

**Study on feasibility of Hybrid rice cultivation for farmers in
U.S. Nagar**

Project Report

Submitted to the



**G. B. Pant University of Agriculture and Technology
PANTNAGAR-263145 (U.S. Nagar), Uttarakhand, India**

By

Sushil Kumar

Id. No. 34572

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF**

Master of Business Administration (Agribusiness)

July, 2013

ACKNOWLEDGEMENT

Firstly, I express my sincere gratitude to "Almighty" who helped me in this great endeavor by making so many great minds to guide me and so many loving hearts to enlighten my path and it is only by the blessing of that almighty lord and the creator of world, who bestowed upon me the zeal and strength, that I was able to complete this arduous task.

It is my privilege to study and conduct my research under **Mr. Saurabh Singh**, Asst. Professor, CABM Pantnagar, Chairman of my Advisory Committee, who provided me the research insight, illuminating and meticulous guidance, calm endurance, continuous and unfailing encouragement, scholarly suggestions, unique supervision, constructive criticisms, sympathetic attitude, plausible appreciation and sustained support during the entire course of investigation and preparation of manuscript.

I emphatically and gratefully acknowledge extend my loyal and venerable thanks to members of my Advisory Committee, **Dr. Devendra Kumar**, Dean CABM and **Dr. M.L. Sharma**, Professor for providing proper guidance, critical comments, valuable suggestions and diligent support lead to timely completion of this work.

In the same vein, it is my great pleasure to extend my profuse thanks to faculty members **Dr. Mukesh Pandey**, **Dr. Ashutosh Singh** and **Mr. Nirdesh Kumar** for their co-operation, valuable suggestions and encouragement during the course of study. The staff members of Agronomy Department deserve special thanks for their help and co-operation.

I wish to record my grateful thanks to **Dr. N.S. Murty** Dean PGS G. B. Pant University of Agriculture and Technology for providing necessary facilities, technical and administrative supports for conductance of this research work.

Special thanks to respondent who patiently answered my queries time and again.

Last but not the least, I would like to convey my heartfelt thanks and indebtedness to all the batch mates and seniors for their utmost cooperation and immense help during the entire project work. They really encouraged me and gave power to overcome all hurdles which I faced.

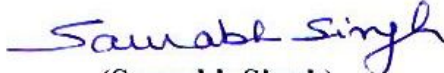
Pantnagar

July 2013

(Sushil Kumar)

CERTIFICATE

We, the undersigned members of Project Advisory Committee of **Sushil Kumar, Id No. 34572**, a candidate for the degree of **Master of Business Administration (Agribusiness)**, agree that the project report entitled "**Study on feasibility of Hybrid rice cultivation for farmers in U.S. Nagar**" may be submitted in partial fulfillment of the requirement of the degree.


(Saurabh Singh)

Chairman

Project Advisory Committee


(Devendra Kumar)

Member


(M.L. Sharma)

Member

EXECUTIVE SUMMARY

Rice is cultivated in all the 13 districts of the state, but maximum area 33 per cent is in district Udham Singh Nagar which produces about 48 per cent of the total rice produced annually in the state. Districts Nainital, Hardwar and Dehradun occupy about 17.5 per cent area and contribute 22.2 per cent in the total production. From productivity point the average productivity of the state is 20.68 q/ha. which is less in comparison to the national average productivity of 21.30 q/ha, so there is a need for hybrid rice adoption in the state but the high cost of seed, less use of fertilizers and pesticide and high input cost limited the farmers in adopting hybrid rice

Result emanated from the analysis have shown that the farmers under all category are lying in increasing return to scale i.e. the production of hybrid rice is going to rise substantially if the resources are being more optimally utilized. Results have shown that expenditure on plant protection chemical and expenditure on machine are the major factors which have significant impact on production of hybrid rice under small farm category. Hybrid rice production under medium farm category was more influenced by expenditure on manure and fertilizer, expenditure on plant protection chemical. The major factors persuading rice productions under large farm category were expenditure on manure, fertilizer and irrigation.

The study revealed that constraints in adoption for hybrid rice in the study area mainly pertained to the availability, quality and price of various production inputs. High incidence of pest and disease, high cost of seeds, inadequate availability of quality seeds, inadequate availability of labour, lack of irrigation facilities, high cost of pesticides etc were the important constraints.

LIST OF TABLES

Table	Title	Page No.
1.1	Area, Production and Productivity of Rice in India	2
1.2	Major crops of Uttarakhand with Area and Production	3
1.3	Area, Production & Productivity of Rice in Uttarakhand	4
1.4	Area, Production & Productivity of Rice in Udham Singh Nagar	5
2.1	Hybrids currently available for cultivation	12
4.1	Age-wise distribution of hybrid rice growers	20
4.2	Education-wise distribution of hybrid rice growers	20
4.3	Income-wise distribution of hybrid rice growers	21
4.4	Family composition and average family size of hybrid rice growers	22
4.5	Distribution of farmers according to the size of operational land holdings	23
4.6	Distribution of seed rate used by farmers	23
4.7	Distribution of irrigation source used by farmers	24
4.8	Distribution of human labour	24
4.9	Distribution of manure application used by farmers	25
4.10	Distribution of fertilizer application used by farmers	25
4.11	Cost of manure and fertilizer used by farmers	26
4.12	Expenditure on machine used by farmers	26
4.13	Expenditure on plant protection	27

4.14	Estimated coefficient of Cobb Douglas production function for small farmer category	27
4.15	Estimated coefficients of Cobb-Douglas production function for medium farmer category	28
4.16	Estimated coefficients of Cobb-Douglas production function for large scale farmer's category	29
4.17	Estimated coefficients of Cobb-Douglas production function for all farmers	29
4.18	Ranking of various constraints faced by small farmers in production of hybrid rice	30
4.19	Ranking of various constraints faced by medium farmers in production of hybrid rice	31
4.20	Ranking of various constraints faced by medium farmers in production of hybrid rice	32

LIST OF FIGURES

Map	Title	Page No.
2.1	Map of hybrid rice research network	11
3.1	Map of district Udham Singh Nagar	15

1. INTRODUCTION

Agriculture in India experienced a spectacular increase in food grains production of paddy and wheat during 1960s. This jump in the productivity rates of crops was so sudden and conspicuous that some economist termed the phenomenon as green revolution, which was the outcome of the use of package of improved practices. Agriculture in India is one of the strong holds of Indian economy and accounts for 13.9 per cent of country's GDP in 2011-2012 as compared to 14.5 per cent in 2010-2011(economic survey 2011-2012) furthermore the sector provides employment to 52 per cent of total population in the country.

Agricultural progress is normally regarded as a prerequisite of economic development. It is true that economic development in modern times has to be associated with industrialization, nevertheless, it is generally accepted that industrialization can follow only on the sound heels of agriculture or, to turn the metaphor, agriculture is the foundation on which the entire superstructure of the growth of industrial sector and other sectors of the economy has to stand.

In India majority of the farming community belongs to marginal and small farmers (76.2%) who have only 29 per cent of the total operational holding, while 71 percent of the operated area is possessed by farmers who have medium and large size holdings. It is projected that by 2025 the country's population will be nearly 1.4 billion requiring annually 380 mt of food grain. The per capita availability of land has declined to as low as 0.48 hectare. With the decline in farm size, it would be increasingly difficult to produce enough food for the family. Only 25 to 30 per cent of the modern agricultural technologies have reached the farmers. This modern technology however has been restricted to favourable farming situations, since there is no further scope for horizontal expansion of land for cultivation. The only alternative left is for vertical expansion and that too through diversification of the farming system.

Rice is one of the most important food crop of India and 2nd of the world. It feeds more than 50 per cent of the world population. It is the staple food of most of the people of South-East Asia. It provides about 29.4 per cent of total calories/capita/day in Asian countries. It accounts for about 90 per cent and 91 per cent of world's rice area and production respectively. Among the rice growing countries, India has world's largest rice growing area 44.5 mha with production of 146.6 mt (2011). Rice accounts for about 34 per cent of India's cropped area and is staple food

for 65 per cent of Indian population. It contributes 43 per cent of total food grains production and 45 per cent of the total cereal production in the country. Rice continues to play vital role in the national food grain supply. India accounts for 15 per cent of total rice production of world. All this data reveals that rice is the most important crop for the overall food security of the country.

Table 1.1: Area, Production and Productivity of Rice in India

Year	Area(mha)	Production (mt)	Productivity (qtl/ha)
2000-01	44.21	84.98	19.01
2001-02	44.90	93.34	20.79
2002-03	41.18	71.82	17.44
2003-04	42.59	88.53	20.77
2004-05	41.91	83.13	19.84
2005-06	43.66	91.79	21.02
2006-07	43.66	93.36	21.31
2007-08	43.91	96.69	22.02
2008-09	45.54	99.18	21.78
2009-10	41.85	89.13	21.30

Source: Agriculture Statistics at a Glance – 2010

1.1 Scenario in Uttarakhand:

The state of Uttarakhand encompasses a geographical area of 53,483 sq. km. which accounts for 1.63 per cent of India's geographical area. Eleven out of thirteen districts in Uttarakhand fall under hills covering more than 75 per cent of the state geographical area. The mainstay of the economy in the state is agriculture even though it occupies only about 12.5 per cent of total area of state. The major crops produced in the state include rice, wheat, barley, corn, mandua etc. (**National agriculture magazine 2000**)

Table 1.2: Major crops of Uttarakhand with Area and Production

S No.	Name of crop	Area(000'ha)	Production(000'metric tonnes)
1.	Rice	294	613
2.	Wheat	395	845
3.	Barley	24	26
4.	Maize	28	38
5.	Urd	13	10
6.	Mustard	15	12
7.	Potato	24	432
8.	Other Oil seed crops	15	20
9.	Other cereals	204	234
10.	Other pulses	44	33

Source: Uttarakhand, Sankhyiki Patrika, 2009-2010

Rice is the major cereal crop of *kharif* season accounting for more than 54 percent of the total area under cereals in the state. The annual rice production of the state is around 5.7 lakh tonnes from an area of about 2.80 lakh hectares. Half of this area is in the plains and half in the hills, but the total rice production of the hills is twice the total production of the hills.

Table 1.3: Area, Production & Productivity of Rice in Uttarakhand

Year	Area(mha)	Production (mt)	Productivity (qtl/ha)
2000-01	3.13	6.22	19.88
2001-02	2.99	6.14	20.56
2002-03	2.83	4.83	17.07
2003-04	2.93	5.69	19.43
2004-05	3.06	5.72	18.69
2005-06	3.02	5.90	16.54
2006-07	2.96	5.91	19.56
2007-08	2.89	5.93	20.52
2008-09	2.96	5.82	19.66
2009-10	2.94	5.50	20.68

Source: Hand book of Statistics 2009-10, Directorate of Rice Research, Patna

Rice is cultivated in all the 13 districts of the state, but maximum area 33 per cent is in district Udham Singh Nagar which produces about 48 per cent of the total rice produced annually in the state. Districts Nainital, Hardwar and Dehradun occupy about 17.5 per cent area and contribute 22.2 per cent in the total production. From productivity point of the average productivity of the state is 20.68 q/ha. There is a wide gap between the productivity of hills (12.55 q/ha) and productivity of plains (27.55 q/ha). The highest productivity among hill districts was observed in Tehri Garhwal which is 1.6 t/ha and lowest in Almora and Pauri Garhwal districts which is about 1 t/ha.

Table 1.4: Area, Production & Productivity of Rice in Udham Singh Nagar

Year	Area(000'hectares)	Production(000'tonnes)	Productivity (kg/ha)
2000-01	110.2	319.2	28.97
2001-02	105.9	326.3	30.81
2002-03	98.6	304.7	30.90
2003-04	101.6	268.2	26.40
2004-05	107.5	281.6	26.19
2005-06	110.6	312.0	28.20
2006-07	101.2	286.7	28.33
2007-08	106.7	316.6	29.67

Source: Udham Singh Nagar, Sankhyiki Patrika, 2008

The main reasons for a wide difference in productivity are:

- (i) There exists a wide variation between hills and plains for irrigation facilities and fertilizer consumption.
- (ii) The hill districts witness harsh climate in terms of prevailing low temperature and moisture stress.
- (iii) Very low or negligible use of chemical fertilizers in the hills, particularly under rainfed upland conditions.
- (iv) Small or marginal and scattered land holdings and woman based agriculture.
- (v) Non-availability of inputs, poor socio-economic condition of the farmers and poor extension network.

1.2 Work Already Done:

The work already done helps in providing basic background to enable formulation of objectives and selection of appropriate analytical tools for attaining the objective:

Kumar *et al.* (2000) analyzed constraints to the adoption of modern varieties of rice and other component technologies in the rainfed lowland ecosystem of Bihar. Both cross-sectional primary data and time-series secondary data were used. They showed that the state suffers from outdated tenurial relations that adversely affect adoption. A related problem in the entire eastern region is the fragmentation of holdings. There is a need to undertake tenurial reforms in a large way and simultaneously consolidate holding. In addition to the unavailability of modern varieties, their poor threshability and thachability, the requirement for additional capital and labor, excessive weed infestation, lack of timely availability of fertilizer, lack of credit along with knowledge and other cultural practices may be instrumental to their slow adoption. The adoption of component technologies such as fertilizer and pesticides seems to have been affected by the adulteration prevalent in the markets..

Janaiah (2003) stated that the availability of quality hybrid seed at a reasonable price is crucial to the success of any hybrid technology in any crop. The history of success in hybrids in crops such as maize, pearl millet, jowar, sunflower, and others has clearly shown the need for an economical and efficient production and distribution of hybrid seed for the large-scale adoption of hybrid crop technology in any country like India .

Chengappa and Janaih (2003) stated that the comparison of profitability of hybrid and inbred varieties of rice has shown that the former have a distinct yield advantage over the inbred varieties now being cultivated in Karnataka. However, higher cost of production due to higher seed cost, higher level of fertilizer and labour use coupled with lower market prices have completely offset the yield gains recorded for hybrid rice technology to reduce cost of cultivation and improving the quality of rice to create a demand pull suiting the taste and preferences of consumer.

Janaiah and Hossain (2003) stated that labor alone accounted for 48% of total input costs, implying that the labor requirement has declined significantly as seed growers gain experience

and skills. This shows the potential of generating substantial employment in a seed production system if hybrid rice cultivation expands on a large scale.

Yuan (2004) stated that the only way to cope with increasing demand given growing constraints on land and water is to increase the productivity. Approaches to improve rice land productivity include higher investment in irrigation infrastructure and machinery, increasing the rate of and/or efficiency in the use of fertilizers and pesticides, and adopting new seed technologies with higher productivity potentials. In this regard, the hybrid rice seed technology is seen by many as a great tool to ameliorate the forecasted rice supply shortage.

Hasan (2009) studied technology adoption, profitability and yield gap in rice cultivation in Bageshwar District of Uttarakhand. They observed that the level of modern farm technology adoption was not encouraging in the study area and it was negatively correlated with altitudes. The overall average technology adoption index was 47.42 per cent. Yield gap was higher at high altitude compared to middle and low altitudes. Significant variation was noticed in case of yield gap among the different altitudes. Level of technology adoption, type of seed, and visits to ADO office and scientists per year were found as major determinants of yield gap.

Nirmala and Muthuraman (2009) examined the economics and major constraints in rice cultivation in Kaithal district of Haryana, India 2007-08. They covered four villages of two blocks and data on constraints and cost-return aspects of rice cultivation were collected from 80 farmers. Total costs in rice production amounted to be Rs. 33778.68/ha. Average yield was 4.99 t/ha. Benefit-cost ratio worked out to be 1.27. Pests and disease incidence, lack of remunerative price and labour shortage were the major constraints in rice production.

Ojogho and Alufohai (2010) examined the economies of scale and technical efficiency of small-scale farmers in Edo State, Nigeria. The data used in the study were mainly from primary sources. The data were collected from 200 rice farmers selected using multistage sampling technique and analyzed using descriptive statistics, and stochastic frontier model. Production functions among hybrid rice and inbred rice producers were estimated independently using the Battese and Coelli (1995) model to specify a stochastic frontier Cobb-Doglas production function with behaviour inefficiency component to estimate all parameters together and the level of significance. The returns-to-scale (RTS) for the production function showed that the farmers operated in the irrational zone (stage I) of the production surface having RTS of 0.676 and 1.299

for inbred and hybrid species respectively. The result of the analysis indicated that presence of technical inefficiency had effects in the food crop production as depicted by the significant estimated gamma coefficient of each model, the generalized likelihood ratio test and the predicted technical efficiencies within the farmers. Improved variety of rice as well as the technology improves the efficiency of the farmers.

Singh *et al.* (2010) conducted study to examine economic assessment of Pusa Rice Hybrid 10 for policy approach to enhancing and stabilizing income of rice farmers in Uttarakhand, India during 2006-08. Initially data were collected from 494 farmers from 36 villages in Udham Singh Nagar district who introduced cultivation of Pusa Rice Hybrid 10 during 2006. The year 2006 was a “farmer’s experimentation” year for hybrid rice because PRH 10 was primarily introduced on farmers’ field in target area. The study revealed that the net returns from Pusa RH 10 were 71 per cent higher than those of inbred varieties in substantial year 2007. In addition, the improved production practices enhanced the yield of Pusa RH 10 and significantly increased the income of farmers due to better market price. Therefore demand increased for seed of Pusa RH 10 in kharif 2008. The B:C ratios of both types of varieties were quite satisfactory, but Pusa RH 10 was more attractive due to higher ratio of 3:20.

1.3 Problem statement

Hybrid rice adoption has been very slow amongst farmers; it is reported to be concentrated with the farmers who have financial capacity to invest, in fields with favorable water supply and with farmers who are market-oriented. This may not be the category into which most of our small and marginal farmers of the country might fit into. There are various problems related to the hybrids in India – which includes grain quality, pest and disease resistance, cost of seed, farm economics etc.

Rice is the major cereal crop of kharif season accounting for more than 54 percent of total area under cereals in Uttarakhand. The annual rice production is around 5.7 lakh tones from an area of about 2.80 lakh hectares. Most of the farmers in state are small and marginal farmers with the limited capital. Also the productivity of the state is less in comparison to the national average productivity, so there is a need for hybrid rice adoption in the state but the high cost of seed,

excessive use of fertilizers and pesticide and high input cost limited the farmers in adopting hybrid rice.

Thus the present study on “**Feasibility of Hybrid rice for farmers in U.S. Nagar**” has been carried out to know the economic viability of hybrid rice for the farmers and the challenges and opportunities faced by the farmers with the use of hybrid rice.

1.4 Objectives

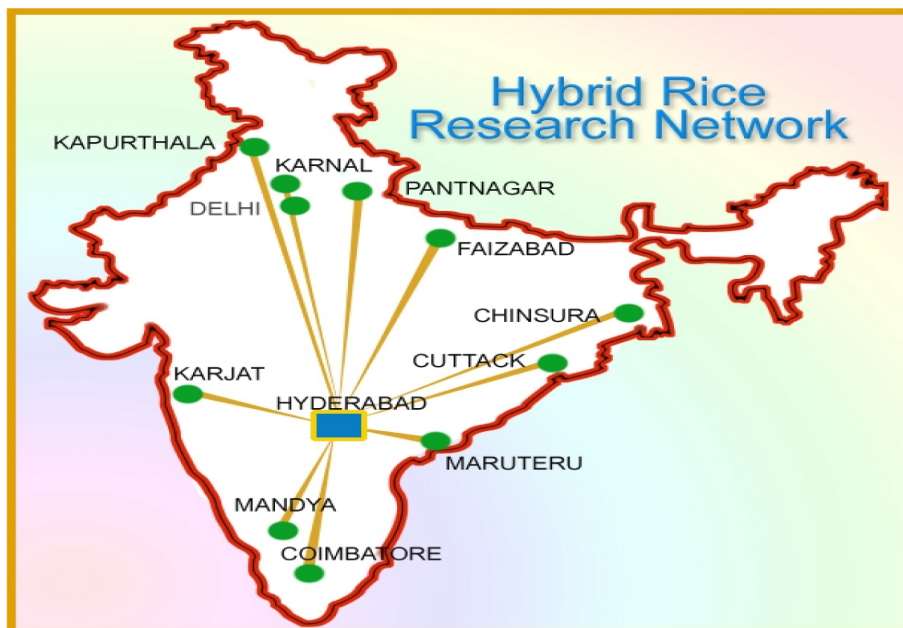
1. To determine economies of scale in case of hybrid rice.
2. To find out the constraints faced by the farmers in adoption of hybrid rice.

2. INDUSTRY DESCRIPTION

The term “hybrid” is used to refer to the first filial generation of a cross between two genetically diverse parents. The commercial hybrid refers to a superior F1, which not only outperforms the better parent but also shows significant (at least 1 t ha⁻¹) yield superiority over the best high-yielding inbred variety of similar duration and possesses acceptable grain quality. Efforts to develop and use of hybrid rice technology in India was initiated during 1970. But the research works were systematized and intensified since 1989 with a mission mode project. Hybrid rice production and development began in India in 1990 when the Indian Council for Agriculture Research, with financial support from the United Nations Development Program, launched the National Research Network on Development and Use of Hybrid Rice technology at 12 sites across the country. Research and development was and continues to be led by the public sector, but the private sector is now taking a more active role. Currently, 16 seed companies are producing hybrid in the country, using eight hybrid lines. Hybrid rice is grown principally in Andhra Pradesh, Karnataka and Tamil Nadu.

As a result of concerted efforts for over two decades, totally 46 hybrids have been released for commercial cultivation in the country. Among these, 29 have been released from the public sector while remaining 17 have been developed and released by the private sector. Based on hybrid seed sold, it is estimated that an area of around 1.1million hectares is under rice cultivation during 2007 in the country. Hybrid rice is cultivated predominantly in eastern Uttar pradesh, Bihar, Jharkhand, Chhatisgarh, Punjab and Haryana.

The vast majority of these seed companies were established in the 1980s, when the government embarked on its major economic liberalisation programme. During those years, the government made seeds of public-bred varieties available to the private sector for multiplication and distribution and it brought down restrictions on the importation of seeds. While the former change encouraged the growth of domestic seed companies, the latter brought the rapid entrance of large foreign seed companies. Today, most hybrid seed companies in India are either owned, in whole or in part, by foreign TNCs or closely allied to them.



Map 1: Hybrid rice research networks in India

More than 97 percent of the hybrid rice seed is by the private seed sector. The leading companies are Hybrid Rice International (Bayer Bio Science), PHI Seeds Ltd., Mahyco, Shriram bioseed, Nath Biogene Ltd, Advanta India Ltd., J.K. Agri- Genetics, Dhanya Seeds Ltd., Seeds works India Ltd., Syngenta India Ltd. etc. More than 50 private sector seed companies are engaged in large scale hybrid rice seed production. (**DRR Technical Bulletin No. 22/ 2007**). It is expected that by the year 2015 hybrids are expected to cover at least 5 million hectares of the rice area in the country, thereby contributing significantly towards national food security.

2.1 Current scenario in hybrid rice industry:

Seed production is costly and time-consuming, and early efforts by private companies have been largely unsuccessful. For instance, Cargill and Ring around Products purchased exclusive licenses for Chinese hybrid varieties outside of China in the 1980s but neither company could produce marketable seeds and both backed out of the agreements by 1992. Nearly all the seed companies conducting research and development of hybrid rice in Asia are owned by or linked to the world's largest seed companies. Several of them already have commercial hybrid rice varieties on the market. In India, there are several local companies

engaged in hybrid rice production, but the bulk of research and development is carried out by foreign corporations.

Table 2.1: Hybrids currently available for cultivation

	Central releases	State releases
Public Sector	KRH 2, Pusa RH 10, DRRH 2, Rajlaxmi, Sahyadri 4, DRRH 3, CRHR 32	PSD 3, Ajay, CoRH 3, Indira Sona, JRH 8
Private Sector	PHB 71, PA 6129, PA 6201, PA 6444, JKRH 401, Suruchi, GK 5003, DRH 775, HRI- 157, PAC 835, PAC 837 US 312, Indam 200-17, NK 5251, 27P11	

It is significant that the TNCs which dominate private hybrid rice research and development are also the world's biggest pesticide and biotechnology companies. It was the high-yielding varieties of the Green Revolution that ushered pest and disease problems onto the farms of Asia, and pesticides soon followed. The high susceptibility of hybrid rice to disease is likely to foster further dependence on agrochemicals. In this sense, hybrid rice presents a tremendous opportunity for pesticide companies, which are reeling from market saturation.

Hybrid rice may also increase pressure for deregulation of international trade in rice seeds. Hybrid rice seed developed by seed companies in India is already exported to Bangladesh and Burma. Such cross-border flows will discourage the development of national industries, but transnational seed companies, with a presence in many countries, can achieve substantial cost savings through economies of scale by concentrating breeding in one or two.

Hybrid rice is also bound to increase pressure for strong intellectual property rights (IPR) regimes in India. At present, there is little pressure for IPR on hybrid rice because few companies are carrying out research and development. As the big companies develop more hybrid lines,

they want to squeeze out smaller competitors with state sanctioned monopoly rights, to protect their investments also demand heavy legal protection. This trend is embedded in the requirements of the WTO agreement on intellectual property, known as TRIPS, which Asian countries have for the most part yet to implement. Given that major rice research institutions, such as IRRI, have begun incorporating patented genes into their breeding programs, such a development will give a clear advantage to the giant TNCs that dominate patents in plant biotechnology.

3. METHODOLOGY

The methodology applied for conducting the present study has been detailed below. This happens to be most vital component of any research process, as whole study and inferences drawn will have any value, only in case of scientific methodology adopted in the process.

3.1 Research Design:

Descriptive Research Design was used for the study. Descriptive research design has been chosen because it shows the cause and effect relationship and also helps in providing further clarity in understanding the problem.

3.2 Information Required:

To determine the feasibility of hybrid rice cultivation, information related to socio-economical factors, economical feasibility of hybrid rice and constraints which growers faced in adoption of hybrid rice was required to fulfill the objectives of the study.

3.3 Source of Data:

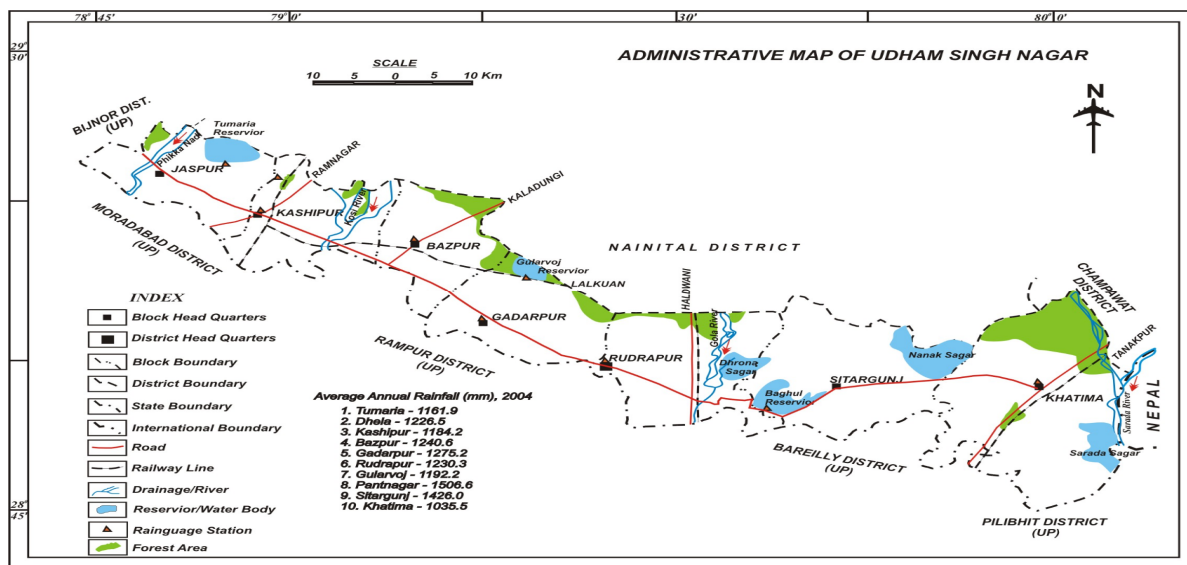
The achievements of the objectives of the proposed study required two types of data. They are as mentioned below:

3.3.1 Secondary Data: Secondary data was collected from different websites and portals, magazines, theses available in the university, State Agriculture Department and Local Government Institution.

3.3.2 Primary Data: Primary data was collected through one to one interaction with farmers. A structured questionnaire was used as it is less time consuming, generates specific and easier to tabulate and interpret. The questions were close as well as open ended, so as to provide ample opportunity for the respondents to give views freely.

3.4 Area of Study:

Study was conducted in Udham Singh Nagar district of Uttarakhand, which is divided into 7 blocks. The map of Udham Singh Nagar is shown in Map 2.



Map 2: Administrative Map of Udham Singh Nagar district

3.5 Sampling Plan:

Following sampling plan was adopted to conduct the study:

3.5.1 Universe:

Universe for the study is Udham Singh Nagar district. There are seven blocks in this district viz. Khatima, Sitarganj, Rudrapur, Gadarpur, Bazpur, Kashipur and Jaspur.

3.5.2 Sampling Unit:

Hybrid rice growing farmers of selected area were taken as sampling unit.

3.5.3 Sample Size:

Out of seven blocks, four blocks viz. Jaspur, Bajpur, Rudrapur and Sitarganj were included in sample to represent whole geographical area of district. From each of selected block, 30 farmers were selected in proportion to size of marginal, small and large farmers, therefore total sample size of 120 farmers was used so as to reduce the errors and improve the effectiveness of the research.

3.5.4 Sampling technique:

Snowball sampling technique was followed in selection of sample farmers

3.6 Research Instrument:

Field survey using a structured questionnaire containing closed ended questions was used as main research instrument to collect the required data from the sample farmers.

3.7 Analytical Tool:

The survey data was analyzed by applying the Cobb-Douglas production function analysis. The Cobb-Douglas production function was employed to establish the input-output relations between yield per hectare as dependent variable and six inputs viz., seed, irrigation, chemical fertilizers, human labour, machine labour and plant protection chemicals as independent variables for hybrid rice crop. The Exponential form of the production function was specified because it has been widely used in estimating input use efficiency by many researchers. The functional form meets the requirement of being self-dual. In addition, it allows examining economic efficiency. This type of production function is linear in its logarithmic form, and therefore easy to estimate by using Ordinary Least Squares (OLS) technique.

The general form of the function fitted was specified as follows:

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} e^u$$

Where,

Y = Yield in Qtl/hectare

X₁ = Seed in Kg/hectare

X₂ = Expenditure on manure and fertilizers in Rs/ hectare

X₃ = Expenditure on plant protection chemicals in Rs/ hectare

X₄ = Human labour in man days

X₅ = Expenditure on machine in Rs/ hectare

X₆ = Irrigation in number

u = Error term

e = nature term (27.182)

a = constant (intercept)

b_1, b_2, b_3, b_4, b_5 and b_6 are the respective partial regression coefficients (elasticity of production) of the explanatory variables.

The seriousness of co-linearity among the independent variables was tested using zero order correlation matrixes. The correlation value greater than 0.80 was considered as a sign of presence of multicollinearity between explanatory variables.

The equation was estimated using ordinary least squares (OLS) method. The Cobb-Douglas form of production function was converted into log linear form prior to applying OLS technique as under:

$$\ln Y = \ln a + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \ln U$$

This function can be expressed in the linear form as

$$y = a + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + U$$

Where

$$y = \ln Y; x_j = \ln X_j \text{ for } j = 1 \text{ to } 6; a = \ln a$$

To test the significance of regression coefficients the standard 't' test was used.

Test for significance:

t-test: The estimated regression coefficients (b_i 's) were tested for their significance at the chosen level using student t-test. Following formula was used.

$$t = \frac{b_i}{SE(b_i)}$$

Where

b_i = slope coefficients of i^{th} input

SE (b_i) = standard error of i^{th} input

Coefficient of multiple determination:

In order to ascertain the goodness of fit, coefficient of multiple determinations (R^2) was calculated using the formula:

$$R^2 = \frac{RSS}{TSS}$$

Where

RSS = regression sum of squares

TSS = total sum of squares

Production constraints faced by hybrid rice growers

To meet the last objective of the study related to the various constraints associated with adoption for hybrid rice, multiple responses of producers were taken into consideration for analysis. Information regarding the constraints faced by the farmers was collected by inquiring the farmers. Important constraints faced by the farmers were based on previous studies. The identified constraints were proposed to the respondents and the respondents were asked to rank them. Production constraints were ranked separately using Garret's ranking technique as follows:

$$\text{Per cent position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where

R_{ij} = Rank given for i^{th} constraints by j^{th} individual,

N_j = Number of constraints ranked by j^{th} individual.

The position of each rank was converted to scores by referring to tables given by Garret and Woodworth (1969). Then for each factor, the scores of individual respondents was summed up and divided by the total number of respondents from whom scores were gathered. The mean scores for all the factors were arranged in descending order and thus rank was assigned to the constraints.

3.8 Duration of Study: Duration of this research work was 60 days i.e. April- May 2013

4. RESULTS

The empirical findings to the different objectives of the study are presented and discussed in this section under following sub sections:

- Socio-economic status of hybrid rice growers.
- Economies of scale of hybrid rice.
- Constraints faced by farmers in the adoption of hybrid rice.

4.1 Socio-Economic Status of hybrid rice Growers

The socio-economic characteristics of the farmers effect the management of the farm as well as the production of the produce. In the present study, the socio-economic status of hybrid rice growers was assessed in terms of parameters like educational profile, family size, operational size of holdings, occupation and income of the hybrid rice growers.

4.1.1 Age-wise distribution of hybrid rice growers

The age of an individual has a great influence on his/her ability to take part in economic activities. Age-wise distribution of sample farmers is shown in Table 4.1 It is evident from the table that on overall basis 45.83 per cent of hybrid rice growers were in the age group of 31–50, around 30.83 per cent of farmers were in the age group of below 30 years and only 23.33 per cent farmers were in the age group of above 50 years.

Further, majority of the small (50 %), medium (40%) and large (46.87%) farmers were in the age group of 31–50 years.

Average age of the small, medium and large farmers was found to be 39.33, 49.90 and 53.87 years, respectively. It can be inferred that hybrid rice growing farmers of the study area were in middle age group.

Table 4.1: Age-wise distribution of hybrid rice growers

Age group (Years)	Category of farms			Overall
	Small(<2 ha)	Medium(2-4 ha)	Large(>4ha)	
<30	20 (41.66)	14(35.00)	3(9.37)	37 (30.83)
31 – 50	24(50.00)	16(40.00)	15(46.87)	55(45.83)
>50	4(8.33)	10 (25.00)	14 (43.75)	28(23.33)
Total	48 (100)	40 (100)	32 (100)	120(100)
Average age	39.33	49.90	53.87	47.70

Note: Figures in parentheses indicate percentage to total

4.1.2 Education-wise distribution of hybrid rice growers

The distribution of farmers according to education level is given in Table 4.2. It is evident from the table that at aggregate level, majority of the farmers 40 per cent attained the school education. However, 45 per cent of the medium farmers and around 43 per cent of the large farmers were found to attain school education. Whereas, approximately 42 per cent of small farmers were literate, 33 per cent attained the school education and 25 per cent had college education.

The result reveals that medium and large farmers were more educated than the small farmers.

Table 4.2: Education-wise distribution of hybrid rice growers (in number)

Education level	Category of farms			Overall
	Small	Medium	Large	
Literate (Informal or formal up to grade 5)	20 (41.66)	12 (30.00)	8 (25.00)	40 (33.33)
School (Grade 6 - 10)	16 (33.34)	18 (45.00)	14 (42.75)	48 (40.00)
College (Grade 10 onwards)	12 (25.00)	10 (25.00)	10 (31.25)	32 (26.67)
Total	48 (100)	40 (100)	32 (100)	120 (100)

4.1.3 Income-wise distribution of hybrid rice growers

The distribution of the respondent-farmers according to their annual income is given in Table 4.3. It can be easily determined from the table that at aggregate level, majority of the farmers (48.34 per cent) had an annual income more than Rs. 2 lakh. However, 87.50 per cent of the large farmers and 65 per cent of the medium farmers had an annual income more than Rs. 2 lakh. Whereas, 50 per cent of small farmers had an annual income less than Rs. 1 lakh. About 42 per cent of small farmers, 35 per cent of medium farmers and 13 per cent of large farmers had an annual income between Rs. 1 lakh to Rs. 2 lakh.

The result reveals that medium and large farmers were more financially viable than the small farmers.

Table 4.3: Income-wise distribution of hybrid rice growers

Income (Rs.)	Category of farms			Overall
	Small	Medium	Large	
< 100000	24 (50.00)	0 (0.00)	0 (0.00)	24 (20.00)
100000- 200000	20 (41.66)	14 (35.00)	4 (12.50)	38 (31.66)
> 200000	4 (8.33)	26 (65.00)	28 (87.50)	58 (48.34)
Total	48 (100)	40 (100)	32 (100)	120 (100)

Note: Figures in parentheses indicate percentage to total

4.1.4 Family composition and average family size of hybrid rice growers

Distribution of sample households according to the size of family is presented in Table 4.4. The result shows that the average size of family at aggregate level was 3.00, where as the average number of male and female was 1.28 and 1.19, respectively. The average family size of small, medium and large farmers was 3.00. The table illustrates that the average number of male and female per family was 1.08 and 0.96 in case of small farmers, 1.40 and 1.35 in case of medium farmers and 1.37 and 1.25 in case of large farmers.

Table 4.4: Family composition and average family size of hybrid rice growers

Category	Male	Female	Children
Small	43 (1.08)	37 (0.96)	29 (0.79)
Medium	40 (1.40)	31 (1.35)	19(0.45)
Large	32 (1.37)	24 (1.25)	16 (0.44)
Overall	115 (1.28)	92 (1.19)	35 (0.58)

Note: Figures in parentheses indicate the average number

4.2 Economies of scale of hybrid rice

To analyze for economic scale of hybrid rice gives us an ample justification for the better use of resources which are available for the production as well as disposal of the product. There is requirement for optimum utilization of input resources which significantly mark for better production of hybrid rice with which farmers could be gained. Studying economies of scale gives refined understanding for the resources used. An analysis of economies of scale in any area may furnish a base for further planning and development of agriculture. In the present study, the economies of scale of hybrid rice growers was assessed in terms of parameters like seed, irrigation, human labour, expenditure on plant protection, expenditure on manure and fertilizer by hybrid rice growers.

The size and distribution of operation land holding of hybrid rice growers is also presented in study. Farmers are categorized into small, medium and large farm on the basis of their operational land holding. All the parameters are emanated and elaborated in the following sub-sections.

4.2.1 Size and distribution of operational land holdings of hybrid rice growers

The operational land holdings of sample hybrid rice growers were collected. The average size of operational holding was found to be 1.34, 2.64 and 4.56 hectares at small, medium and large farmers respectively. Table 4.5 presents the distribution of farmers according to the land holding size. Majority of the sampled respondents were found belonging to small and medium

category. From the table it can be seen that majority of the sample respondents (40 per cent) had an operational land holding of less than 2 ha, 33.33 per cent had 2 - 4 ha and 26.67 per cent had more than 2 hectare.

Table 4.5: Distribution of farmers according to the size of operational land holdings

Serial no.	Average operational land holding size	Number of respondent	Percentage to total	Average size of operational land holding
1	Small (< 2 ha.)	48	40	1.34
2	Medium (2-4 ha.)	40	33.33	2.64
3	Large (> 4 ha.)	32	26.67	4.56
	Overall	120	100	

Note: Figures in parentheses indicate percentage to total

4.2.2 Seed requirement

Seed requirement by the categorized sample farmer has been shown in Table 4.6. It is evident from the table that seed used in different categories of farm per hectare is quite similar. There is only 0.16 per cent of difference between seed rate used by large and medium farmers. The percentage difference of seed rate used by small and large farmers is 0.32 percent.

Table 4.6 Distribution of seed rate used by farmers

Serial no.	Average operational land holding size	Quantity of seed used (Kg/ha)	Percentage difference from large farmers
1.	Small (< 2 ha.)	75.78	0.32
2.	Medium (2-4 ha.)	75.90	0.16
3.	Large (> 4 ha.)	76.02	-

4.2.3 Irrigation requirement

Irrigation source is taken out under different category as shown in table 4.7 Data mention that irrigated area under large category of farmer is highest of about an average of 2.16 followed by small and medium category of farmers i.e. 1.45 and 1.31(table 4.7). The irrigated area under

medium category of farmer is 39.35 per cent lower than large category of farmers while small category farmer have 32.87 per cent less possession of irrigation source.

Table 4.7 Distribution of irrigated area used by farmers

Serial no.	Average operational land holding size	Average Irrigated area	Percentage difference from large farmers
1.	Small (< 2 ha.)	1.31	39.35
2.	Medium (2-4 ha.)	1.45	32.87
3.	Large (> 4 ha.)	2.16	

4.2.4 Human labour

As per table 4.8, no of man days requirement in small category of farmer is highest i.e. 29 followed by large and medium category i.e. 23 and 22 respectively. The medium level farmers need 31 percent of less man days as required in small category of farmers.

Table 4.8 Distribution of human labour

Serial no.	Average operational land holding size	Human labour (man days/ha)	Percentage difference from small farmers
1.	Small (< 2 ha.)	29	-
2.	Medium (2-4 ha.)	22	31
3.	Large (> 4 ha.)	23	20

4.2.5 Manures and Fertilizer

The application of manure in farmer's fields is evaluated and shown in table 4.9. Result revealed that there is wide variation in use of manure application. As from table 4.9, 135 quintal per ha is being used in small farmer's category. The application of manure is lower in amount in case of medium and large farmer's category resulting about 125 and 90 quintal per ha respectively. Percentage difference between small and large farmer is about 46.66 while only 38.88 per cent between medium and large farmer's.

Table 4.9 Distribution of manure application used by farmers

Serial no.	Average operational land holding size	Manure used (Qtl/ha)	Percentage difference from large farmers
1.	Small (< 2 ha.)	132	46.66
2.	Medium (2-4 ha.)	125	38.88
3.	Large (> 4 ha.)	90	-

For fertilizer used by farmers in their field which is emanated in table 4.10 shows that there is slight variation in between the application. As per table 4.10 highest dose of fertilizer is being used by the large category farmer's of about 85 quintal per hectare. Use of fertilizer by the medium and small category of farmer's is 80 and 75 quintal only.

Table 4.10 Distribution of fertilizer application used by farmers

Serial no.	Average operational land holding size	Fertilizer used (Qtl/ha)	Percentage difference from large farmers
1	Small (< 2 ha.)	75	11.76
2.	Medium (2-4 ha.)	80	5.88
3.	Large (> 4 ha.)	85	-

4.2.6 Cost of manure and fertilizer

Manure and fertilizer cost has been evaluated together. Cost incurred to the large category farmer is highest of about 2845 Rs/ha, table 4.11. Cost incurred to small and medium category of farmer is 2284 and 2565 Rs/ha respectively. About 20 and 10 percentages difference for small and medium category has been taken out as per with large category farmers.

Table 4.11 Cost of manure and fertilizer used by farmers

Serial no.	Average operational land holding size	Cost(rs/ha)	Percentage difference from large farmers
1	Small (< 2 ha.)	2284	20
2.	Medium (2-4 ha.)	2565	10
3.	Large (> 4 ha.)	2845	-

4.2.7 Expenditure on machine

Expenditure on machine in medium category level of farmer is 5362 followed by 4722 and 4214 in large and small category of farmers. As per table, small category farmers have 21 per cent less expenditure as compared with medium category farmer.

Table 4.12 Expenditure on machine used by farmers

Serial no.	Average operational land holding size	Expenditure on machine (Rs)	Percentage difference from Medium farmers
1	Small (< 2 ha.)	4214	21
2.	Medium (2-4 ha.)	5362	-
3.	Large (> 4 ha.)	4722	12

4.2.8 Expenditure on plant protection

Plant protection expenditure of the farmers is evaluated and tabulated in 4.13. It is evident from the figure that large category of farmers have highest expenditure on plant protection of about 4721.3 Rs followed by 4695.13 Rs in medium category of farmers. The average expenditure of small category farmer is 4213.51 Rs. There is only slight difference of

0.55 per cent for medium level farmers while small category farmer's expenses are 10.75 per cent less than large category farmers.

Table 4.13 Expenditure on plant protection

Serial no.	Average operational land holding size	Average expenditure on plant protection (Rs)	Percentage difference from Large farmers
1	Small (< 2 ha.)	4213.51	10.75
2.	Medium (2-4 ha.)	4695.13	0.55
3.	Large (> 4 ha.)	4721.3	-

4.2.9 Regression analysis with Cobb douglas production function

Factor affecting hybrid rice productions were analyzed by taking Cobb Douglas production function to show input and output relation. Results of regression analysis of yield of hybrid rice pertaining to category of small scale farms, given in Table 4.14, depicted that seed, expenditure on plant protection chemical and expenditure on machine were the major factors responsible for significant impact on yield of hybrid rice. Only seed rate show an inverse relationship with the production while expenditure on plant protection chemical and expenditure on machine reveal a positive relation with production of hybrid rice. Expenditure on machine was the most dominant and significant factor to increase the production indicating that one unit (Rs) increase in expenditure on machine could result in an increase of about 2.25 kg of production. A perusal of Table 4.14 also revealed that all the explanatory variables collectively explained about 78 per cent of the variations in the yield of hybrid rice under small scale farmer's category.

Table 4.14 Estimated coefficient of Cobb Douglas production function for small farmer category

Number of observations	Regression Co-efficient							R ²
	a	β_1	β_2	B ₃	B ₄	β_5	β_6	
48	1.1399	-0.2229**	0.1973	0.0938**	0.4647	0.0225*	-0.0410	0.78

* showing significance at 1% level, ** showing significance at 5 % level

Regression analysis on yield of hybrid rice pertaining to category of medium scale farmer, given in Table 4.15, shows that expenditure on manure and fertilizer, expenditure on plant protection chemical and expenditure on machine were the major factors responsible for significant impact on yield of hybrid rice. Over here show expenditure on machine have an inverse relationship with the production while expenditure on manure and fertilizer and expenditure on plant protection chemical reveal a positive relation with production of hybrid rice. In this category expenditure on manure and fertilizer was the most dominant and significant factor to increase the production indicating that one unit (Rs) increase in expenditure on manure and fertilizer could result in an increase of about 40 kg of production. As with table 4.15, it is also emanated that all the explanatory variables collectively explained about 72 per cent of the variations in the yield of hybrid rice under category of medium scale farmers.

Table 4.15 Estimated coefficients of Cobb-Douglas production function for medium farmer category

Number of observations	Regression Co-efficient							R ²
	a	β_1	β_2	β_3	β_4	β_5	β_6	
40	7.2148	0.4641	0.4006**	0.3802**	-0.2612	-0.0460***	-1.0733	.7115

* showing significance at 1% level, ** significance at 5 % level, *** significance at 10 % level

Regression analysis on yield of hybrid rice pertaining to category of large scale farmer, given in Table 4.16, shows that seed rate, expenditure on manure and fertilizer and irrigation were the major factors responsible for significant impact on yield of hybrid rice. Over here seed rate have an inverse relationship with the production while expenditure on manure and fertilizer and irrigation reveal a positive relation with production of hybrid rice. Over here expenditure on manure and fertilizer was the most dominant and significant factor to increase the production indicating that one unit (Rs) increase in expenditure on manure and fertilizer could result in an

increase of about 52 kg of production. As with table 4.16, it is also emanated that all the explanatory variables collectively explained about 87 per cent of the variations in the yield of hybrid rice under category of large scale famers.

Table 4.16 Estimated coefficients of Cobb-Douglas production function for large scale farmer’s category

Number of observations	Regression Co-efficient							R ²
	a	β_1	β_2	β_3	β_4	β_5	β_6	
32	0.8914	-1.226**	0.5237*	0.0046	0.066	0.2073	0.4023**	0.8736

* showing significance at 1% level, ** significance at 5 % level

An aggregate merged pool of all the three categories of farmers was analyzed on production of hybrid rice. Regression analysis done as shown in Table4.17 reveals that seed rate, expenditure on plant protection chemicals and expenditure on machine are the major factors which are responsible for significant impact on production of hybrid rice. Pooled data table also shows that overall only seed rate has inverse relation with the production while expenditure on plant protection chemical and expenditure on machine have positive relation with production of hybrid rice. In positive figure, expenditure on machine was the most significant factors to increase the production indicating that one unit (Rs) increase in expenditure on machine could result in an increase of about 38 kg of production. As with table 4.17, it is also emanated that all the explanatory variables collectively explained about 76 per cent of the variations in the yield of hybrid rice for all the farmers.

Table 4.17 Estimated coefficients of Cobb-Douglas production function for all farmers

Number of observation	Regression Co-efficient							R ²
	β_0	β_1	β_2	β_3	β_4	β_5	β_6	
120	-0.2614*	-1.0259	0.7248	0.146***	0.466	0.3823***	0.5717	0.76

* showing significance at 1% level, ** significance at 5 % level, *** significance at 10 % level

4.3: Constraints faced by the farmers in adoption for hybrid rice

The constraints faced by farmers in production of hybrid rice are discussed under this section. To investigate the constraints faced by farmers, several production constraints were put before the sample farmers and asked to rank them according to their severity. The ranks given by the farmers were converted into the average per cent position and then into scores. Finally, the scores were converted into the ranks with the help of Garrett ranking table.

4.3.1 Constraints faced by the small farmers in adoption for hybrid rice

Prioritizing of various constraints involved in adoption for hybrid rice based on Garrett scores is depicted in Table 4.18. An analysis of the table indicates that the high cost of seeds was the most severe constraint amongst various production constraints with a average score of 68.17. The inadequate availability of fertilizers was reported to be the second most important constraint at small farm level, whereas the high incidence of pest and disease was ranked as the third most important constraint faced by small farmers..The other severe constraints faced by small growers were low output prices during harvesting, inadequate irrigation facilities, unavailability of quality pesticides.

Table 4.18 Ranking of various constraints faced by small farmers in production of hybrid rice

S. No.	Constraints	Total Score	Average Score	Rank
1	High cost of seeds	3272	68.17	1
2	Inadequate availability of labour	1783	37.15	10
3	High incidence of pest and disease	3018	62.88	3
4	Weed occurrence	1890	37.90	9
5	Untimely rains	2046	42.63	7
6	Inadequate irrigation facilities	2243	46.73	5
7	High output price fluctuations	1953	40.69	8

8	Low output price during harvesting	2520	52.50	4
9	Unavailability of quality pesticides	2108	43.92	6
10	Inadequate availability of fertilizers	3207	66.81	2

4.3.2 Constraints faced by the medium farmers in adoption for hybrid rice

The major constraints involved in adoption for hybrid rice faced by the medium farmers were identified and presented in the Table 4.19. It is evident from the table that the most severe constraint faced by the medium farmers is the inadequate availability of fertilizers with a average score of 71.75. High cost of seeds is the second most important constraint faced by the medium farmers with a average score of 66.23

Table 4.19 Ranking of various constraints faced by medium farmers in production of hybrid rice

S. No.	Constraints	Total Score	Average Score	Rank
1	High cost of seeds	2609	66.23	2
2	Inadequate availability of labour	1878	46.95	5
3	High incidence of pest and disease	1753	43.83	6
4	Weed occurrence	1650	41.25	8
5	Untimely rains	1990	49.75	4
6	Inadequate irrigation facilities	1571	39.27	9
7	High output price fluctuations	1659	41.47	7
8	Low output price during harvesting	2501	65.53	3
9	Unavailability of quality pesticides	1505	37.63	10
10	Inadequate availability of fertilizers	2870	71.75	1

4.3.3 Constraints faced by the large farmers in adoption for hybrid rice

Table 4.20 reveals that the most severe constraint was found to be inadequate availability of labour with a average score of 63.94. Next to the problem of inadequate availability of labour, inadequate availability of fertilizers was another foremost constraint with a average score of 65.94. Fluctuations in output prices was ranked third important constraint in adoption for hybrid rice with a average score of 63.94 by the large farmers.

Table 4.20 Ranking of various constraints faced by medium farmers in production of hybrid rice

S. No.	Constraints	Total Score	Average Score	Rank
1	High cost of seeds	2046	39.59	8
2	Inadequate availability of labour	2229	69.66	1
3	High incidence of pest and disease	1549	48.40	5
4	Weed occurrence	1289	40.28	7
5	Untimely rains	1634	51.06	4
6	Inadequate irrigation facilities	1244	38.87	9
7	High output price fluctuations	1267	63.94	3
8	Low output price during harvesting	1541	48.16	6
9	Unavailability of quality pesticides	1074	33.56	10
10	Inadequate availability of fertilizers	2110	65.94	2

The other such constraints descended orderly based on the seriousness of the problems were untimely rains, high incidence of pest and disease, low output price during harvesting, weed occurrence, high cost of seed, inadequate irrigation facilities and unavailability of quality pesticides.

5. RECOMMENDATIONS FOR THE ACTION

The research method followed was basically descriptive in nature. The survey was limited to farmers producing hybrid rice. Time was fundamental dimension while studying the lives of persons and their socio-economic conditions. Therefore due to time limitations, longitudinal study over the period of time was not carried out.

The study was carried out to know the economic feasibility of hybrid rice along with the socio-economic status of the farmers, what major constraints are withdrawing the use of hybrid rice in the study area. So this research may help and form the platform for further research in hybrid rice economics.

Following are the suggestion from the conduct study:

1. Expenditure on machine, expenditure on manure and fertilizer, expenditure on plant protection chemical and irrigation facilities are the most significant factors which have impact over the yield of the hybrid rice under different category of farmers. There is need to provide the information for particular factors persuading the production of hybrid rice different farm level.
2. The high cost of seed, inadequate availability of fertilizers, inadequate availability of labour are the major constraint for adoption of hybrid rice. Hybrid rice varieties are expensive in nature, mainly because of the complex technology involved in developing and rendering them beyond the reach of the average farmer. To increase the adoption of hybrid rice, the government needs to provide subsidies to farmers for packaged technology used for the production. The wages of labour is needed to be increased so that there shortage could be solved.

6. REFERENCES

- Agriculture statistics at a glance- (2010), Department of agriculture and cooperation, Ministry of agriculture,GOI
- DRR (Directorate of Rice Research) (2007), Development and use of hybrid rice technology in India: project report. Hyderabad (India)
- Hand book of Statistics (2009-100), Directorate of rice research, Patna
- Hasan, R. (2009), Technology adoption, profitability and yield gap in rice cultivation in Bageshwar district of Uttarakhand.
- Janaiah A. (2000), Economic impact of crop management on productivity and profitability of hybrid and inbred rices in India: evidence from a farm-level study. *Indian J. Agric. Sci.* 70(2).
- Janaiah, A., and Chengappa, P.G. (2003), The seed delivery system in Andhra Pradesh: institutional and policy issues. *Indian J. Agric.Market.* 17(2).
- Janaiah, A., and Hossain, M., (2003), Can hybrid rice technology help productivity growth in Asian tropics? Farmers' experiences. *Econ. Political Weekly* 38(25):2492-2501.
- Kumar, P., Rosegrant, M.W. and Viraktamath, B.C. (2000), Productivity and sources of growth for rice in India. *Econ. Political Weekly* 29(53):A183-A188.
- Ojogho,O., and Alufohai, G.O. (2010), "Progress in the Development and Use of Hybrid Rice Outside China", *Hanoi,*. pp. 10–11.
- Singh H.N., Singh U.S. and Mohanty S. (2010), "Economic assessment of Pusa Rice Hybrid 10: a policy approach to enhancing and stabilizing income of rice farmers in Uttarakhand, India" *Presented at the 28th International Rice Research Conference, Hanoi, Vietnam.*
- Uttarakhand Sankhyiki Patrika, (2009-10).
- Viraktamath, M.C. and B. Nirmala. (2009). Economics of hybrid rice seed production in India.
- Yuan, LP. (2004), "Recent Progress in the development of Hybrid Rice in China" in Proceedings of the Workshop on Policy Support for Rapid Adoption of Hr on large scale adoption in Asia.

ANNEXURE I

QUESTIONNAIRE FOR FARMERS

1. Block:

2. Village:

3. Name of Respondent:

4. Contact No.:

5. Age:

6. Gender:

7. House Hold Details:

Type of House		No. of Family Members			No. of Dependents in Family			No. of Family Members Involved in Agriculture & Allied work		
Kucha	Pucka	M	F	Total	Male	Female	Total	Male	Female	Total

8. Family Education:

Adults	Gender	Education	Children	Gender	Education
1			1		
2			2		
3			3		
4			4		

9. Land Holding & Other Assets:

Irrigated Land			Other Assets					
Own Land (Acres)	Land on Lease (Acres)	Total (Acres)	Tractor (No.)	Agriculture Implements	Motorized Vehicle		Mobile Phone (No.)	Any Other
					Type	No.		
					2Wheeler			
					3Wheeler			
					4Wheeler			

10. Source of Irrigation:

Source	Quantity/No.	Area Irrigated	Percentage of Total Land
Submersible (no.)			
Tube well (no.)			
Canal (no.)			
River (no.)			
Drip Irrigation			

11. Crops You are Cultivating:

Crop	Land Devoted (Acres)	Variety	Irrigated	Un-Irrigated	Production/Acre	Price/Ql.
Wheat						
Paddy						
Pease						
Sugar Cane						
Horticulture						
Floriculture						

12. Agriculture Allied Activities:

Activity	No. of Units Owned	Income/Annum
Dairy (No. of Milch Cattle)		
Fisheries (No. of Ponds)		
Poultry (No. of Chickens in Farm)		
Mechanical Services (Tractor, Combine Harvester, Thresher etc.)		

13. Other Source of Income (Other than Agriculture & Allied Activities):

Work	Tick (√)	Income/Month
Labor		
Salaried Job	Govt.	
	Private	
Any Other		

14. Irrigation cost

No. of operation	Human labour days				Source	Rate	Electricity or fuel charges	Total water charges	
	Days	Type		Rate					Total Exp.
		Hired	Owned						

15. Operational cost:

Sl.No.	Operations	No of operations	Human labour days					Farm Machinery/ tools hours				
			Days	Type		Rate (Rs/Mandays)	Total Exp.	Hr.	Owned/hired	Rate	Total Exp.	
				Hired	owned							
1	Land preparation											
2	Manuring											
3	Fertilizer application											
4	Sowing											
5	Plant Protection											
6	Harvesting											
7	Threshing											
8	Transportation											

16. Harvesting

Operation	Date	Man-days				Value	Produced Quantity	Sold Quantity	Price	Value
		Family		Hired						
		M	F	M	F					
Harvesting										

17. Material cost:

Sl.No.	Material	Quantity		Rate/Kg	Value	Area
		Own	Purchased			
1	Seed					
2	Manure					
3	Fertilizers					

a.	Nitrogenous					
b.	Phosphatic					
c.	Compound/Mixture					
d.	Other					
4	Plant Protection					
a.	Insecticide					
b.	Fungicides					

18. Constraints faced in adoption of hybrid rice:

Sl. No.	Problems	Response
1	High cost of pesticide	
2	Inadequate availability of labour	
3	High incidence of pest and disease	
4	Unavailability of quality pesticide	
5	Untimely rains	
6	Lack of irrigation facilities	
7	High output price fluctuation	
8	Low output price during harvesting	
9	Inadequate availability of quality seeds	
10	Inadequate availability of fertilizer	
11	Weed occurrence	

ANNEXURE II

GARRETT RANKING CONVERSION TABLE

The conversion of orders of merits into units of amount of “soces”

Percent	Score	Percent	Score	Percent	Score
0.09	99	22.32	65	83.31	31
0.20	98	23.88	64	84.56	30
0.32	97	25.48	63	85.75	29
0.45	96	27.15	62	86.89	28
0.61	95	28.86	61	87.96	27
0.78	94	30.61	60	88.97	26
0.97	93	32.42	59	89.94	25
1.18	92	34.25	58	90.83	24
1.42	91	36.15	57	91.67	23
1.68	90	38.06	56	92.45	22
1.96	89	40.01	55	93.19	21
2.28	88	41.97	54	93.86	20
2.69	87	43.97	53	94.49	19
3.01	86	45.97	52	95.08	18
3.43	85	47.98	51	95.62	17
3.89	84	50.00	50	96.11	16
4.38	83	52.02	49	96.57	15
4.92	82	54.03	48	96.99	14
5.51	81	56.03	47	97.37	13
6.14	80	58.03	46	97.72	12
6.81	79	59.99	45	98.04	11
7.55	78	61.94	44	98.32	10
8.33	77	63.85	43	98.58	9
9.17	76	65.75	42	98.82	8
10.06	75	67.48	41	99.03	7
11.03	74	69.39	40	99.22	6
12.04	73	71.14	39	99.39	5
13.11	72	72.85	38	99.55	4
14.25	71	74.52	37	99.68	3
15.44	70	76.12	36	99.80	2
16.69	69	77.68	35	99.91	1
18.01	68	79.17	34	100.00	0
19.39	67	80.61	33		
20.93	66	81.99	32		

VITA

Sushil Kumar, the author of this manuscript, born on November 26th, 1989 at Uttarkashi, district of Uttarakhand. After passing his senior secondary school examinations from Kendriya Vidyalaya Uttarkashi in 2007, he got admission at College of Home Science, G.B. Pant University of Agriculture & Technology from where he completed B.Sc. in Home Science in year 2011. Due to interest in management, he joined post graduate degree programme in management and therefore he got admitted in G.B. Pant University of Agriculture & Technology, Pantnagar to pursue the study programme leading to degree of MBA (Agribusiness) degree. While pursuing MBA, he did his summer internship at Indo-Gulf Fertilizer (An Aditya Birla Enterprise). In the month of November, 2012 during campus placement season, he was selected by MAHYCO seeds for the post of Management trainee.

Permanent Address:

Sushil Kumar S/O Hari Krishan

District Cooperative Bank Ltd.

Uttarkashi, Uttarakhand INDIA. 249193

Email: sushilkumar00927@yahoo.com