



## POLICY APPROACH FOR FOOD SECURITY IN TRIBAL AREA THROUGH ADOPTION OF HYBRID RICE TECHNOLOGY IN UTTARAKHAND

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**Abstract-** The present study was undertaken in tribal area of Uttarakhand state. Objective of this paper is economic evaluation of hybrid rice technology for adoption and food security in tribal dominating area. 145 rice plots were randomly selected from three villages of community development block Kalsi to analyze cost and returns of hybrid and non hybrid rice. The yield of hybrid rice was 71 quintals per hectare which was 90% higher than non hybrid rice (37 quintals per ha) and 14% increase in cost of cultivation resulted into 88% increase in net returns in hybrid rice as compared to non-hybrid rice in the selected tribal area. 65% farm income was increased in year 2013-14 from previous year due to introduction of hybrid rice in the tribal field. Inequality in farm income was decreased which was showed by Lorenz and Gini-coefficient. It was 0.68 in 2013-14, which was less as compared to 0.74 in year 2012-13. This study further emphasized policies for adoption of hybrid rice cultivation as an important and most suitable rice variety for strengthening food security and poverty reduction in tribal area.

**Keywords-** Hybrid rice, costs and returns, income inequality, Lorenz curve and gini-coefficient.

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### Introduction

Rice occupies a substantial proportion in the diet of millions of Indian people and thus stands for a prominent place in Indian agriculture [1]. It is the most important cereal crop in India in terms of area and production. It is cultivated over an area of 42.86 million hectare with production of 105 million tones. It constitutes 25% to agricultural GDP [2]. It is the staple food for more than 60 per cent of Indian population. The present production level of 105 million tons needs to be increased up to 120 million tons by the year 2020 to meet out the demand of increasing population and to maintain food self-sufficiency. This increase in production has to be achieved in the back drop of declining and deteriorating resources such as land, water, labour and other inputs and without adversely affecting the environment. Plateauing trend in the yield of High Yielding Varieties (HYVs), declining and degrading natural resources like land and water and acute shortage of labour make the task of increasing rice production quite challenging. The current situation necessitates looking for some innovative technologies to boost rice production.

Hybrid rice is one of the new varieties adopted in 1994 in India. The average productivity of hybrid paddy has been estimated at 72 to 75 quintals per hectare while the average productivity of inbred paddy has been estimated at 20 to 30 quintals per hectare in the country as a whole. The area under hybrid rice in India was 2.50 million hectare with yield 48 quintals per hectare in 2013 [3]. Hybrid rice has 15-30% higher yield than local or high yielding varieties. These higher yields allow for more intensive rice production and results in higher farm income and more abundant food supplies for households. Despite these promising results, the pace of hybrid rice adoption in India has been slow in comparison with other countries [4].

In India, the hybrid rice cultivation is not practiced in all the states more or less in an equal manner due to farmer's lack of interest in adopting the hybrid varieties in rice cultivation, lack of coordination and tardy implementation of schemes. There

are wide variations in adopting the hybrid rice cultivation in India. Most of the India's hybrid rice is currently grown in the eastern and northern parts of the country where yields have been low 80% of India's hybrid rice is limited to areas such as Jharkhand, Bihar, Uttar Pradesh and Uttarakhand. There have been significant efforts by state governments to encourage hybrid rice adoption but uptake has been slow. There is a limited scope to increase land under rice cultivation in India because 60% of farms depend on monsoon for irrigation water and land resources are increasingly under pressure from urbanization. So, hybrid rice may contribute to addressing India's serious food security concerns. Many challenges are faced by tribal population due to land and water scarcity and pressure on natural resources in India. The technological innovation in agricultural production plays pivotal role in ensuring food security in the tribal area. Therefore, tribes need to find new varieties for their survival. Indian agricultural scientists have introduced a number of hybrid varieties of rice in the last two decades. If tribal has not adopted hybrid varieties, it would have faced food crisis in future.

Rice occupies the most important place in the agricultural sector and the state economy of Uttarakhand. The area under rice cultivation has exhibited declining trend and production increased mainly due to modern technology applied in agricultural sector. The area under rice in Uttarakhand in 2012-13 was 262.8 million hectare with production of 579.8 million tones. The productivity of rice was 2206 kg per hectare, which is very low as compare to national average [5]. With the limited scope for area expansion the role of agricultural research and development is critical, in order to generate employment and additional income for the rural poor. Enhanced productivity, profitability and competitiveness surface as the main sources of agricultural growth for the future. This can be triggered by innovations and applications of science in agriculture. The hybrid rice was quite appropriate for tribal farmers and sustainable production of paddy. The area under hybrid rice in Uttarakhand was 5000 ha in 2013 [3]. There are 3 % farmers of tribal community but hold 6 % of agriculture land which is the reason that tribal holds

very poor infrastructure for their livelihood and needs additional attention of developmental activities in Uttarakhand. The ICAR, New Delhi launched tribal sub plan for upliftment tribal people of which one of the component is hybrid rice cultivation. Long time food security for tribal population can be ensured if hybrid varieties are popularized in the state.

Keeping the above cited facts in view this study was conducted to find cost and returns of hybrid and non-hybrid rice and also examine the impact of the hybrid rice technology on tribal household income.

### Materials and Method

The present study was carried out in Kalsi block of the Dehradun district of Uttarakhand. This study was based on primary and secondary data. The primary data of rice cultivation were collected from each sample farmer by intensive household survey through the specially prepared schedules and questionnaires for 2012-13 and 2013-14.

A team of scientists conducted intensive survey to identify villages and farmers for implementation of hybrid rice technology. Out of 87 villages of Kalsi block, 3 villages namely Vyasbhad, Vyas nahri and Haripur were selected randomly [6]. Out of these three villages 39, 48 and 58 rice plots were selected from Vyasbhad, Vyas nahri and Haripur randomly to make total of 145 rice plots for the study. These 145 rice plots were selected from 89 farmers from three villages. The present study used a comparison of the conditions of the tribal farm household of the hybrid rice technology programme in pre and post hybrid rice technology period. The difference in pre and post hybrid rice technology period was analyzed. Descriptive analysis was used for calculating costs and returns of hybrid and non hybrid rice on selected farmer's field for comparison between them. The Lorenz Curve and Gini coefficient is used for farm income distributions before and after the introduction of hybrid rice variety. This tells which proportion of farm income is in the hands of given percentage of population. The Lorenz graph for a graphical represents the ratio of the difference between the line of absolute equality and the Lorenz curve, which represents the income distribution among population

quintiles. Gini-coefficient is calculated as the ratio of the area between the Lorenz curve and the absolute equality line, divided over the total area under the 45° line [7].

$$\text{Gini} = \text{Concentration (A)}/\text{Maximum concentration area (A+B)}$$

### Results and Discussion

Rice occupies the most important place in the agricultural sector and state economy of Uttarakhand. Hybrid rice (PA6444) cultivation was introduced in tribal dominated villages of Kalsi block of district Dehradun during 2013-14. Hybrid rice was new for tribal farmer. The training of technical know-how and critical farm input was given to farmer for successful cultivation of hybrid rice. At end of season, feedback was taken from the farmer and study was done to know the impact of hybrid rice cultivation over non-hybrid rice on tribal farmer's field.

#### Extent of inputs use in hybrid and non hybrid rice cultivation

In the selected villages 72 plots were under hybrid rice and 73 were under non hybrid rice crop [Table-1]. The total area under hybrid and non hybrid rice were 14 ha and 18 ha respectively. Farmer used less seed and labour which is 60% and 5 % respectively whereas nitrogen, phosphorus and potash were used more than 13%, 7% and 17 % respectively in hybrid rice over non-hybrid rice.

#### Costs and returns of hybrid and non-hybrid rice cultivation

The yield of hybrid rice was 71 quintals per hectare in the selected tribal area which is 34 quintals per ha higher than non-hybrid rice. By increasing cost of cultivation of hybrid rice by 13 %, 16 % and 15 % net returns were increased by 83%, 61% and 144% in Vyasbhad, Vyas nahri and Haripur village respectively over non-hybrid rice. In all the three villages with 14% increase in cost of cultivation resulted into 88% increase in net returns in hybrid rice as compared to non-hybrid rice in the study area. This show adoption of hybrid rice facilitates tribal farmers to strengthen the farm income and food security.

**Table-1 Physical input use in hybrid and non-hybrid rice production**

Input	Vyasbhad		Vyas nahri			Haripur			Overall			
	NH	H	NH	H		NH	H		NH	H		
Plot (No.)	15	24	29	19		29	29		73	72		
Area (ha)	3.56	8.44	6.62	2.24		7.88	3.54		18.06	14.22		
Percentage change over non hybrid												
Inputs	NH	H	Δ%	NH	H	Δ%	NH	H	Δ%	NH	H	Δ%
Seed (Kg/ha)	40	16	-60	42	18	-57	43	18	-58	42	17	-60
Labor (m/ha)	70	69	-1	74	71	-4	75	70	-7	74	70	-5
N (Kg/ha)	73	80	10	76	85	12	65	77	19	71	80	13
P (Kg/ha)	11	13	18	16	18	13	13	14	8	14	15	7
K (Kg/ha)	6	6	-	6	7	17	6	7	17	6	7	17

NH- non hybrid, H-hybrid, Δ% - percentage change over non hybrid, m/ha-man days per hectare

**Table-2 Costs and returns of hybrid and non-hybrid rice by villages**

Input	Vyasbhad		Vyas nahri		Haripur		Overall	
	NH	H	NH	H	NH	H	NH	H
Plots (No.)	15	24	29	19	29	29	73	72
Area (ha)	3.56	8.44	6.62	2.24	7.88	3.54	18.06	14.22
Yield (Qtl./ha)	41.42	68.98	42.85	74.76	29.42	69.12	37.22	70.90
% increase over-non hybrid		67		74		135		90
[A] Gross return (Rs./ha)	57918	87476	65470	93448	49538	86405	57589	88621
[B] Cost (Rs./ha)	26634	30085	26888	31291	26700	30620	26761	30619
% increase over-non hybrid		13		16		15		14
[A-B] Net return (Rs./ha)	31284	57391	38582	62158	22838	55785	30828	58002
% increase over-non hybrid		83		61		144		88
Seed (Rs./ha)	554 (2.1)	4777 (15.9)	594 (2.2)	5419 (17.3)	605 (2.3)	5239 (17.1)	590 (2.2)	5132 (16.8)
N (Rs./ha)	1416 (5.3)	1557 (5.2)	1401 (5.2)	1577 (5.0)	1179 (4.4)	1445 (4.8)	1316 (4.9)	1517 (5.0)
P (Rs./ha)	403 (1.6)	546 (1.8)	542 (2.0)	656 (2.1)	413 (1.6)	532 (1.7)	462 (1.7)	569 (1.9)
K (Rs./ha)	201 (0.8)	251 (0.8)	207 (0.8)	244 (0.8)	193 (0.7)	266 (0.9)	200 (0.8)	255 (0.8)
Labor (Rs./ha)	13996 (52.6)	13783 (45.9)	14845 (55.2)	14136 (45.2)	14992 (56.2)	13954 (45.6)	14729 (55.0)	13945 (45.6)
Other* (Rs./ha)	10064 (37.8)	9171 (30.5)	9299 (34.6)	9259 (29.6)	9318 (34.9)	9184 (30.0)	9464 (35.4)	9201 (30.1)

NH- non hybrid, H-hybrid, \*includes machine power, bullock power and plant protection chemicals etc, Figures in parentheses indicate percentage of total cost

### Enhancement in farm income

Analysis revealed that the average annual income from different sources of household was Rs. 171706 with a 26.40% share of farm income in the base year 2012-13, which was increased to Rs 200469 (37.19%) in year 2013-14. The variable proportions of income from different farming sources for the year 2012-13

and 2013-14 are presented in [Table-3]. Study indicates that the increase in percentage share of income was found substantial in all the activities followed on farmers' field. 65% farm income was increased in year 2013-14 from previous year due to introduction of hybrid rice in the tribal field.

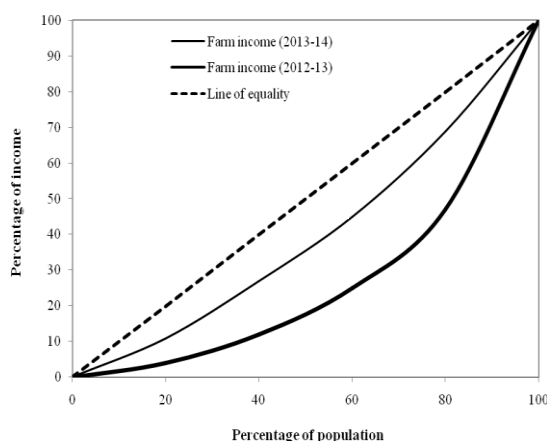
**Table-3** Average annual income (Rs.)/ household from various sources.

S No.	Activities	Base year 2012-13	Assessment year 2013-14	Change over base year (%)
A.	Farm income (Rs.)	45327	74550	64.47
	Share (%)			
1.	Rice	2.37	5.30	2.93
2.	Wheat	1.39	1.40	0.01
3.	Vegetables	0.72	4.39	3.67
4.	Pulses	0.18	1.06	0.88
5.	Poultry	0.37	5.48	5.11
6.	Mushroom	0.00	0.60	0.60
7.	Livestock*	8.62	8.39	-0.23
8.	Others**	12.74	10.58	-2.16
	Sub-total	26.40	37.19	10.69
B.	Non-farm income (Rs.)	126379	125919	-0.36
1.	Govt. services	27.48	23.54	-3.94
2.	Pvt. Services	4.61	4.08	-0.53
3.	Business	33.21	28.66	-4.55
4.	Others***	8.30	6.53	-1.77
	Sub-total	73.60	62.81	-10.79
	Total income	171706	200469	16.75

\*income from animal sale & dairy product, poultry, goat, t \*\* income from farm laborer, orchards & hiring of tractors etc., \*\*\* income from laborer, carpenter, tailor, jeweler, contractor, property dealer etc.

### Farm income distribution

The farm income distribution was showed by Lorenz Curve. In the [Fig-1], the Lorenz curve of farm income of 2013-14 was near to line of equality, which indicates inequality of income lesser as compared to previous year (2012-13). The Gini-coefficient further indicated the extent of inequality in farm income distribution. It was 0.68 in 2013-14, which was less as compared to 0.74 in year 2012-13 [Fig-1] due to introduction of hybrid rice in tribal areas, which stabilized farm income due to more production with less cost. Hybrid rice is now popular among tribal farmers to strengthen food security of small and marginal tribal farmers.



**Fig-1** Lorenz curve of farm income for households

### Conclusion and Policy Implication

Though cost incurred in cultivation of hybrid rice was 14% higher but net returns in hybrid rice were increased by 88 % as compared to non-hybrid rice. Income inequality creates low and insecure incomes for tribal farmers, which have impact on saving and future investment to get out of poverty. The study further emphasized hybrid rice as an important and most suitable rice variety for

strengthening food security and poverty reduction in tribal area. So government should launch programmes for technical knowhow for cultivation of hybrid rice as well as provide good quality hybrid rice seeds at a subsidized price for its adoption among tribal farmers.

### Conflict of Interest: None declared

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