880	40689	39284.5	14.73
Net Returns over C_2	30075	33554	31814.5	22883	26909	24896	20.80

Source: Compiled from field survey, 2021

3.2 Efficiency in groundnut production across CHC and Non-Beneficiaries farmers

~~With purpose to examine the impact of adoption of improved farm machineries owing to establishment of CHCs on efficiency in groundnut production, using~~ DEA ~~approach~~ was used to determine~~T~~technical efficiency (TE), allocative efficiency TAE), scale efficiency (SE) and economic efficiency (EC) in groundnut production for both the CHC farmers and non-CHC farmers was estimated and to know the status of efficiency of groundnut farms, farms of both the CHC and n~~N~~on-b~~B~~eneficiaries villages were classified into four categories on the basis of their technical efficiency score into (i) Efficient having TE equal to one; (ii) Less efficient having TE more than 0.8 but less than 1; (iii) Moderately efficient having TE score more than 0.6 but less than 0.8 and (iv) Inefficient having TE score less than 0.6.~~and are~~The results are summarized in~~to the t~~ Table 4. Perusal of the table reveals~~ed~~ that out of a total 80 sample farms, 18.8 percent of beneficiaries and 13.8 percent of non-beneficiaries of CHC were technically efficient; 50 percent of beneficiaries and 40 percent of non-beneficiaries were less efficient; 31.2 percent of beneficiary and 46.2 percent of non-beneficiary were moderately efficient and none of the farms either in CHC or Non-Beneficiaries villages were technically inefficient. The overall technical efficiency of beneficiaries was high compared to non-beneficiary's farms.Chinnappa *et al*., (2018) also observed that farmers hiring machineries from private individual were less efficient compared to those hiring machineries from formal custom hire service providers.

Only 2.5 percent of beneficiaries and none of the non-beneficiaries of CHC had an allocative efficiency score 1~~ and efficient~~. However, 57.5 percent of beneficiaries and 75.0 percent of non-beneficiaries were inefficient in allocating their resources had allocative efficiency score of less than 0.6. Overall results convey that allocative inefficiency was ~~in more in case of~~greater on non-beneficiary~~ies of CHC~~ compared to beneficiary~~'s~~ farms. ~~necessary to expand their business to cover more number farmers as the demand is high during peak season. Ranade *et al.* (2006) and Kulkarni,(2009) observed that Custom hiring services have multiple opportunities to provide better implements to their clients at reasonable rates~~

Economic~~The cost~~-efficiency was~~t farms were~~ also ~~less ~~lower~~in the case of~~for non-beneficiaries of CHC ~~as ~~compared to beneficiaries, and more than 72.5 percent of farms had cost efficiency scores less than 0.6 and hence inefficient in both cases. Hiremath *et al.* (2015) also found that the successof CHCs in the district of Raichur has substantially assisted small and marginal farmers to carry out farmscores operations on time at low cost.

Table 4. Distribution of farms (%) according to Technical (TE), Allocative (AE) Scale (SE) and Economic efficiency (CE) in groundnut production

Efficiency level	TE		AE		EC	
	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries
Efficient (E=1)	18.8	13.8	2.5	0.0	2.5	0.0
Less efficient (E> 0.8 <1)	50.0	40.0	13.8	7.5	11.3	0.0
Moderately efficient (E> 0.6 <0.8)	31.2	46.2	26.2	17.5	13.8	27.5

Comment [A20]: I don't understand why TE was used to categorize the findings. I would think it more meaningful to have a metric for total efficiency that is constituted of TE, AE, SE and EC (maybe just the average of all these) and use that to formulate the categories of efficient, less efficient, moderately efficient and inefficient. If TE is enough to capture all the dimensions of efficiency, then why have the rest?

Comment [A21]: This, again, highlights the need to clarify the relationship between the 160 sample farmers and the so-called "sample farms". One would expect that, if these were one and the same thing, there would be 160 "sample farms" but they are now 80, where did the other 80 vanish to? The author need to clarify this issue. Are these different entities? Is it a matter of response rate or of incomplete information with the other respondents?

Comment [A22]: Where is this result and how were the overall efficiencies calculated? Indeed, it would be very helpful if the overall TE, AE, SE and EC for all relevant categories were shown. This is of paramount importance because the author routines refers to "overall" efficiency yet there are no results related to such metrics.

Comment [A23]: This citation style is different from most in the document and should be changed for the sake of consistency.

Comment [A24]: I failed to follow the argument advance by the author. How is this finding by Chinnappa et al relevant to the present study in light of the results presented? The author should give an explicit explanation of this relationship if it does indeed exist.

Comment [A25]: Again, there should be results of the so-called "overall" score for the different beneficiaries.

Comment [A26]: This citation style is different from most in the document and should be changed for the sake of consistency.

Comment [A27]: This citation style is different from most in the document and should be changed for the sake of consistency.

Comment [A28]: Again, accepting this explanation is hampered by the fact that the results do not give the "overall" / "Total" / "average" EC for each beneficiary category.

Comment [A29]: The table does not have results for SE as claimed by the caption.

Inefficient (E <0.6)	0.0	0.0	57.5	75.0	72.5	72.5
Total ~~No. of Farms~~	100~~80~~	~~80~~100	~~80~~100	~~80~~100	~~80~~100	~~80~~100

Source: Compiled from field survey (N = 80), 2021

Similarly, the share of scale efficient farm was more among beneficiary farms in comparison to non-beneficiary farms. However, none of the farms in both the categories were inefficient. The share of less efficient farms was 63.7 percent in case of beneficiary farms as compared to 70.0 percent in case of non-beneficiary farms.

The a~~A~~bove discussion indicates that ~~all~~ the technical, allocative, scale and cost efficiencies~~y~~~~was~~ were~~more~~ higheramong farms covered by formal CHC in comparison to farms in villages not covered by formal CHCs. However, ~~this~~ these resultsalso indicate~~s~~ the existence of ample ~~opportunity~~ roomfor improvement in all the technical, allocative, cost and scale efficiency in the entire study area irrespective of whether the villages are covered by CHC or not. This may be due to low mechanization in the area as well as poor ~~awareness about the improved package of practices of~~practices for growing groundnuts. In addition to all other efforts, mechanization of farms can play an important role in improving technical efficiency and hence greater emphasis is required on mechanizing the less mechanized farms.

3.3 Factors influencing farmers to hire machinery from CHC

A binary logit model was used to identify the factors~~With a purpose to understand the factors~~ affecting the decision ~~of~~ bya farmers to choose services from CHC,~~binary logit model was used to identify the factors~~. The results of the logit model presented in the Table 5 show~~ed~~ that machine labor, net income, hired human labour, yield and seeds were observed to be significant at 1 percent level of understanding of significance while age and irrigation ~~have~~ werefound to be significant at 5 percent level of significance. The ~~parameters like~~factors; age, machine labor, net income, irrigation and yield were positively related to the participation. The animal labour and seeds were found to negatively influence the farmer's decision to hire machinery from CHC. The marginal effect of age, machine labour, net income, irrigation and yield had negatively influenced the farmer's decision to hire machinery from CHC. With increase in age by one year the probability of hiring farm machinery from CHC by the farmer increases by 0.13 per cent keeping the other things constant. Similarly, if the farmer wants to increase machine labor hours by 1 hour the probability that farmers will go to hire machinery from CHC increases by 0.09 per cent. If farmers want to increase animal labour hours by 1 percent, then the probability to hire machineries by farmers from CHC decreases by 0.00002 per cent. To overcome the problem faced by marginal and small farmers in India during the peak season, use of farm machinery will solve the issue.

Comment [A30]: Where are the results for scale efficiency?

Comment [A31]: Awareness does not necessarily result in adoption of good practices and so is not directly related to production levels. The actual practices being carried out are the ones directly related to production levels.

Table 5.Binary logit estimates for factors influencing farmers to hire machinery from CHC

Parameter	Coefficient	Marginal effect (dy/dx)	Z value	P >|z|
Age(Years)	0.06602**	0.13**	2.07	0.04
Education (Illiterate=1,Primary=2,Secondary=3, PUC=4,Degree=5)	0.2498	0.52	0.77	0.44
Machine labour (Total hrs.)	0.4636***	0.0973***	3.69	0
Net income(Rs/ha)	0.00053***	0.00011***	4.49	0
Animal labour (Total hours)	0.000102	0.0000215	0.44	0.87
Hired human labour (Total hrs.)	-0.05053***	-0.00218***	-3.16	0.002
Irrigation (1=yes,0=no)	1.35005**	0.307**	1.99	0.04
Yield (Qtl/Ha)	1.4897***	0.312***	2.67	0.008
Seeds(Total cost)	-0.000745***	-0.0001***	-3.49	0
Pseudo-R-squared	0.58			
LR chi2(10)	125.72			
Prob> chi2	0			

Note: *** significant at 1% level, ** significant at 5% level

4. CONCLUSION

The study highlights the positive impact of CHCs on agricultural mechanization in Anantapur District, Andhra Pradesh. Beneficiary farmers experienced lower input costs, higher profitability, and greater efficiency compared to non-beneficiaries. Factors such as machine labor, net income, and yield influenced farmers' decisions to hire machinery from CHCs positively. Overall, the findings emphasize the importance of CHCs in promoting mechanization and suggest the need for further expansion to enhance agricultural productivity and sustainability in the region. To further promote agricultural mechanization and the effectiveness of Custom Hiring Centers (CHCs), policymakers should focus on expanding CHC networks, providing financial support and subsidies, offering training programs for farmers, investing in rural infrastructure, promoting information and awareness campaigns, fostering collaboration with the private sector, and implementing robust monitoring and evaluation mechanisms.

REFERENCES

1. Chinnappa B, Patil KK, Sowmya HS. Economic impact of custom hiring service centres in Maize cultivation: a case study from Karnataka. Indian Journal of Agricultural Economics. 2018 ;73(4):478-500.
2. Cooper WW, Seiford LM, Zhu J, editors. Handbook on data envelopment analysis.2011.
3. Hiremath G, Joshi AT,LokeshaH. 2014. Performance of custom hiring service (CHS) in tractor based farm machineries-an economic analysis (doctoral dissertation, University Of Agricultural Sciences, Raichur).

4. GurungTR, KabirW, BokhtiarSM. (eds.) Mechanization for Sustainatractor-baseball Agricultural Intensification in SAARC Region. SAARC Agriculture Centre, Dhaka, Bangladesh. 2017.
5. Kulkarni SD. Mechanization of Agriculture. Indian Scenario, Central Institute of Agricultural Engineering (CIAE), Bhopal, India. 2009.
6. Kumar P,Mahadevaiah GS. Breakeven analysis of custom hiring service centres operating in agriculture– An economic study in Karnataka. Stat, 2018;9(1):141-148.
7. Madhukar B, Reddy PBH, Lakshmi T, Ramu YR. Constraints in adoption of farm mechanization and suggestions to overcome the constraints, Pharma Innovation, 2021;10(6):376-379.
8. MehtaCR,Chandel NS, Senthilkumar T, Singh KK.Trends of Agricultural Mechanization in India. CSAM Policy Brief, 2014;2: 1-13.
9. Nagaraj PS, SwamyD, Madhushree A, VidyadharaB. A Study on Knowledge and Adoption of Farm Mechanization by Paddy Grower in Tungabhadra Project Area, Karnataka. International Journal of Agriculture and Food Science Technology. 2013:4(4): 385-390
10. Parashunath, Hiremath GM, Prashanth J. Constraints of farmers in utilizing custom hiring service (CHS) of tractor based farm machinery- An Analysis. International J. of Agril. Sci and Res. 2016;6(1):217-220.
11. RanadeDH, Chourasia MC, Shrivastava NK, PatidarD. Improved Tools and Scope for their Custom Hiring in Malwa Region-ACase Study. Agricultural Engineering Today, 2006;30(1&2): 28-31.
12. Raina A, Thakur R, Kumar S. Extent and Impact of Farm Mechanisation in Hilly State of Himachal Pradesh. Indian J. Extension Education. 2021:57(1):61-66.
13. SinghCS, Kumar C, Sudhakar PC, NathA, Sinha AK, Singh R. Mechanization of Indian agriculture-keeping pace with change. Agro India, 2004: 8 (5):12-14.
14. Singh G. Agricultural mechanisation development in India. Indian Journal of Agricultural Economics, 2015;70(1): 64–82.
15. Verma SR. Impact of agricultural mechanization on production, productivity, cropping intensity income generation and employment of labour. Status of farm mechanization in India. 2006;2006:133-53.