Impact Study on Introduction of Green Gram *(Vigna radiata L.)* Cultivation in Sundarban, West Bengal

Central Inland Fisheries Research Institute
(Indian Council of Agricultural Research)
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IMPACT STUDY ON INTRODUCTION OF GREEN GRAM *(VIGNA RADIATA L.)* CULTIVATION IN SUNDARBAN, WEST BENGAL

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Foreword

Rapid economic growth is essential for achieving food security for all. The challenge is to achieve that growth in a way that benefits the poor- Pro Poor Economic Growth. Pro poor economic growth can take place only if poor people have access to productive resources and remunerative employment.

Sundarban, the biggest delta of the world covering 10000 square kilometer area is famous for its Mangrove ecosystem, Sundari tree and Biosphere reserve. Agriculture in Sundarban is totally depending on rice based cropping system. Under ICAR's Frontline Demonstration programme on oilseeds and pulses, Demonstration on Green gram cultivation technology was conducted on farmers' field in 5 adopted development blocks of KVK of CIFRI, Kakdwip. Impact study on "Introduction of Green Gram Cultivation in Rice Fallow System in Sundarban, West Bengal" has been done to assess the socio-economic advancement of farming communities in reference to various social, economic indicators, sustainability and food and livelihood security. This study has thrown light on the changes in the livelihood of the farming populace of Sundarban.

D. Nath
Director

PREFACE

In the context of sustainable agricultural development, agricultural extension has a very crucial role to play. The tasks and responsibilities of extension service will need to be broad-based and holistic in contents and scope, thus beyond agricultural technology transfer. Its normal task of transferring and disseminating to farmers appropriate agricultural technologies and good farm practices would not be sufficient. Traditional Extension has been a top down process. Scientists developed products and methods which, following promulgation by Extension agencies: farmers were expected top adopt. Farmers' aattitude and their lack of knowledge were considered to be the main barriers to adoption. Little consideration was give to farmers point of view.

Agriculture in Sundarban is represented by rice based cropping systems, where rice is the most dominant crop and in most parts it was the single crop grown and harvested in whole agriculture year. With the start of Technology Mission on pulses, Frontline Demonstration on Green gram were conducted in five development blocks of KVK viz. Kakdwip, Namkhana, Patharpratima, Sagar and Kulpi.

This impact study was conducted in the year 2002-2003 and thrown light on the valuable information about the social and economic development of the farming community through the adoption of Green Gram cultivation in Sundarban. The results has shown that how the objectives of sustainability, Environmental protection and food and livelihood security was achieved. This research study has also given some insight into the increase in labour utilisation and decrease in rural to urban migration.

Hope this study will help Scientists and Researchers in future studies.

AUTHORS

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IMPACT STUDY OF INTRODUCTION OF GREEN GRAM (*Vigna radiata L.*) CULTIVATION IN RICE FALLOW SYSTEM OF SUNDARBAN, WEST BENGAL

INTRODUCTION

The world has entered in 3rd millennium, but humanity faces a glaring contradiction; the persistence of desperate hunger and environmental degradation among plenty. Each day the earth witness 800 million people go hungry and about 170 million children less than 5 years of age suffer from malnourishment. This situation is a human tragedy on a vast scale, made even worse because it is unavoidable. Although many Indians still do not have access to adequate diet, although the national food situation is better today and we are self-sufficient in cereals. The nation produces and consumes about 200 million tones of food grains each year (includes seeds and wastage).

Agriculture is viewed broadly as a dynamic sector tightly interconnected to the rest of the economy. Agriculture now becomes a key element within a food and agri-industrial system. It creates economic growth by generating jobs, incomes and savings; reduces poverty and food insecurity; enhances the natural resource base; and fastens greater social contributions including domestic tranquility.

The recent changes in the orientation of the agricultural research, both at the international and national level, the development of appropriate crop production technologies for various agro-ecological zones and systems, advent of powerful, user-friendly information and communication technologies and cumulative effect of globalization of agricultural economy world wide and redefining the future of mankind.

The movement towards stronger participation by farmers in agriculture research and extension is fuelled by a growing realisation that the socio-economic and agro-ecological conditions of (especially low income) farmers are complex, diverse and risk prone and that conventional approach, based on research station trials followed by unidirectional technology transfers is unlikely to be fruitful. Close engagements with the farmers through the cycle of diagnosis, experimentation and dissemination increases understanding of these conditions, of the opportunities and constraints farmers face and of their own technical knowledge.

Several well tested and proven technologies to enhance production and productivity of the crops and powerful communication technologies are available in the hands of researchers; still the world is challenge by the vicious cycle of poverty, malnutrition and environmental degradation. In a country like India

where a large population is vegetarians, the cheap and best sources of protein are still pulses. Besides being rich in protein, they sustain the productivity of cropping system. Their ability to use atmospheric nitrogen through biological nitrogen fixation is economically sounder and ecologically acceptable.

Table-1 Share of pulses in nutritional supply

Per capita / day	World	Asia	India
Energy (Kcal)	56.00	51.90	117.40
Protein (mg)	3500	3100	6900
Fat (mg)	400	400	1000

The share of pulses in the nutritional supply of per capita/day in Indian diet in comparison to world and Asian per capita consumption of pulses is considerably higher (Table 1). India's subscription to considerably higher consumption of pulses is to insure supply of more protein as well as fat and for generation of adequate energy.

Sundarbans, world biggest delta, is one of the most unique regions, measuring over 10000² Kms. This mangrove ecosystem stretches across coastal West Bengal and Bangladesh over the northern parts of Bay of Bengal. It is dominated by rice-rice based cropping system, where generally rice-fallow cropping system is being enhanced every year. The current situation has geometrically been deteriorating the soil potential with very high incidence of salinity and spread of uncultivated land.

Small and marginal farmers whose livelihoods depend only on agriculture predominantly populate this area. Any change in cropping practices there is worthless unless it is —

- Culturally appropriate
- In agreement with self interest
- Clearly beneficial
- Not economically risky

Moreover, the small and marginal farmers in this tract have certain limitations which include —

- Lack of capital beyond family supply
- Habit of not investing or using credit or outside input
- Little access to outside agricultural support system
- Reluctance to take risks.

Being abreast with all these characters, introduction of summer Green gram cultivation in the 5 adopted blocks of Krishi Vigyan Kendra of CIFRI viz. Kakdwip, Namkhana, Patharpratima, Sagar and Kulpi were started under Frontline Demonstration Programme on oilseeds and pulses with special emphasis on growing at least one crop in summer season when the field is lying vacant. The critical yield gap in production of Green gram crop at national level is given in the following Table -2.

Table –2 Critical yield gaps in Green gram farming

Crop	Yield potential on research plots (q/ha)	Yield under FLD at farmers field (q/ha)	National average (q/ha)
Green gram	11-12	9-10	3.81

Transfers of technology are what keep the wheels of agricultural development moving. The success of agricultural and rural development strategy as initiated, planned and developed by the planners and the scientists hinges on the effectiveness of the extension machinery and personnel, whose task is to transfer the technology from lab to land.

The present impact study of introduction of green gram cultivation in rice fallow cropping system in Sundarbans was done to assess the socio-economic betterment of farming community with following objectives:

- To study social as well as economic betterment of farming community through adoption of Rice-Green gram crop rotation
- To study various constraints affecting farmers in adoption of these technologies
- To study the impact of KVK activities on rural population.

METHODOLOGY

The study was conducted in 4 selected villages viz. Nandabhaga, Debnibas, Belpukur, and Gangadharpur from within the adopted community development blocks of KVK, Kakdwip. The coverage was made of 60 farmers randomly, 15 from each village belonging to marginal, small and medium category.

This study was done using Participatory Rural appraisal techniques, Formal household Survey using questionnaire with open ended questions and Focused Group Discussion with the participants. PRA tools used for this purpose were transect, resource map, Seasonality of livelihood (pre and post) change of livelihood (pre and post), timeline and economic ladder analysis before the start of FLD on Green Gram and after 10 years.

As a part of exploratory study a schedule was developed to elicit responses from farmers about Green gram cultivation in Rice-fallow system. The primary purpose was to determine what changes did happen after cultivating Green gram since last several years. Details regarding their characteristics, cropping pattern, adoption pattern, seed source, varietals preference of the farmers, biotic and abiotic constraints and cost of cultivation. In addition to this, it also includes questions about farm size and farmers' experience as well as questions regarding concerns they have in growing Green gram.

Under Focused Group discussion, list of activities undertaken through FLD on Green gram in the respective villages was made. It is later validated with local informants to ensure that no important activity should be omitted. Considering each activity the villagers were asked about the effect of KVK programme on increasing income, food availability, soil nutrient replenishment, sustainability of land and constraints being faced by them.

This impact study was conducted in the month of May-June 2002, using before- after analysis. Triangulation of data was done to improve the validity and reliability of the result. Although open-ended questions tend to be more difficult and time consuming to analyze, they presumably provide "unbiased, unconstrained and thoughtful responses". Answering these questions allowed respondents the opportunity to elaborate on responses that would otherwise be constrained if close-ended questions were asked.

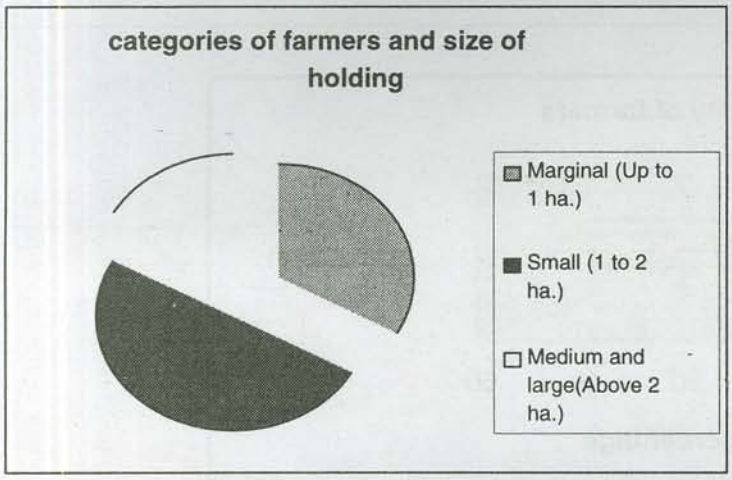
RESULTS AND DISCUSSION

Demographic Characteristics

A total of sixty farmers were selected for this study from four selected villages, *viz.* Nandabhaga, Debnibas, Belpukur, and Gangadharpur, belonging 33% to marginal farmers, 50% to small farmers and 17% to medium and large farmers. The distribution of various categories of farmers is given in Table 3. The great majority (more than 80%) of the farming population of this area belongs to small and marginal category.

Table-3 Category of farmers and size of holding

Categories and size of holding	farmers(N=60)	Percentage
1. Marginal (Up to 1 ha.)	20	33
2. Small (1 to 2 ha.)	30	50
3. Medium and large (Above 2 ha.)	10	17



The farmers surveyed (90%) do largely depend on agriculture as the only source of income, while 10% of them have secondary source of income that includes business and daily wage income from non-farming work though in every case farming remains to constitute their primary source of income and livelihood.

The educational qualification of respondent farmers shows that 70% of them are having education up to secondary level. 20% of them can only read and write, while remaining 10% are illiterate. This shows that rate of literacy among farming population is satisfactory and this may have helped them in responding quickly to new technologies. Eighty percent of the respondent farmers belong to the general categories and 20% of them are to Scheduled Caste/ Scheduled Tribe and Other Backward Classes.

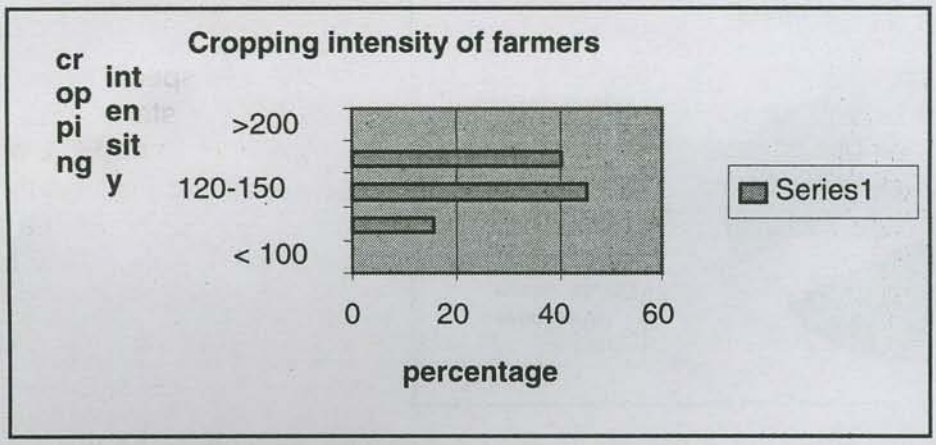
Agricultural Characteristics

To cope with the prevailing land situation in Sundarbans, all the selected farmers under this study were motivated by extension agents to grow green gram on lowland. The predominant soil type is clay loam texture.

The average cropping intensity in Sundarban areas at present is only 116%. 40% of the respondent farmers have cropping intensity of more than 150%, 45% of the farmers have in between 120-150% and 155 of them have a cropping intensity of less than120%.

Table-4 Cropping intensity of selected farmers

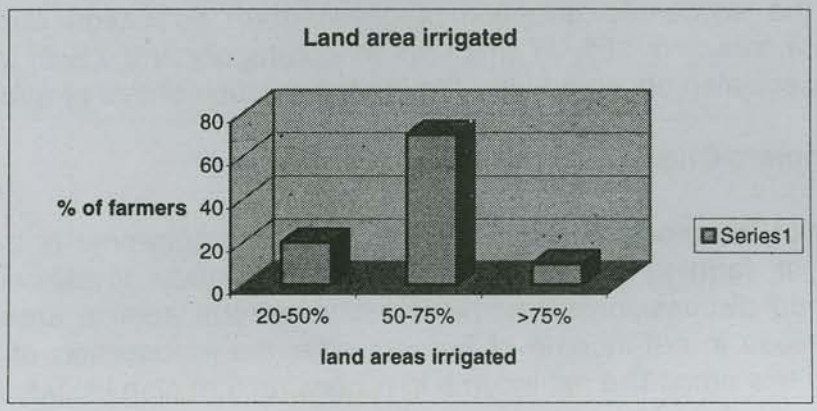
Cropping intensity	No. of farmers (N=60)	Percentage
1. less than 100	-	-
2.100-120	9	15
3. 120-150	27	45
4. 150 -200	24	40
5. 200 and above	-	-



The prevalent farming situation in Sundarbans areas being characterised by Kharif season with paddy cultivation in rain-fed condition and water requirement for growing Rabi and summer crops is met only through residual soil moisture and/or stored rain-water. One of the greatest lacunae faced by the farmers of this area is lack of soil moisture. The green gram crop requires only one irrigation during its whole life span. But farmers with assured irrigation facilities prefer vegetable and commercial crops like betel vine to food grain and oilseeds crops. 20% of the respondent farmers have irrigated land between 20 to 50% while 70% of them have irrigated land between 50 to 75% and only 10% of the farmers have more than 75% of their land irrigated. 95% of the respondents have pond as their source of irrigation and only 5% are irrigating their field using canal water.

Table –5 Land areas irrigated

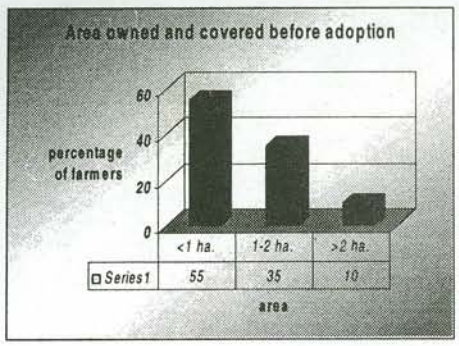
Land area irrigated (%)	No. of farmers(N=60)	Percentage
1. 0-10	-	-
2.10- 20	-	-
3. 20-50	12	20
4. 50-75	42	70
5. 75 and above	6	10

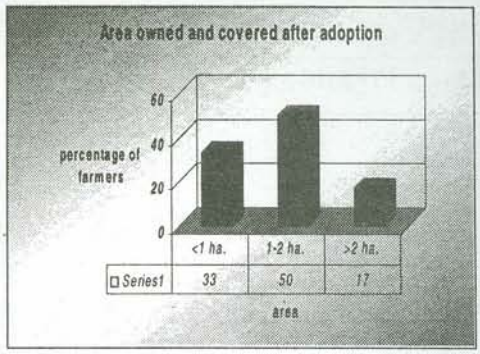


During the discussion and survey the respondents were specifically asked about the land-base, i.e., cultivated land that they had before the start of FLD and at present. It has been found that before the start of this programme 55% of the farmers belonged to marginal farmers' category, having a land area of less than 1 hectare and at present the percentage has been reduced to 33%. Before the start of FLD 35% of the farmers had land area of 1 to 2 hectares that has now been increased to 50%. The category of Medium and large farmers included only 10% before the start of FLD, and the percentage has at present escalated to 17%.

Table -6: Total land area owned and covered

Area owned and covered	Before		After	
	Farmers (N=60)	Percentage	Farmers (N=60)	Percentage
Up to 1 ha.	33	55	20	33
1-2 ha.	21	35	30	50
2 and above	6	10	10	17





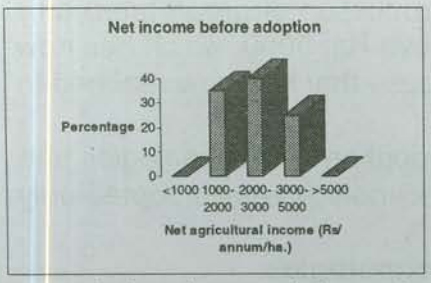
A decrease of 22% was seen in farmers with less than 1 hectare of land area after the successful adoption of green gram cultivation during summer season. An increase of 15% in small farmers' category and 7% in large farmers categories were also observed after the implementation of this programme.

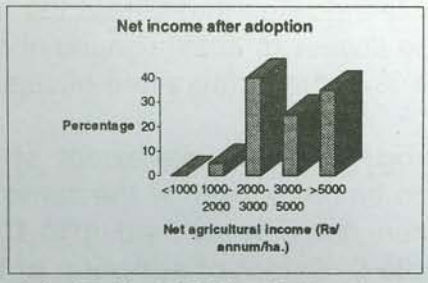
Socio-economic Characteristics

One of the most significant aspects of any programme is the economic betterment of farming community. During PRA study (livelihood analysis), focused group discussion and household survey, one special area of concern was an increase in net income of farmers after the introduction of green gram cultivation in this area. The net income in rupees/annum also includes the income coming from next paddy crop grown after the green gram crop, because the following paddy crop gets their nutrient supply through fixed nitrogen of preceding green gram crop. The replenishment of soil nutrient by the green gram crop always reduces the cost of cultivation of next paddy crop because of its stored nitrogen supply.

Table-7 Changes in Net income

Net agricultural income (Rs/ annum/ha.)	Before		After	
	Farmers (N=60)	Percentage	Farmers (N=60)	Percentage
Less than 1000	-	-	-	-
1000-2000	21	35	3	5
2000-3000	24	40	24	40
3000-5000	15	25	15	25
5000 and above	-	-	18	35





It is observed from the table 7 that 35% of the farmers earlier had net income less than Rs. 2000/annum. This percentage has now been reduced to only 5%. The percentage distribution in middle income groups having 2000-3000 and 3000-5000 income per annum has not been altered. The high income group having more than 5000 income per annum has registered a percentage as high as 35% while none was there before FLD. It is notable that agricultural growth reduces inequality among the poor as well as lifting the poor above the poverty line. This increase in net income has provided extra money to the farming community. 30% of them have purchased pump sets for irrigation, which was only owned by 5% of the farmers before the introduction of Green gram cultivation. Only 10% of the respondents had sprayer before, and the percentage has now gone up to 35%.

Table-8 Other assets acquired by farmers

Assets (value	Before		After	
in Rupees)	Farmers (N=60)	Percentage	Farmers (N=60)	Percentage
1. Pump sets	3	5	18	30
2. Sprayer	6	10	21	35
3. House				
a. Kutcha				
0-2000	6	10	-	-
2000-5000	24	40	15	25
5000-10000	18	30	24	40
10000 and above	-	-	18	30
b. Pucca				
10000-20000	6	10	6	10
Above 20000	-	-	6	10

The above table indicates that before the introduction of green gram only 30% farmers have the access to *kutcha* house of above Rs. 5000, which has now risen to 70%. Only 10% of the farmers had *pucca* house that has now reached to 20%.

Impact of Technology : Regarding extent of adoption of technologies the respondents are quite emphatic, earlier the same technology were adopted only by 5-20% of the farmers has now reached up to 100%

Table-9 Extent of adoption of technologies

Technologies	Before		After	
	Farmers (N=60)	%	Farmers (N=60)	%
1. Improved seeds	6	10	60	100
2. Recommended seed rate	9	15	60	100
3. Seed treatment	9	15	54	90
4. Bio-fertilizers	-	-	24	40
5. Routine plant protection measures	6	10	60	100
6. Green manuring	-	-	48	80
7. Improved cultivar	6	10	60	100
8. water management	-	-	36	60
9. Integrated nutrient management	-	-	21	35

Table 9 indicates that 100% adoption has been achieved with improved seeds, seed rates, routine plant protection measures and improved cultivars. But the least adoption was seen in respect of integrated nutrient management because of its recent nature and 40% in the adoption of Rhizobium inoculation because of non-availability of Rhizobium culture in the local market.

One of the main aspects of this study was to ascertain the change in the yield and the productivity of green gram in Sundarbans. Before the start of this programme the productivity of green gram in this area was in the range of 1 to 5 q/ha, which has now increased to more than 8 q/ha.

Table –10 Change in the yield/productivity under the intervention

Yield (q/ha)	Before		After	
	Farmers (N=60)	Percentage	Farmers (N=60)	Percentage
1-3	9	15	-	-
3-5	40	67	9	15
5-8	11	18	24	40
8 and above	-	-	27	45

The above table shows that productivity of green gram has increased significantly over the years and at present 45% of the farmers are getting yield of 8 q/ha and above.

Not the change in the productivity but the social impact of introduction of green gram has given a boost to the social capital to the farm populace of the Sundarban.

Table –11 Social impact of intervention

Social indicators	Before		After	
	Farmers (N=60)	Percentage	Farmers (N=60)	Percentage
1. Houses				
a. Marginal farmers				
Kutcha	12	20	12	20
Mixed	-	-	3	5
Pucca	-	-	-	-
b. Small farmers				
Kutcha	18	30	24	40
Mixed	-	-	6	10
Pucca	-	-	-	-
c. Medium and large farmers				
Kutcha	6	10	-	-
Mixed	-	-	6	10
Pucca	-	-	4	7
2. Medicare				
a. Marginal farmers	-	-	12	20
b. Small farmers	12	20	18	30
c. Medium and large farmers	6	10	10	17
3. Education				
a. Marginal farmers				
i. Just literate	3	5	3	5
ii. Primary	3	5	9	15
iii. Secondary	-	-	-	-
iv. Graduate and above	-	-	-	-
b. Small farmers				
i. Just literate	3	5	12	20
ii. Primary	6	10	6	10
iii. Secondary	3	5	12	20
iv. Graduate and above	-	-	-	-
c. Medium and large farmers				
i. Just literate	-	-	6	10
ii. Primary	3	5	3	5
iii. Secondary	-	-	1	2
iv. Graduate and above	-	-	-	-

The above table indicates that the social impact of green gram cultivation has brought a revolutionary change living of Sundarban populace and made their

livelihood sustainable. The Medicare facility, which was earlier only available to 30 % of population, has now reached up to 67%. Literacy rate has also increased significantly and more than 70% farmers are now literate. Social capital has also improved the awareness of farmers with regard to better health care and also improved the food security scenario of Sundarban.

Economic impact of introduction of green gram cultivation has also not only brought a dynamic change in the marketable surplus of as well as in the household saving required for farming as well as family consumption. The economic impact of intervention is given below in separate table for each farming category.

Table-12 Economic impact of intervention on marginal and landless farmers

Economic indicators	Before		After	
	Farmers (N=33)	Percentage	Farmers (N=20)	Percentage
1. Land per farm				
< 0.5 ha.	6	18	12	60
0.5-1.0 ha.	-	-	-	-
2. Contribution in inputs (%)				
a. Family sources				
< 10	-	-	-	-
10-25	3	9	-	-
25-50	6	18	-	-
50 and above	3	9	12	60
b. Purchased				
< 10	-	-	-	-
10-25	-	-	6	30
25-50	-	-	6	30
50 and above	12	36	-	-
c. KVK				
< 10	12	36	8	40
10-25	12	36	8	40
25-50	-	-	-	-
50 and above	-	-	-	-
3. Gender contribution (%)				
0-20	-	-	-	-
20-40	6	18	9	45
40-60	6	18	3	15
60 and above	-	-	-	-

The above table shows that marginal farmers which numbers were earlier 33 (55%) in total selected respondents has now come down to 20 (33%) of total respondents. The most significant economic impact was observed in the land holding of marginal farmers and at present more than 60%% of them have lands. Gender contribution in green gram farming has also increased and now 20-40% work is done by 45% of the farmwomen.

Economic impact on small farmers has also indicates about certain dramatic change, the number of small farmers has increased over the years. The total respondents selected for the study were 21 (35%) before intervention has now reached to 30 (50%) of total population. The details are given in below table.

Table –13 Economic impact of intervention on Small farmers

Economic indicators	Before		After	
	Farmers (N=21)	Percentage	Farmers (N=30)	Percentage
1. Land per farm				
1.0-1.5ha.	12	43	12	40
1.5-2.0ha.	9	-	-	-
2. Contribution in inputs (%)				
a. Family sources				
< 10	-	-	-	-
10-25	3	14	3	10
25-50	15	71	3	10
50 and above	3	14	24	80
b. Purchased				
< 10	-	-	-	-
10-25	-	-	3	10
25-50	-	-	15	50
50 and above	9	42	6	20
c. KVK				
< 10	3	14	9	30
10-25	5	23	15	50
25-50	-	-	-	-
50 and above	-	-	-	-
3. Gender contribution (%)				
0-20	-	-	5	16
20-40	-	-	5	16
40-60	-	-	5	16
60 and above	-	-	6	20

The above table shows that the gender contribution which was non existent earlier has went up significantly over the years. Farmwomen are now taking part in green gram cultivation and their family members in the farming operation. Contribution of family sources in the inputs has also increased over

the years. The farmers belonging to medium and large farmers' category were 6 (10%) in numbers before intervention has increased to 10 (17%) now in the total selected respondent population. The table shows the economic impact of intervention on the medium and large categories of farmers.

Table 14 Economic impact of intervention on Medium and Large farmers

Economic indicators	Before		After	
	Farmers (N=6)	Percentage	Farmers (N=10)	Percentage
1. Land per farm				
2-2.5 ha.	3	50	4	40
2.5 ha. and above	3	50	6	60
2. Contribution in inputs (%)				
a. Family sources				
< 10	-	-	-	-
10-25	-	-	-	-
25-50	4	66	4	40
50 and above	2	33	6	60
b. Purchased				
< 10	-	-	-	-
10-25	-	-	-	-
25-50	-	-	4	40
50 and above	4	66	4	40
c. KVK				
< 10	2	33	3	30
10-25	1	16	1	10
25-50	-	-	-	-
50 and above	-	-	-	-
3. Gender contribution (%)				
0-20	-	-	-	-
20-40	1	16	3	30
40-60	-	-	1	10
60 and above	-	-	-	-

The land holding pattern has taken a leap turn and at present 60% of the farmers in medium and large categories have 2.5 ha and above land under their possession. The input contribution from family sources has also increased over the years.

Labour utilization (man days/annum) has also increased after the intervention because of the increase in the activity calendar due to the increase in the cropping intensity of the farming community.

Table 15 Changes in labour utilization

Labour utilization	Before		After	
(man days/annum)	Farmers (N=60)	Percentage	Farmers (N=60)	Percentage
a. Marginal farmers				
< 100	3	5	-	-
100-150	3	5	6	10
150-200	-	-	9	15
200-250	-	-	-	-
b. Small farmers				
< 100	9	15	-	-
100-150	6	10	-	-
150-200	3	5	6	10
200-250	-	-	15	25
c. Medium and large farmers				
< 100	-	-	-	-
100-150	3	5	-	-
150-200	2	3	6	10
200-250	-	-	4	7

The table 15 indicates that the labour utilization which was up to 100 to 150 man days/ year before the intervention has now sharply increased to 150-250 days/ year and at present 47% of the farmers is engaging farm labourers for more than 200 days per annum. This also means that the rural to urban migration during the lean season has also decreased to a considerable extent. The extension of farming throughout the year will also boost the livelihood security of rural population as a whole.

Any impact study could not be completed without knowing the factor of non adoption of new technologies. The table given below shows the factors responsible for the non adoption of summer green gram cultivation under different categories viz. knowledge and information, technological, socio-economic and infrastructural and managerial. The data denotes here multiple responses under different categories.

Table 16 Factors of non adoption

Factors	Farmers (N=60)	%	Rank order (Group wise)
I. Knowledge and Information			
1. Lack of information	18	30	I
2. Lack of knowledge about Rhizobium inoculation	10	16	II
II. Technological			
1. Not convinced of superiority	9	15	
2. Risk and uncertainty	24	40	III
3. Incompatibility	12	20	
4. Lack of timely assured irrigation	30	50	II
5. Non availability of Rhizobium culture	36	60	I
6. Complexity	9	15	
III. Socio-Economic			
1. Small holding	36	60	II
2. Unsustainable farm situation	30	50	III
3. Financial Limitation	45	75	I
4. High cost of inputs	27	45	IV
IV. Infrastructural and Managerial			
1. Marketing of output	30	50	III
2. Labour Supply	12	20	
3. Lack of timely availability of input	33	55	II
4. Difficulties in transport	18	30	
5. Management	12	20	
6. Harvesting and disposal trouble	39	65	I
7. Security of crops	27	45	IV

The above table shows that under technological factors of non adoption, lack of Rhizobium culture has caused severe hindrance in the adoption of green gram in this area. Under socio-economic factors, financial limitation is the most significant cause of non adoption of and the small holding is the second most important factor. Under infrastructural and managerial factors of non adoption, harvesting and disposal troubles is the most important one and marketing problems, lack of timely availability of inputs and security of crops are another factors of non adoption of summer green gram cultivation in this area.

FINDINGS AND CONCLUSIONS

Impact study on introduction of Green gram cultivation in rice-fallow system of Sundarban has provided a lot of information and important findings.

This study was undertaken to know the on-farm benefits of summer Green gram cultivation in Sundarbans. The results has shown that the income of the farmers have grown considerably and 35% of the farmers growing Green gram are getting more than Rs. 5000/annum. This study has also revealed that 355 of the farmers cultivating green gram have acquired assets of more than Rs. 10000.

Maximum numbers of farmers growing green gram are small and marginal farmers and summer green gram cultivation increased their household income as well as food security.

Green gram farming has contributed significantly in social capital formation viz. increase in Medicare and health facilities, access to education to the farm families, better feeding habit, better housing, gender contribution to agriculture as well as other benefits. The social capital can help in improving of management and productivity of environmental assets. It will also increase the productivity of physical as well as human capital.

The various factors associated with the non adoption of the new technologies are a great cause for concern. One of the great lacunae is the non availability of Rhizobium culture, which should be rectified immediately by the department of agriculture and research institutes/university.

The extent of adoption of technologies has significantly changed over the years. More than 80% of the farmers are now using the green manuring technology because of the soil nutrient replenishment characteristics of green gram, which provides good amount of available nitrogen to the next paddy crop.

Saving in production costs has come from technical changes in the crop management and increased input efficiency.

Wide spread adoption of modern seed- fertilizer technology led to a significant shift in the food supply function, contributing to a fall in real food supply.

This study has also revealed that growth in the agriculture sector has economy-wide effect viz. increase in the land ownership, acquiring of new assets and farm implements, increase in labour utilization which results into decreasing rural to urban migration and reduces the unemployment rate and disguised unemployment. It has also utilized the previously unutilized family labour resources.

Improvement in food security through the application of new technologies at the community level can lead to the people's enhanced local capacity to engage in development activities in other areas as well.

Direct involvement of beneficiaries in adopting Green gram cultivation technology suitable to their condition has given high payoffs in terms of enthusiasms and interest and also in ensuring that the technology addresses the priority needs that have been identified by the beneficiaries.

Summer green gram cultivation has also ensured sustainable natural resource management objectives. Vulnerability to natural disasters can substantially be reduced through the adoption of green gram cultivation because of the improvement in productivity, increase cash income and acquired assets that families can fall back on when disasters occurs.