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Original Research Article

Comparative Analysis on Economic Efficiency of Hybrid and Inbred Rice Production in Udham Singh Nagar district of Uttarakhand

Abstract

A study was conducted to evaluate hybrid rice cultivation in blocks of highest acreage in Udham Singh Nagar district. A three stage sampling technique was employed for constructing sampling plan. In the first stage of sampling plan was the selection of blocks, selection of villages on second stage and respondent selection was done at on stage third. Probability proportion to size method technique was followed to select respondents which make a sample size of 60 farmers comprising of 28 small, 17 medium and 15 large farmers from 4 villages. Objective of this paper to estimate the costs and returns based on CACP concept and to examine resource use efficiency of hybrid and inbred rice varieties in study area. Farm-level data analyzed by using suitable and appropriate tools and technique. This study revealed that the netreturns ofinbred varieties overcostC_3wereRs. 19639/,Rs. 27580/ and Rs. 29548/ha on small, medium and large farms,respectively. The corresponding figures for hybrid rice were Rs. 25589/, Rs. 30039/ and 36069/ha on small, medium and large farms respectively. Result shows that cultivation of hybrid rice seems more beneficial venture of farmers in surveyed area. Effort should be made to expand area under hybrid rice cultivation on larger scale.

Key words: H*ybrid rice, CACP, Net return*

Introduction

Agriculture is the main source of income for the families in India. Farms cover half of the land and almost three-quarter of that land is used to grow the two major cereals rice and wheat. Rice (*Oryza sativa* L.) is the primary food for more than 3 billion people around the world and show one fourth of the global rice production area (about 40 million ha) is in rainfed lowlands of the humid and sub-humid tropics of South and South-east Asia and Africa. The population of our country has increased around 18crore but production of rice increased by around 10 million tons in last decade. The level of rice production may not be sufficient to feed the ever increasing population in the future. The scope for expansion of area under rice has already been exhausted, the only way to increase the production by increasing the productivity of rice through modern technology. The hybrid rice may be potential technology to increase the average productivity level of rice in the country [1].

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In hill agriculture rice is major food crop because rice is staple food of people of Uttarakhand. It is a main crop of the state and grown in an area of 54% of total area of cereal *i.e.*2.94 lakh hectares accounting over time. Production of rice is 5.50 lakh tones out of which plains and hills constitute about 3.72 (67.60%). Average productivity of rice in the state is around 20.50 qtl per ha.[2]

Farmers in developing country fails to exploit full potential of agriculture technologies and make allocative errors with this yield show wider variation which is usually reflecting a corresponding variation in the management capacity of the farmers. This shows that huge untapped potential still exists for raising productivity and income of the farmers by improving factors efficiency [3].

The factors responsible for inefficient utilization of technologies need to be identified and addressed properly for achieving a higher productivity in rice. The launching of Hybrid variety in India has enhanced the production of rice throughout country which shows better utilization of available resources. The concept of efficiency is vital to policy makers both at micro and macro levels. This studies on efficiency in paddy cultivation focus on the possibility of increasing the paddy yield while conserving the resources. This paper focuses to estimate the return and costs from inbred and hybrid rice from different size groups of farmers.

Methodology

The present study was conducted in Udham Singh Nagar district of Uttarakhand and it was based on both primary as well as secondary data. A three stage sampling technique was used for selection of the farmers. Out of seven blocks of the district two blocks and from each block four villagers were selected randomly. The farmers were categorized into three group on the basis of land holding*i.e.*Small (<2 ha), Medium (2-4 ha) and Large (>4 ha) and probability proportion to size method was used to select farmer Therefore, a sample of 60 hybrid rice growers was obtained which were 28, 17 and 15 on small, medium and large sized farms respectively. For calculating the cost and return form hybrid and inbred rice CACP cost concept was used [4]

CACP cost concept was given below.

Cost A_1 : It is calculated by summing the following costs

a) Value of hired human labour (casual labour)
b) Value of hired and owned machine power
c) Value of fertilizers
d) Value of seed (farm produced and purchased)
e) Value of plant protection chemicals

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f) Irrigation charges
g) Interest on working capital
h) Depreciation on farm implements
i) Land revenue
j) Miscellaneous expenses

Cost A_2 : Cost A_1 + Rent paid for leased-in land

Cost B_1 : Cost A_1 + Imputed interest on the value of owned capital assets (excluding land)

Cost B_2 : Cost B_1 + Imputed rental value of owned land (Net of land revenue) + rent paid for leased-in 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_2* : Cost C_2* was estimated by taking into account statutory minimum or actual wage rate whichever is higher.

Cost C_3 : Cost C_2* + 10 per cent of cost C_2* on account of managerial function performed by farmers.

The returns were computed over various cost concepts specified above. Gross returns were calculated at the price to which the rice produce was sold by the producers. Net returns were calculated by subtracting Cost A_1, A_2, B_1, B_2, C_1, C_2, C_2* and C_3 from gross returns.

Results and Discussion

Cost of rice cultivation under inbred and hybrid rice variety

There are many inputs used in cultivation of rice i.e. human labour, machine power, seed, irrigation water and fertilizer, plant protection chemicals etc.

The human labour employed by farmers growing rice under inbred variety was 74.32 man days per ha, whereas the same was 79.33 man days per ha employed by farmers growing hybrid rice. Further in case of inbred variety, human labour was employed 67.00 man days per ha by small sized farms and in medium 71.00 man days per while in case of their counterpart large sized farm was employed 82.00 man days per ha. Similarly in hybrid rice human labour was used 61.00 man days per ha by small, 85.00 man days per ha by medium farms and the same for large sized farms was 92.00 man days per ha. The differences of human labour across farm categories may be due to differences in number of intercultural operation in rice cultivation.

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Table 1: Input use levels of rice growing farmers under inbred and hybrid rice variety(per ha)

Sl. No.	Particulars	Inbred rice				Hybrid rice			
	Material input	**Small**	**Medium**	**Large**	**Over all**	**Small**	**Medium**	**Large**	**Over all**
	Labour days								
1	Nursery establishment	3.00	2.00	2.00	2.66	3.00	2.00	2.00	2.66
2	Transplanting	25.00	28.00	30.00	27.66	20.00	29.00	34.00	28.66
3	Fertilizer application	3.00	2.00	2.00	2.33	3.00	3.00	2.00	2.66
4	Weeding	8.00	12.00	17.00	12.33	8.00	13.00	18.00	13.00
5	Irrigation	2.00	3.00	3.00	2.66	2.00	4.00	6.00	3.00
6	Plant protection chemical	2.00	2.00	3.00	2.33	2.00	5.00	6.00	3.00
7	Total pre – harvest labour	43.00	49.00	57.00	49.66	38.00	61.00	68.00	55.66
8	Harvesting	24.00	22.00	25.00	24.66	23.00	24.00	24.00	23.66
	Total labour	**67.00**	**71.00**	**82.00**	**74.32**	**61.00**	**85.00**	**92.00**	**79.33**

Analysis of table indicates that machine power, rice growing farmers with inbred variety was employed 6.75hrsper ha while in case of their counterparts growing rice under hybrid rice was employed 7.66 hours per ha. In case of rice growing under inbred variety, machine power was employed 6.00, 7.00 and 7.25 hours on small, medium and large sized farms respectively. The corresponding figures in case of hybrid rice were 6.8, 7.75 and 8.45 hours per ha by small, medium and large sized farms, respectively. There was not much difference observed among the farmers uses machine power in rice cultivation on sample farms.

Table 1 further indicates that use of seed quantity by farmers growing inbred rice was found to be 33.91 kg per ha whereas it was used 16.36 kg per ha by farmers growing hybrid rice. In case rice cultivation under inbred variety, seed quantity was used 32.50 kg per ha by small, 33.75 kg per ha by medium sized farms growing rice while its counterpart large sized farms was used 35.50 kg per ha of seed quantity. In case of hybrid rice variety, seed quantity was used 14.50 kg per ha by small, 16.85 kg per ha by medium sized farm whereas the same was used 17.75 kg per ha by large sized farms under hybrid rice. The differences in seed rate may be attributed to optimum spacing maintained under hybrid rice for proper physiological growth of seedlings which are vigorous in nature and less frequency of gap filling operations.

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In respect to irrigation water, farmers growing rice under inbred variety was applied 5.66 irrigation per ha. Whereas, it was applied 7.33 per ha by farmers growing hybrid rice sample farms.

Table 2: Input apply in physical form(per ha)

1	**Machine power (in hrs.)**	6.00	7.00	7.25	6.75	6.80	7.75	8.45	7.66
2	**Seeds (kg)**	32.50	33.75	35.50	33.91	14.50	16.85	17.75	16.36
3	**Irrigation (no.)**	5.00	6.00	6.00	5.66	7.00	8.00	7.00	7.33
4	**Plant protection chemicals (kg.)**	15.50	14.75	16.00	15.41	17.00	18.65	20.85	18.83
5	**Fertilizer (kg)**								
	Urea	110.50	120.00	135.50	122.00	130.70	140.00	150.50	140.00
	DAP	60.45	55.00	62.65	59.36	70.25	65.85	58.55	64.88
	MOP	45.50	47.75	40.42	44.55	50.00	53.60	56.75	53.45
	Zn	22.50	24.50	25.75	24.25	20.00	23.50	24.75	22.75

To find out profitability in rice cultivation, the cost of cultivation and the returns over various costs were computed using CACP cost concepts for both inbred and hybrid rice. The costs and returns were calculated for small, medium, large and overall farm categories and expressed in rupees per hectare.

Farmers differ with respect to the extent of resources owned and their use. Some resources are owned by them while others are purchased or hired in different proportions. Farmers gave different weightage to different resources for making production decisions. While calculating the profitability of any crop, the consideration of costs is taken differently by different farmers. Some farmers are interested to know the returns over direct costs involved in the crop cultivation while the others are interested in considering the indirect costs as well such as rental value of land and imputed value of owned labour. Therefore, it was considered worthwhile to work out the net returns over various cost concepts viz., cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3.

Operational cost

In the study area, rice was grown during the kharif season. Labour is essential for transplanting, weeding, sowing, fertilizer application, spraying etc. Due to scarcity of labour in peak period the wages of labour was varied for different operations for this reason the expenditure incurred on hired labour was high enough. Farmers growing rice under inbred variety incurred on an average expenditure on human labour Rs. 8123.52 per ha while the

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expenditure on human labour Rs 13276.27 per ha was made farmers growing rice with hybrid. rice grown with inbred, the small, medium and large farmers made on expenditure of Rs 9837.71, 22225.00 and 7321.33 per ha on human labour, respectively, while rice grown with hybrid on small, medium and large farmers incurred Rs. 7841.82, 14086.43 and 17900.56 per ha on human labour, respectively.

Table 3: Operational Cost involve rice cultivation under inbred and hybrid rice variety(Rs./ha)

S.N.	Particulars	Inbred rice				Hybrid rice			
	Operational cost	Small	Medium	Large	Over all	Small	Medium	Large	Over all
1	Nursery establishment	450	300	300	350	450	300	600	500
2	Transplanting	4375	3000	3150	3508.33	3191.82	5075	6400	5500
3	Fertilizer application	450	300	300	350	300	1000	500	600
4	Weeding	1200.00	1000.00	1050.00	1083.33	1200.00	1800.00	3000.00	1766.66
5	Irrigation	500.00	300.00	300.00	366.60	500.00	800.00	1200.00	833.33
6	Plant protection chemical	300	300	400	333.30	300	1000	1500	933.33
7	Total pre – harvest labour	7275	5400	5500	5991.65	5941.82	9975	13200	10133.32
8	Harvesting	2562.71	2011.54	1821.33	2131.86	1900	4111.43	4700.56	3142.95
	Total cost	**9837.71**	**7211.54**	**7321.33**	**8123.52**	**7841.82**	**14086.43**	**17900.56**	**13276.27**

Material cost

The expenditure made on material for rice cultivation such as, tractor power, seeds, irrigation, plant protection chemical, and fertilizer constitutes the component of material cost. It was observed from the table that material cost incurred in the cultivation of rice was estimated to be Rs. 11899.79 and Rs. 15063.21 per ha on rice growing farms using inbred and hybrid rice, respectively.

The expenditure made on tractor power was estimated to be Rs. 5177.80 per ha on farms using inbred variety, whereas the same was estimated to be Rs. 6412.68 per ha on

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farms using hybrid rice. The expenditure on tractor power was estimated to be Rs. 4245.08, 5253.56 and Rs. 6034.77 per ha by small, medium and large farmers using inbred rice variety, respectively. The expenditure made on tractor power varied from Rs. 5110.44, 5511.14 and 8616.47 per ha by small, medium and large size farmers using hybrid rice.

Among the material inputs expenditure on fertilizes was most important item of material cost. The expenditure made on fertilizer was estimated to be Rs. 3744.85 per ha on farms using inbred variety, whereas the same was estimated to be Rs. 4005.00 per ha on farms using hybrid rice. The expenditure on seeds was estimated to be Rs. 983.50 and Rs. 2723.33 by farmers using inbred and hybrid rice, respectively.

Table 4: Material Cost involve rice cultivation under inbred and hybrid rice variety(Rs./ha)

S.N.	Material cost	Small	Medium	Large	Over all	Small	Medium	Large	Over all
1	Tractor power	4245.08	5253.56	6034.77	5177.80	5110.44	5511.14	8616.47	6412.68
2	Seeds	815.51	988.67	1146.56	983.58	2650.00	2720.00	2800.00	2723.33
3	Irrigation	705.93	817.27	915.34	812.85	700.23	800.29	934.09	811.54
4	Plant protection chemicals	1084.94	1189.29	1267.90	1180.74	1012.00	1120.00	1200.00	1110.66
5	Fertilizer								
	Urea	879.00	1060.22	1074.00	976.50	1003.75	1070.00	1304.00	1023.20
	DAP	1501.00	1375.00	1575.70	1484.00	1656.25	1595.25	1633.20	1622.00
	MOP	498.56	694.96	533.00	575.50	650.00	658.80	737.75	764.85
	Zn	572.00	737.00	722.00	677.00	520.00	611.00	643.50	594.10
	Total cost of fertilizer	**3450.56**	**3879.29**	**3904.70**	**3744.85**	**3730.00**	**3935.00**	**4350.00**	**4005.00**
	Sub total	10302.02	12128.08	13269.27	11899.79	13202.67	14086.43	17900.56	15063.21

Other cost

The third component of the cost of rice cultivation was other costs. Other cost consisted of (1) rental value of land prevalent in the area (2) interest on working capital (3) depreciation on the farm assets used in the cultivation of rice crop (4) interest on the value of farm assets and (5) land revenue. The rental value of land was an important item of other cost, which was estimated to be Rs. 16000.00 per ha for rice for across the all size of farms and locations. The depreciation charges was estimated to be Rs 1235.35, 1562.36 and 1656.37 per ha for small, medium and large farmers using inbred rice variety

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whereas 1562.39, 1656.37 and 1484.70 per ha was estimated for the farmers using hybrid rice. The interest on the value of owned fixed capital assets was another important item of other costs and estimated to be Rs. 1526.66 per ha for farmers growing rice using inbred rice whereas the same was estimated to be Rs 1541.94 per ha for farmers growing rice using hybrid rice. The interest on the value of fixed capital assets was varied Rs. 1325.16, 1456.89 and 1674.89 per ha in inbred rice and Rs.1400.23, 1502.23 and 1723.35 per ha for hybrid rice.

Cost A_1 which is also called out of pocket expenses (cash expenses) was analysed to be Rs19116.48 per ha on farms growing rice using inbred rice variety the same was estimated to be Rs 21077.60 per ha on farms growing rice using hybrid rice. Cost B_1 and Cost B_2 were estimated to be Rs. 20602.13 and Rs. 36602.13 per ha for rice growing farmers using inbred rice while the same were Rs 22619.54 and 38619.54 per ha for rice growing famers using hybrid rice variety. Cost C_3 on per ha basis, considered to be cost of rice cultivation was estimated to be Rs. 45430.57 and Rs 46301.06 for rice growing farmers using inbred and hybrid rice, respectively. It can be concluded from the above analysis that overall cost of rice cultivation (Cost C_3) using inbred and hybrid rice hadsmall difference. But small, medium and large farmers using inbred and hybrid both rice had considerable difference in total cost of rice cultivation. On cost C_2 and cost C_2* were found to be the considerable difference in small, medium and large farmers using inbred and hybrid rice.

Table 5: Other Cost involve rice cultivation under inbred and hybrid rice variety (Rs./ha)

	Other cost	Small	Medium	Large	Over all	Small	Medium	Large	Over all
1	Interest on working capital	881.70	917.29	1040.48	963.67	781.91	817.29	940.88	846.69
2	Rental value of owned land	16000	16000	16000	16000	16000	16000	16000	16000
3	Land revenue	175	175	175	175	175	175	175	175
4	Depreciation	1235.35	1562.39	1656.37	1428.05	1235.35	1562.39	1656.37	1484.70
5	Interest on value of	1325.16	1456.89	1674.89	1526.66	1400.23	1502.23	1723.35	1541.94

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	owned fixed assets								
6	**Miscellaneous expenses**	773.11	1231.19	958.80	987.70	1098.13	1231.19	1257.10	1195.47
	Sub total	19617.21	20111.57	20546.74	19199.22	20690.62	21288.10	21752.7	21243.80
	Grand total	**39630.05**	**40458.14**	**42196.22**	**40761.47**	**41735.11**	**46425.29**	**50742.76**	**46301.06**

Net return from rice under inbred and hybrid rice on sample farms (Rs /ha)

The returns from rice cultivation using inbred and hybrid rice and returns over various costs have been presented and the study reveals that the yield of rice on farms using inbred was 51.67 qtls per ha whereas the same was found to be 61.33 qtls per ha on farms using hybrid rice. Rice growing farmers using hybrid rice the gross return Rs.78640.83 and farmers using inbred variety the gross return Rs. 71020.00.

It is clear from the table that on an average rice growing farmers using inbred variety were getting a net income of Rs 25589.41 per ha over total cost (Cost C_3) whereas farmers growing hybrid rice variety were getting a net income of Rs 32339.77 per ha. There is net difference in income of hybrid rice cultivation over inbred variety by Rs.6750.36 per ha. From above analysis, it can be concluded that hybrid rice cultivation is more profitable than the inbred rice varieties. However, and it is also reveals the expenses on material cost was relatively higher in hybrid rice cultivation than the inbred varieties.

Conclusion

The scope for expansion of area under rice has already been exhausted, the only way to enhance of profitability in rice cultivation through modern technology. The hybrid rice may be potential technology to increase the average productivity level of rice in the country. Hybrid rice has potential to 20-30 per cent higher than the inbred rice within same maturity duration as reported in previous studies.High cost of hybrid seed is restricting farmers from adopting hybrid rice technology. Thus the subsidy should be provisioned on seeds of hybrid rice for its popularization among the rice growers.

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Author Contributions:

Ashish Prakash: Conducted survey and Collection of data

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R S Shekhawat: Statistical Analysis of data

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Surendra Sandu: Edited and writing of paper

Abbreviations:

CACP: Commission for Agricultural Costs & Prices

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Note*- If in future any Misstep / Flaw / Fluff / Plagiarism /conflict found in article, experimental data, procedure of article, then article will be immediately retracted from publication process.

Literature Cited

1. Singh, H.N., Singh S.P, Singh U.S., Singh J., Zaidi N.W. and Mohanty S.2013.Economic Evaluation of Pusa Rice Hybrid 10 Cultivation: A Micro-economic Evidence of Uttarakhand, India.*Indian Journal of Traditional knowledge*. 12(3): 472-477.
2. Statistica Abstract of India. 2015. Ministry of Agriculture and Farmers Welfare. Government of India.
3. Chengappa, P.G.,Janaiah, A. and Gowda, M.V.S. 2003. Profitability of Hybrid Rice Cultivation in Karnataka. *Economic and Political Weekly.* 38(25):2531-2534.
4. Commission for Agricultural Cost and Prices. 1985. Ministry of Agriculture and Farmers Welfare. Government of India.