



Program Based Research Grant (PBRG)



Sub-project Completion Report on

Improvement of Farm Productivity through Intervention with Improved Agricultural Technologies in Char land Eco-System

February 2018 to January 2022

Coordinating Organization
Planning & Evaluation Division
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215



BANGLADESH AGRICULTURAL RESEARCH COUNCIL

New Airport Road, Farmgate, Dhaka-1215, Bangladesh

www.barc.gov.bd

Program Based Research Grant (PBRG)
Sub-project Completion Report
on
**Improvement of Farm Productivity through Intervention with
Improved Agricultural Technologies in Char land Eco-System**

Implementing Organization



**On-Farm Research Division
Bangladesh Agricultural Research Institute**



**Planning and Development Section
Bangladesh Institute of Nuclear Agriculture**



**Agronomy and Farming Systems Division
Bangladesh Sugarcrop Research Institute**



**Animal Production Research Division
Bangladesh Livestock Research Institute**

Project Implementation Unit
National Agricultural Technology Program-Phase II Project
Bangladesh Agricultural Research Council
Farmgate, Dhaka 1215

December 2021

Citation:

Ahmed, K. U., M. A. Salam, A.S.M.M. R. Khan and S.C. Sarker. 2021. Improvement of Farm Productivity through Intervention with Improved Agricultural Technologies in Char land Eco-System. Sub- project Completion Report, pp: 158

Edited by:

Project Implementation Unit
National Agricultural Technology Program-Phase II Project (NATP-2)
Bangladesh Agricultural Research Council (BARC)
New Airport Road, Farmgate, Dhaka - 1215
Bangladesh

Acknowledgement:

The execution of PBRG sub-project has successfully been completed by Bangladesh Agricultural Research Council (BARC) using the research fund of WB, IFAD and GoB through Ministry of Agriculture. We would like to acknowledge to the World Bank for arranging the research fund and supervising the PBRGs by BARC. It is worthwhile to mention the cooperation and quick responses of PIU-BARC, NATP-2 in respect of field implementation of the sub-project in multiple sites. Preparing the sub-project completion report required to contact a number of persons for collection of information and processing of research data. Without the help of those persons, the preparation of this document could not be made possible. All of them, who have made it possible, deserve appreciation. Our thanks are due to the Director PIU-BARC, NATP-2 and his team who given their whole hearted support to prepare this document. We hope this publication would be helpful to the agricultural scientists of the country for designing their future research projects in order to technology generation as well as increasing production and productivity for sustainable food and nutrition security in Bangladesh. It would also assist the policy makers of the agricultural sub-sectors for setting their future research directions.

Published:

December 2021

Printed by:

Samrat Printers
218 Fakirapool, Motijheel, Dhaka-1000
Cell: 01685474517

Abbreviation and Acronyms

AEZ	:	Agro-Ecological Zone
BARC	:	Bangladesh Agricultural Research Council
BARI	:	Bangladesh Agricultural Research Institute
BRRI	:	Bangladesh Rice Research Institute
BINA	:	Bangladesh Institute of Nuclear Agriculture
BSRI	:	Bangladesh Sugar crop Research Institute
BLRI	:	Bangladesh Livestock Research Institute
BAU	:	Bangladesh Agricultural University
BCR	:	Benefit Cost Ratio
BCRDV	:	Baby Chick Ranikhet Disease Vaccine
BQ	:	Black Quarter
CSO	:	Chief Scientific Officer
C.C.	:	Current Charge
Cm	:	Centimeter
CRFSR&D	:	Climate Resilient Farming Systems Research and Development
DD	:	Deputy Director
DLS	:	Department of Livestock Services
DLO	:	District Livestock Officer
DAE	:	Department of Agricultural Extension
Dec	:	Decimal
FSR	:	Farming Systems Research
FSRDP	:	Farming System Research and Development Program
FGD	:	Focus Group Discussion
FMD	:	Foot and Mouth Disease
FSRD	:	Farming System Research and Development
GO	:	Government Organization
GM	:	Gross Margin
GIFT	:	Genetically Improved Farm Tilapia
Ha	:	Hectare

HYV	:	High Yielding Variety
HS	:	Hemorrhagic Septicemia
Kg	:	Kilogram
LSP	:	Local Service Provider
MBCR	:	Marginal Benefit Cost Ratio
NARS	:	National Agricultural Research System
NATP	:	National Agricultural Technology Project
NGOs	:	Non Government Organizations
OFRD	:	On-Farm Research Division
PIU	:	Project Implementation Unit
PBRG	:	Program Based Research Grant
PRC	:	Paired Row Cane
RCBD	:	Randomized Complete Block Design
PPR	:	Peste des Petits Ruminants
RDV	:	Ranikhet Disease Vaccine
REY	:	Rice Equivalent Yield
SDG	:	Sustainable Development Goal
SRDI	:	Soil Resources Development Institute
SRC	:	Single Row Cane
STP	:	Space Transplanting
T. aman	:	Transplanted Aman Rice
T. aus	:	Transplanted Aus Rice
TSP	:	Triple Super Phosphate
TVC	:	Total variable cost
t/ha, t ha ⁻¹	:	Tons per Hectare
Tk.	:	Taka
ULO	:	Upazila Livestock Officer
UAO	:	Upazila Agriculture Officer
UMS	:	Urea Molasses Straw
WP	:	Wettable Powder

Table of Contents

Sl. No.	Subject	Page No.
	List of Tables	xiii
	List of Map	xxii
	List of Figure	xxiv
	List of Picture	xxv
	Executive Summary	xxvii
A.	Sub-project Description	1
1.	Title of the PBRG sub-project	1
2.	Implementing organization (s)	1
3.	Name and full address with phone, cell and E-mail of Coordinator and PI/Co-PI (s)	1
4.	Sub-project budget (Tk.)	2
4.1	Total (in Tk. as approved)	2
4.2	Latest Revised (if any)	2
5.	Duration of the sub-project	2
5.1	Start date (based on LoA signed)	2
5.2	End date	2
6.	Background of the sub-project	3
7.	Sub-project general objective (s)	3
8.	Sub-project specific objectives	3
9.	Implementing location (s)	4
10.	Methodology in brief	5
11.	Results and Discussion	20
11.1	Year round vegetables and fruits production and its disposal pattern at FSRD Site : Char Kharicha, Mymensingh (BARI)	20
11.2	Year round vegetables and fruits production and its disposal pattern at FSRD Site: Charpara, Sonatola, Bogura (BARI)	23
11.3	Year round vegetables and fruit production in homestead at FSRD site:Nawvanger Char, Jamalpur (BINA)	25
11.4	Year round vegetables production in the homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	28
11.5	Year round fruit production in homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	29

Sl. No.	Subject	Page No.
11.6	Year round vegetables production in homestead at FSRD Site: Baghabari, Sirajganj	31
11.7	Utilization pattern of year round vegetables and fruit production in homestead at FSRD Site: Baghabari, Sirajganj	32
11.8	Vegetables production nearby the homestead at FSRD Site: Nawvanger Char, Jamalpur (BINA)	33
11.9	Chewing type sugarcane production in house boundary at FSRD Site: Char Kharicha, Mymensingh (BARI)	34
11.10	Performance of chewing type sugarcane cultivation in homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	34
11.11	Establishment of mini orchard in farmer's household at FSRD Site: Char Kharicha, Mymensingh (BARI)	35
11.12	Establishment of mini orchard at FSRD Site: Charpara, Sonatola, Bogura (BARI)	35
11.13	Establishment of mini orchard (Binalebu-1) at the backside of the homestead at FSRD Site: Nawvanger Char, Jamalpur (BINA)	35
11.14	Plantation and management of existing fruit trees at farmer's homestead at FSRD site: Char Kharicha, Mymensingh (BARI)	35
11.15	Plantation of saplings and management of fruit trees at FSRD Site: Charpara, Sonatola, Bogura (BARI)	36
11.16	Plantation and management of existing fruit trees in homestead at FSRD site: Nawvanger Char, Jamalpur (BINA)	36
11.17	Plantation of fruit saplings and management of existing fruit tree at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	37
11.18	Plantation of fruits and spice sapling and management of existing fruit trees in the homestead at FSRD Site: Baghabari, Sirajganj (BLRI)	38
11.19	Production of Vermicompost at FSRD Site: Char Kharicha, Mymensingh (BARI)	39
11.20	Fodder production nearby homestead at FSRD Site: Char Kharicha, Mymensingh (BARI)	39
11.21	Cultivation of Napier grass in homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	39
11.22	Family labor utilization pattern	40
11.23	Improvement of existing cropping pattern at FSRD site : Char Kharicha, Mymensingh (BARI)	41

Sl. No.	Subject	Page No.
11.24	Improvement of existing cropping pattern at FSRD Site: Charpara, Sonatola, Bogura (BARI)	42
11.25	Improvement of existing cropping pattern at FSRD Site: Nawvanger Char, Jamalpur (BINA)	44
11.26	Improvement of existing cropping pattern at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	46
11.27	Replacement of existing Sugarcane varieties by newly developed BSRI varieties at FSRD Site, Padma Char, Ishurdi, Pabna (BSRI)	48
11.28	Improvement of existing cropping pattern at FSRD site: Baghabari, Sirajganj (BLRI)	48
11.29	Production program on HYV of different crops at FSRD Site: Char Kharicha, Mymensingh (BARI)	50
11.30	Production program on HYV of different crops at FSRD Site: Charpara, Sonatola, Bogura(BARI)	52
11.31	Production program on HYV of different crops at FSRD Site: Nawvanger Char, Jamalpur (BINA)	53
11.32	Improvement of cattle health through deworming at FSRD site: Char Kharicha, Mymensingh (BARI)	55
11.33	Improvement of cattle health by deworming at FSRD Site: Baghabari, Sirajganj (BLRI)	56
11.34	Improvement of cattle health through deworming and dewormed + vitamin ADE injection at FSRD Site: Padma Char, Ishurdi, Pabna(BSRI)	56
11.35	Cattle fattening through UMS and UMS +Vitamin ADE injection at FSRD Site: Padma Char, Ishurdi, Pabna(BSRI)	56
11.36	Vaccination of cattle at FSRD site: Char Kharicha, Mymensingh (BARI)	57
11.37	Vaccination of livestock at FSRD site: Charpara, Sonatola, Bogura (BARI)	57
11.38	Deworming and vaccination programme on livestock at FSRD Site: Nawvanger Char, Jamalpur (BINA)	58
11.39	Vaccination on cattle to reduce mortality rate at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	58
11.40	Vaccination programme on livestock to reduce mortality at FSRD Site: Baghabari, Sirajganj (BLRI)	59
11.41	Artificial insemination on cattle at FSRD Site: CharKharicha, Mymensingh	60
11.42	Beef fattening at FSRD Site: Charpara, Sonatola, Bogura (BARI)	60

Sl. No.	Subject	Page No.
11.43	Beef fattening programme as a source of income generation at FSRD Site: Nawvanger Char, Jamalpur (BINA)	60
11.44	Goat rearing in the farmer's household for increase income of farmers at FSRD site: CharKharicha, Mymensingh (BARI)	61
11.45	Goat rearing in the farmer's household for increase income of farmer's at FSRD Site: Baghabari, Sirajganj (BLRI)	61
11.46	Sheeprearing at farmer's household at FSRD site : Charpara, Sonatola, Bogura (BARI)	62
11.47	Sheep rearing in the farmer's household for increase income of farmer's at FSRD Site: Baghabari, Sirajganj (BLRI)	62
11.48	Vaccination of poultry birds at FSRD site: Char Kharicha, Mymensingh (BARI)	63
11.49	Vaccination of poultry birds at FSRD site: Charpara, Sonatola, Bogura (BARI)	64
11.50	Vaccination programme on poultry birds at FSRD Site: Nawvanger Char, Jamalpur (BINA)	64
11.51	Vaccination on poultry birds at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	65
11.52	Vaccination programme on poultry birds at FSRD Site:Baghabari, Sirajganj	65
11.53	Turkey rearing in the farmer's household at FSRD site: Char Kharicha, Mymensingh (BARI)	66
11.54	Performance of Turkey in farmer's level for egg and meat purpose at FSRD Site: Baghabari, Sirajganj (BLRI)	67
11.55	Duck rearing in the farmer's household at FSRD Site: CharKharicha, Mymensingh (BARI)	67
11.56	Duck rearing in farmer's household at FSRD site: Charpara, SonatolaBogura (BARI)	68
11.57	Duck rearing in the farmer's household at FSRD Site: Baghabari, Sirajganj (BLRI)	69
11.58	Sonali chicken rearing at farmer's level for egg and meat purpose at FSRD Site: Char Kharicha, Mymensingh (BARI)	70
11.59	Rearing of Sonali chicken for meat purpose and income generation at FSRD Site: Nawvanger Char, Jamalpur (BINA)	70
11.60	Chicken (Sonali) rearing in farmer's household for income generation at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	71
11.61	Hilly chicken rearing in the farmer's household for meat purpose at FSRD Site: Baghabari, Sirajganj (BLRI)	72
11.62	Rearing of pigeon for income generation at farmer's household at FSRD Site: Nawvanger Char (BINA)	73

Sl. No.	Subject	Page No.
11.63	Pigeon rearing in the farmer's household at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	73
11.64	Rearing of pigeon at farmer's household at FSRD Site: Baghabari, Sirajganj (BLRI)	74
11.65	Fodder crop cultivation nearby homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	74
11.66	Fodder crop cultivation nearby homestead at FSRD Site: Baghabari, Sirajganj (BLRI)	75
11.67	Maximization of farmer's income through carp polyculture at low cost management at FSRD site: Char Kharicha, Mymensingh (BARI)	75
11.68	Maximization of farmer's income through carp polyculture technique at low cost management FSRD site: Charpara, Sonatola, Bogura (BARI)	76
11.69	Maximization of farmer's income through carp polyculture at low cost management at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	77
11.70	Maximization of farmer's income through carp poly culture technique at low cost management at FSRD Site: Baghabari, Sirajganj (BLRI)	78
11.71	Maximization of farmer's income through the culture of monosex tilapia at low cost management at FSRD site: Char Kharicha, Mymensingh (BARI)	79
11.72	Fish culture in backyard pond at FSRD Site: Nawvanger Char, Jamalpur (BINA)	80
11.73	Net pen fish culture in open water sources at FSRD Site: Nawvanger Char, Jamalpur (BINA)	80
11.74	Off-farm activities at FSRD site: Char kharicha, Mymensingh (BARI)	80
11.75	Off-farm activities at FSRD site: Charpara, Sonatola, Bogura (BARI)	81
11.76	Off-farm activities at FSRD Site: Nawvanger Char, Jamalpur (BINA)	81
11.77	Off-farm activities at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	82
11.78	Off-farm activities at FSRD site: Baghabari, Sirajganj (BLRI)	82
11.79	Cost and return from different component at FSRD Site: Char Kharicha, Mymensingh and Charpara, Sanatola, Bogura (BARI)	83
11.80	Cost and return from different component at FSRD Site: Nawvanger Char, Jamalpur (BINA)	84
11.81	Cost and return from different component at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	84
11.82	Cost and return from different component at FSRD Site: Baghabari, Sirajganj (BLRI)	85
11.83	Integration of farm component (BINA)	85
11.84	Integration of farm component (BSRI)	86

Sl. No.	Subject	Page No.
12.	Research highlights	86
12.1	Year round vegetables and fruits production at homestead area	86
12.2	Efficient use of other farm resources nearby homestead area	87
12.3	Year round vegetables and fruit production at homestead	88
12.4	Vegetables production nearby homestead	89
12.5	Plantation and management of existing fruit trees	90
12.6	Raised mini nursery of vegetables seedling using vermicompost in seed starting cell tray	91
12.7	Year round vegetables production in homestead at FSRD site	92
12.8	Year round fruit production in homestead at FSRD site	93
12.9	Performance of chewing cane variety cultivation in homestead at FSRD Char land ecosystem	93
12.10	Distribution of fruit saplings	94
12.11	Year round vegetables and fruit production at homestead	95
12.12	Development of alternate cropping pattern against existing cropping pattern	96
12.13	Improvement of cropping pattern Jute (var. JRO 524)-T. Aman (var. Binadhan-11)-Maize (var. Hybrid 981)	97
12.14	Improvement of cropping pattern Aus (var. Binadhan-19)-T. Aman (var. Binadhan-7)-Mustard (var. Binasarisha-9)-Mungbean (var. Binamoog-8)	97
12.15	Improved cropping pattern Radish (Mollica) - Radish (Mollica) - Carrot (Orange king) - Wheat (BARI Gom 31)	98
12.16	Improved cropping pattern Radish (Mollica)-Carrot (Orange king) - Groundnut (BARI Chinabadam-8)	99
12.17	Improvement of the existing Boro-Fallow-T. Aman cropping pattern through inclusion of oil seed and pulse crops	100
12.18	Replacement of existing sugarcane varieties by newly developed BSRI varieties in FSRD Char land Eco system (BSRI)	102
12.19	Production program with HYVs of different crops under existing cropping pattern at FSRD site, Mymensingh and Bogura (BARI).	102
12.20	Production program with HYVs of different crops at FSRD site Nawvanger Char, Jamalpur (BINA)	103
12.21	Deworming of cattle followed by vaccination at FSRD site, Mymensingh	104

Sl. No.	Subject	Page No.
12.22	Vaccination of cattle, goats, sheep and poultry birds at FSRD site, Mymensingh and Bogura	104
12.23	Rearing of cattle, poultry birds at FSRD site, Mymensingh and Bogura	105
12.24	Beef fattening program at FSRD site, Mymensingh.	106
12.25	Vaccination and deworming program of cattle and poultry birds	106
12.26	Fattening of cattle under farmer's condition	107
12.27	Rearing of Sonali chicken at farmer's household	107
12.28	Rearing of pigeon at farmer's household	108
12.29	Improvement of cattle health through deworming and dewormed+ vitamin ADE injection	108
12.30	Vaccination on cattle to reduce mortality rate	109
12.31	Vaccination on poultry at FSRD Site	109
12.32	Chicken rearing in farmer's household for income generation	110
12.33	Improvement of cattle health and reduced mortality of poultry birds by deworming and vaccination	110
12.34	Beef fattening at farmers household	111
12.35	Sheep rearing in the farmer's household for increase income of farmers	111
12.36	Goat rearing in the farmer's household for increase income of farmers	112
12.37	Performance of Turkey at farmer's level for egg and meat purpose	112
12.38	Hilly chicken rearing at farmer's household for meat purpose	113
12.39	Rearing of pigeon at farmer's household	113
12.40	Maximization of farmer's income through the technique of carp polyculture at low cost management FSRD site: Char Kharicha, Mymensingh and Charpara, Sonatala, Bogura (BARI)	114
12.41	Maximization of farmer's income through Carp Polyculture Technique at low cost management at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)	114
12.42	Maximization of farmer's income through carp polyculture technique at low cost management at FSRD Site: Baghabari, Sirajganj (BLRI)	115
12.43	Maximization of farmer's income through the culture of monosex Tilapia at low cost management at FSRD site: Char Kharicha, Mymensingh (BARI)	115

Sl. No.	Subject	Page No.
12.44	Fish culture in backyard pond after recession of flood water at FSRD Site : Nawvanger Char, Jamalpur (BINA)	116
12.45	Fish cultivation in open water sources through net pen fish culture at FSRD Site: Nawvanger Char, Jamalpur (BINA)	116
B.	Implementation Status	117
1.	Procurement	117
2.	Establishment/renovation facilities	118
3.	Training/study tour/seminar /workshop/conference organized	118
C.	Financial and Physical Progress	121
D.	Achievement of Sub-project by Objectives (Tangible form): Technology generated/developed	123
E.	Information/Knowledge generated/Policy generated	129
F.	Materials Development/Publication made under the Sub-project	134
G.	Description of generated Technology/Knowledge/Policy	136
i.	TechnologyFactSheet	136
ii.	Effectiveness in policy support	148
H.	Technology/ Knowledge generation/Policy Support	148
i.	Immediate impact on generated technology	148
ii.	Generation of new knowledgethat help in developing more technology in future	148
iii.	Technology transferred that help increased agricultural productivity and farmer's income	149
iv.	Policy support	149
I	Information regarding Desk and Field Monitoring	150
i.	Desk Monitoring	150
ii.	Field Monitoring	150
iii.	Weather data, flood/salinity/drought level and natural calamites	153
J.	Sub-project Auditing	154
K.	Lessons Learned	155
L.	Challenges	156
M.	Suggestions for Future Planning	156
N	References	157

List of Tables

Sl. No.	Title	Page No.
10.1	Sub-project locations/sites	6
10.2	Category-wise selected farmer's information of different FSRD sites.	6
10.3	Narekelimodel (eight niches) was followed at FSRD site: Char Kharicha, Mymensingh (BARI)	8
10.4	Goyeshpur model (nine niches) was followed at FSRD site: Char para, SonatolaBogura (BARI)	8
10.5	Modified Goyeshpur model (nine niches) was followed at FSRD site:Nawvanger Char, Jamalpur (BINA)	9
10.6	Modified Goyeshpur model (nine niches) was followed at FSRD site: Padma Char, Ishurdi, Pabna (BSRI)	10
10.7	Modified Goyeshpur model (nine niches) was followed at FSRD site:Baghabari, Sirajgong (BLRI)	10
10.8	Different activities other than vegetables and fruits production in the homestead at FSRD during February 2018-January 2021.	11
10.9	Management practices followed in improvedand existing cropping pattern at FSRD Site: Char Kharicha, Mymensingh (BARI) during 2018-2020	12
10.10	Management practices followed in improvedand existing cropping pattern at FSRD Site: Charpara, Sonatola, Bogura (BARI) during 2018-2020	12
10.11	Crop managements of improved and existing cropping pattern at FSRD site: Nawvanger Char, Jamalpur(BINA) during 2018-2020	13
10.12	Crop managements of improved and existing cropping pattern at FSRD site: Nawvanger Char, Jamalpur(BINA) during 2018-2020	14
10.13	Crop managements of improved and existing cropping pattern at FSRD Site: Padmar Char, IshurdiPabna (BSRI) during 2018-2020	14
10.14	Crop managements of improved and existing cropping pattern at FSRD Site: Padmar Char, Ishurdi, Pabna (BSRI) during 2018-2020	15
10.15	Crop managements of improved and existing cropping pattern at FSRD Site: Baghabari, Sirajganj (BLRI) during 2018-2020	15
10.16	Crop managements of improved and existing cropping pattern at FSRD Site: Baghabari, Sirajganj (BLRI) during 2018-2020	15
10.17	Crop managements of newly developed sugarcane varieties by BSRI at FSRD site Padma Char, Ishurdi, Pabna during 2018-2020	16
10.18	Management practices, variety, number of farmers, area covered by different crops at FSRD site, Mymensingh and Bogura during 2018-2021	16
10.19	Management practices, variety, number of farmers, area covered by different crops at FSRD site, Bogura during 2019-2021	17

Sl. No.	Title	Page No.
10.20	Production programme of jute, rice, groundnut, mustard and banana at FSRD site: Nawvanger Char, Jamalpur	17
10.21	Livestock activities in the FSRD sites	18
11.1.1	Year-round vegetables and fruits production from different niches of homestead at FSRD site, Mymensingh during 2018 to 2021	21
11.1.2	Year-round vegetables and fruits production from different niches of homestead during 2018 to 2021	22
11.1.3	Year round vegetables and fruits production and its utilization pattern at before and after intervention during 2018 to 2021	23
11.2.1	Year round vegetables and fruits production from different niches of homestead at FSRD site, Bogura during 2018 to 2021	24
11.2.2	Year round vegetables and fruits production from different niches of homestead during 2018 to 2021 (Comparative data)	25
11.2.3	Year round vegetables and fruits production and its utilization pattern at before and after intervention during 2018 to 2021	25
11.3.1	Year-round vegetables and fruits production from different niches at FSRD site during 2018 to 2021	26
11.3.2	Year round vegetables, fruits production and income from different niches of homestead at FSRD site during Feb. 2018 to Jan. 2021 (Comparative data)	26
11.3.3	Year round vegetables and fruits production and utilization pattern before and after intervention at FSRD site during 2018 to 2021.	27
11.4.1	Year round vegetables production from different niches at FSRD site, Padmar char, Ishurdi, Pabna during 2018 to 2021	28
11.4.2	Year round vegetables production and utilization pattern before and after intervention at FSRD Site, Padma Char, Ishurdi, Pabna during 2018 to 2021	28
11.5.1	Year round fruits production from different niches at FSRD site, Padma Char, Ishurdi, Pabna during 2018 to 2021	29
11.5.2	Year round fruits production and utilization pattern before and after intervention during 2018 to 2021	29
11.6.1	Season wise vegetables and fruits production from different niches at FSRD Site, Baghabari, Sirajganj during 2018 to 2021	31
11.6.2	Round the year vegetables and fruits production from different niches in homestead at FSRD site during 2018 to 2021 (Comparative data).	31
11.7.1	Round the year vegetables and fruits production and utilization pattern before and after intervention at FSRD site during 2018 to 2021	32
11.8.1	Yield and cost return analysis of vegetables production nearby the homestead before and after intervention at FSRD site Nawvanger Char, Jamalpur during 2018 – 2021	33

Sl. No.	Title	Page No.
11.9.1	Yield and cost return analysis of chewing type sugarcane in house boundary of homestead at FSRD site, CharKharicha, Mymensingh during 2019-2020	34
11.10.1	Yield, cost and return analysis of chewing type sugarcane cultivation in homestead at FSRD Site: Padma Char, Ishurdi, Pabna during 2018-2021	34
11.14.1	Distribution of fruit saplings at FSRD site, Char Kharicha, Mymensingh during 2018 – 2021	36
11.15.1	Distribution of fruit saplings at FSRD site, Bogura during 2019 to 2021	36
11.16.1	Sapling distribution of fruit trees at FSRD Site: Nawvanger Char, Jamalpur during 2018-2021	37
11.17.1	Performance of different fruit varieties at FSRD site, Padma-Char, Ishurdi, Pabna	37
11.18.1	Distribution of fruit and spices saplings at FSRD site, Baghabari, Sirajganj during 2018- 2021	38
11.21.1	Performances of Napier grass at FSRD Site, Padma Char, Ishurdi, Pabna during 2018-2020	39
11.22.1	Family labor utilization pattern for homestead activities at FSRD site (Average of five site) during 2018-2021	40
11.23.1	Yield and economic return of improved and existing cropping pattern at the FSRD site, Char Kharicha, Mymensingh during 2018-19 and 2019-20	41
11.23.2	Yield and economic return of improved and existing cropping pattern at the FSRD site, CharKharicha, Mymensingh during 2018-2019	42
11.24.1	Yield and economic return of four crop based cropping pattern against existing cropping pattern at the FSRD site, Charpara, Sonatola, Bogura during 2018-20	43
11.24.2	Yield and economic return of three crop based cropping pattern against existing cropping pattern at FSRD site, Charpara, Sonatola, Bogura during 2018-20	44
11.25.1	Yield and economic analysis of improved and existing cropping patterns at FSRD site Nawvanger Char, Jamalpur during 2018-2019	44
11.25.2	Yield and economic analysis of improved and existing cropping patterns at FSRD site, Navanger Char, Jamalpur during 2019-20	45
11.25.3	Yield and economic analysis of alternate and existing cropping patterns at FSRD Site, Nawvanger Char, Jamalpur during 2018-19	45
11.25.4	Yield and economic analysis of improved and existing cropping patterns at FSRD Site, Nawvanger Char, Jamalpur during 2019-20	46
11.26.1	Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Padma Char, Ishurdi, Pabna, during 2018-2019	46
11.26.2	Yield and economic analysis of improved and existing cropping patterns at the FSRD site, Padma Char, Ishurdi, Pabna, during 2018-2019	47

Sl. No.	Title	Page No.
11.27.1	Performance of different varieties of sugarcane at FSRD Site Padma Char, Ishurdi, Pabna during 2018-2021 (Ave. of 3 years)	48
11.28.1	Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Baghabari, Sirajganj during 2018-2019	49
11.28.2	Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Baghabari, Sirajganj during 2019- 2020.	49
11.28.3	Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Baghabari, Sirajganj during 2018-2019	50
11.28.4	Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Baghabari, Sirajganj during 2019- 2021	50
11.29.1	Performance of different crops under production program at FSRD site, Char Kharicha, Mymensingh during 2018-21	52
11.30.1	Crop yield and economic return of different crops under production programs at FSRD site, Charpara, Sonatola, Bogura during 2019-21	53
11.31.1	Performance of jute variety under production program at FSRD site, Nawvanger Char, Jamalpur during April to July 2020	53
11.31.2	Performance of rice variety under production program at FSRD site, Nawvanger Char, Jamalpur during July- October 2020	53
11.31.3	Performance of mustard variety under production program at FSRD site, Nawvanger Char, Sadar, Jamalpur during 2020-21	54
11.31.4	Performance of groundnut variety under production program at FSRD site, Nawvanger Char, Sadar, Jamalpur during 2020-21	54
11.31.5	Performance of banana under production program at FSRD site, Nawvanger Char, Jamalpur	54
11.32.1	Average body weight gain, milk production and lactation period after deworming at FSRD site, Mymensingh during 2018-2020	55
11.33.1	Average body weight gain, milk production and lactation period after different treatment at FSRD site Baghabari, Sirajganj during 2018- 2021.	56
11.34.1	Body weight gained and milk production after different treatment provided on cattle at FSRD Site Padma Char, Ishurdi, Pabna during 2018-2020.	56
11.35.1	Body weight and market value increment by feeding UMS and UMS + Vitamin ADE injection at FSRD Site, Padma Char, Ishurdi, Pabna during 2018-2020	57
11.36.1	Mortality rate (%) of cattle before vaccination and after vaccination against major diseases at FSRD Site, Char Kharicha, Mymensingh during 2018- 2020	57
11.37.1	Mortality rate (%) of livestock before vaccination and after vaccination against major diseases at FSRD Site, Sonatola, Bogura during 2018 – 2021	58

Sl. No.	Title	Page No.
11.38.1	Average body weight gain, milk production and lactation period after deworming at FSRD site, Nawvanger Char, Jamalpur 2018-20	58
11.38.2	Mortality (%) of livestock before and after vaccination against major diseases at FSRD site Nawvanger Char, Jamalpur during 2018- 2021	58
11.39.1	Mortality (%) of cattle before and after vaccination against different major diseases at FSRD Site, Padma Char, Ishurdi, Pabna, during 2018-2021	59
11.40.1	Mortality (%) of livestock before and after vaccination against major diseases at FSRD site Baghabari, Sirajganj during 2018- 2021	59
11.41.1	Performance of artificial insemination after attaining 6 months of growing at FSRD site, Char Kharicha, Mymensingh during February –December, 2020	60
11.42.1	Performance of beef fattening at household level at FSRD site, Charpara, Sonatola, Bogura during 2018 –2021	60
11.43.1	Body weight and market value of cattle under beef fattening program at FSRD Site, Nawvanger Char, Jamalpur during 2018-2021	61
11.44.1	Performance of goat rearing at household level at FSRD site, CharKharicha,Mymensingh during Nov. 2020–Jan. 2021	61
11.45.1	Performances of distributed goat in farmer’s household at FSRD Site Baghabari, Sirajganj during 2018- 2021	61
11.46.1	Performance of sheep rearing in household level at FSRD Site,Charpara, Sonatola, Bogura during 2018 –2021	62
11.47.1	Performances of distributed sheep in farmer’s household at FSRD Site Baghabari, Sirajganj during 2018- 2021	63
11.48.1	Mortality rate (%) of chicken before vaccination and after vaccination against major diseases at FSRD Site, Char Kharicha,Mymensingh during 2018- 2021	63
11.49.1	Mortality rate (%) of poultry birds before vaccination and after vaccination against major diseases at FSRD site, Bogura during 2018 – 2021	64
11.50.1	Mortality (%) of poultry birds before and after vaccination against major diseases at FSRD Site, Nownanger Char, Jamalpur during 2018 - 2021	65
11.51.1.	Mortality (%) of poultry birds before and after vaccination against major diseases at FSRD Site, Padma-Char, Ishurdi, Pabna during 2018-2021	65
11.52.1	Mortality (%) of poultry birds before and after vaccination against major diseases at FSRD Site Baghabari, Sirajganj during 2018- 2021	66
11.53.1	Performance of Turkey rearing after 5 months of distribution at FSRD Site, Char Kharicha, Mymensingh during 2018-2019	66
11.54.1	Performances of Turkey in farmer’s household at FSRD Site Baghabari, Sirajganj during 2018- 2021	67

Sl. No.	Title	Page No.
11.55.1	Performance of Duck rearing after 6 months of distribution at FSRD Site, Char Kharicha, Mymensingh during 2019-2021	68
11.56.1	Performance of Khaki Campbell rearing at FSRD Site, Sonatola, Bogura during 2019 – 2020	68
11.56.2	Individual body weight gain by Khaki Campbell rearing at FSRD Site, Bogura during 2019- 2020	69
11.56.3	Utilization pattern of eggs hatched by Khaki Campbell at FSRD site Bogura during 2019-2020	69
11.57.1	Performance of improved breed of duck (Beijing) after 6 months of rearing at FSRD Site Baghabari, Sirajganj during 2018- 2021	69
11.58.1	Performance of <i>Sonali chicken</i> at farmer's household level up to 3 months of rearing at FSRD Site, Char Kharicha, Mymensingh during Nov. 2020 – Jan. 2021	70
11.59.1	Performances of Sonali breed at farmer's level in 75 days of rearing at FSRD Site, NawvangerChar, Jamalpur during 2019-2021	70
11.60.1	Performances of Sonali Chicken at FSRD Site, Padma-Char, Ishurdi, Pabna during 2018- 2021	71
11.61.1	Average performances of Hilly chicken for meet purpose after rearing of 6 months at FSRD site Baghabari, Sirajganj during 2018- 2021	72
11.62.1	Performance of pigeon rearing in farmer's household at FSRD Site: Nawvanger Char, Jamalpur during 2018-2021	73
11.63.1	Performance of pigeon rearing in farmer's household at FSRD Site Padma Char, Ishurdi, Pabna during 2018-2021	73
11.64.1	Performance of supplied pigeons to different farmer's household at FSRD Site Baghabari, Sirajganj during 2018-2020	74
11.65.1	Yield, cost and return analysis of Pakchong grass production nearby homestead at FSRD Site Padma Char, Ishurdi, Pabna (Avg. of three years)	74
11.66.1	Yield and economics of Napier grass production nearby homestead at FSRD Site Baghabari, Sirajganj (Ave. of three years)	75
11.67.1	Performance of fish under carppolyculture in seasonal pond at FSRD Site, Char Kharicha, Mymensingh during 2018-2019	76
11.67.2	Production and economic return at pre and post intervention of carpPolyculture technique at FSRD Site, Char Kharicha, Mymensingh during 2018-2019	76
11.67.3	Utilization pattern of harvested fish under carppolyculture at FSRD Site, Char Kharicha, Mymensingh during 2018-2019	76
11.68.1	Performance of carppolyculture in seasonal ponds at FSRD Site, Sonatola, Bogura during 2018-2021	76

Sl. No.	Title	Page No.
11.68.2	Production, cost and return of carppolyculture in seasonal ponds at FSRD Site, Sonatola, Bogura during 2018-2021	76
11.68.3	Utilization pattern of harvested fish under carppolyculture in seasonal ponds at FSRD Site, Sonatola, Bogura during 2018-2021	77
11.69.1	Fish production program at FSRD site Padma-Char, Ishurdi, Pabna, during 2018-2019	77
11.69.2	Yield and economics of carp polyculture at FSRD Site, Padma-Char, Ishurdi, Pabna during 2018-2021	77
11.69.3	Utilization pattern of harvested fishes at FSRD site, Padma Char, Ishurdi, Pabna during 2018-2021	78
11.70.1	Performance of carppolyculture at FSRD site Baghabari, Sirajganj during 2018- 2021 (Ave. of three years)	78
11.70.2	Total fish production, utilization pattern and income before and after intervention at FSRD site Baghabari, Sirajganj during 2018- 2021	79
11.71.1	Performance of monosex tilapia in seasonal pond at FSRD Site, Char Kharicha, Mymensingh during 2019-2020	79
11.71.2	Production and economic return of monosex tilapia at FSRD Site, Char Kharicha, Mymensingh during 2019-2020	79
11.71.3	Utilization pattern of harvested tilapia fish at FSRD Site, Char Kharicha, Mymensingh during 2019-2020	79
11.72.1	Pond number, pond area, fish production and gross margin at the FSRD Site, Nawvanger Char, Jamalpur during 2020-21	80
11.73.1	Performance of mixed culture of carp fishes with monosex tilapia using net pen fish culture in open water resources during October 2020 to February 2021	80
11.73.2	Total fish production, utilization pattern and income of harvested fishes at FSRD site during October 2020 to February 2021	80
11.74.1	Economic return of off-farm activities at FSRD Site, Char Kharicha, Mymensingh during 2018- 2021	81
11.75.1	Economic return of off-farm activities at FSRD Site, Charpara, Sonatola, Bogura during 2018– 2021	81
11.76.1	Economic return of off-farm activities at FSRD Site, Nawvanger Char, Jamalpur during 2018 - 2021 (av. of four farmers)	81
11.77.1	Economic return of off-farm activities at FSRD Site, Padma Char, Ishurdi, Pabna during 2018 - 2021	82
11.78.1	Economic return of off-farm activities at FSRD Site, at Baghabari, Sirajganj 2018- 2021	82
11.79.1	Economic return from different sub-systems for integration of farming system at FSRD Site: Char Kharicha, Mymensingh during 2018 - 2021	83

Sl. No.	Title	Page No.
11.79.2	Economic return from different sub-systems for integration of farming system at FSRD Site: Charpara, Sonatola, Bogura during 2018 - 2021	83
11.80.1	Economic return from different sub-systems for integration of farming system at FSRD Site: Nawvanger Char Jamalpur, during 2018 –2021	84
11.81.1	Technologies used and return from different sub-systems of integrated farming systems at FSRD Site: Padma Char, Ishurdi Pabna during 2018 – 2021	84
11.82.1	Technologies used and return from different sub-systems of integrated farming systems at FSRD Site: Baghabari, Sirajganj during 2018- 2021	85
12.3.1	Proposed cropping patterns of year round profitable vegetables and fruits production in different niches at FSRD site Nawvanger Char, Jamalpur	88
12.4.1	Yield and economics of vegetables production nearby the homestead before and after intervention at FSRD site Nawvanger Char, Jamalpur during 2018 – 2021	90
12.5.1	Sapling distribution of fruit trees at FSRD site Nawvanger Char, Jamalpur	90
12.7.1	Proposed cropping patterns of year round profitable vegetables and fruits production in different niches at FSRD site Padma Char, Ishurdi, Pabna	92
12.9.1	Homestead chewing cane cultivation cost and returns analysis (av. of three years)	94
12.10.1	Sapling distribution of fruit trees at FSRD site Padma Char, Ishurdi, Pabna	94
12.11.1	Vegetables based cropping pattern and fruits production in homestead at FSRD Site, Baghabari, Sirajganj	95
12.13.1	Crop managements of alternate cropping pattern and existing cropping pattern at FSRD site Nawvanger Char, Jamalpur	97
12.14.1	Crop managements of alternate cropping pattern and existing cropping pattern at FSRD site Nawvanger Char, Jamalpur	98
12.15.1	Crop managements of improved and existing cropping pattern at FSRD site, Padma Char, Ishurdi Pabna	99
12.16.1	Crop managements of improved and existing cropping pattern at FSRD site, Padma Char, Ishurdi, Pabna	100
12.17.1	CP-1 Crop managements of alternate and existing cropping pattern at FSRD site Baghabari, Sirajganj	101
12.17.2	CP-2 Crop managements of improved and existing cropping pattern at FSRD site Baghabari, Sirajganj	101
12.20.1	Production programme of jute, rice, groundnut and mustard at FSRD site Nawvanger Char, Jamalpur	103

Sl. No.	Title	Page No.
B.1.1	BARC procurement information	117
B.1.2	BARI procurement information	117
B.1.3	BINA procurement information	117
B.1.4	BSRI procurement information	118
B.1.5	BLRI procurement information	118
B. 2.	Establishment/renovation facilities	118
B.3.1	Information on training/workshop/meeting organized by BARC	118
B.3.2	Information on training/workshop/field days arranged by BARI	119
B.3.3	Information on training/workshop/method demonstration/field day/meeting organized by BINA	119
B.3.4	Information on training/workshop/method demonstration/field day/meeting organized by BSRI	120
C.1.	Combined Financial and physical progress	121
C.2.	Financial and physical progress of BARC Component	121
C.3.	Financial and physical progress of BARI Component	121
C.4.	Financial and physical progress of BINA Component	122
C.5	Financial and physical progress of BSRI Component	122
C.6	Financial and physical progress of BLRI Component	122
D.1.1.	Technology generated/ developed by BARI Component	123
D.2.1	Technology generated/ developed by BINA Component	125
D.2.2	Technology validated by BINA Component	126
D.3. 1	Technology generated/developed by BSRI Component	127
D.3. 2	Technology validated by BSRI Component	127
D.4.1	Technology generated/ developed by BLRI Component	128
E.1.	Information/knowledge generated/policy generated by BARI Component	129
E.2.	Information/knowledge generated/policy generated by BINA Component	131
E.3.	Information/knowledge generated/policy generated by BSRI Component	131
E.4	Information/knowledge generated/policy generated by BLRI Component	133
F.1.	Materials Development/Publication made under the Sub-project by BARC Component	134
F.2.	Materials Development/Publication made under the Sub-project by BARI Component	135
F.3.	Materials Development/Publication made under the Sub-project by BINA Component	135
F.4	Materials Development/Publication made under the Sub-project by BSRI	136

Sl. No.	Title	Page No.
I.1.1	Desk Monitoring BINA Component	150
I.1.2	Desk Monitoring BSRI Component	150
I.2.1.1	Field Monitoring FSRD site Mymensingh	150
I.2.1.2	Field Monitoring FSRD site Bogura	151
I.2.2	Field Monitoring FSRD site Jamalpur	152
I.2.3	Field Monitoring FSRD site Padma Char	152
I.2.4	Field Monitoring FSRD site Baghabari	153
I.3.1.1	Weather data of Bogura during the years of February 2018 to December 2020	153
J.1.	Sub-project auditing information of BARC	154
J.2	Sub-project auditing information of BARI Component	154
J.3	Sub-project auditing information of BINA Component	154
J.4	Sub-project auditing information of BSRI Component	154
J.5	Sub-project auditing information of BLRI Component	154

List of Map

Sl. No.	Title	Page No.
9.1	FSRD site Char Kharicha. Mymensingh	4
9.2	FSRD site Charpara, Sonatola, Bogura	4
9.3	FSRD site Nawvangar Char , Jamalpur	5
9.4	FSRD site Padma-Char Ishurdi, Pabna	5
9.5	FSRD site Baghabari, Sirajganj	5

List of Figure

Sl. No.	Title	PageNo.
10.1	Existing cropping pattern with improved cropping pattern Cropping pattern-2	14
11.83.1	Integration of farm component	85

List of Picture

Sl. No.	Title	Page No.
10.1	Vaccination Program	18
10.2	Cattle fattening programme	19
10.3	Fingerlings distribution	19
11.1.1	Vegetables production at FSRD Site : Char Kharicha, Mymensingh	20
11.1.2	Fruit production at FSRD Site : Char Kharicha, Mymensingh	21
11.3.1	Vegetables production at FSRD site Nawvanger Char, Jamalpur	27
11.5.1	Fruit production at FSRD site Ishurdi, Pabna	30
11.5.2	Homestead vegetables garden at FSRD Site Ishurdi, Pabna	30
11.7.1	Vegetables production at FSRD site Baghabari, Sirajganj	33
11.8.1	Vegetables production at the land near to homestead at FSRD site Nawvanger Char, Jamalpur	33
11.9.1	Chewing type sugarcane production in house boundary at FSRD Site: Char Kharicha	34
11.10.1	Chewing cane cultivation in homestate at FSRD site Ishurdi, Pabna	34
11.15.1	Saplings distribution at FSRD Site :Charpara, SonatolaBogura	36
11.16.1	Plantation of fruit trees at homestead (before and after intervention)	37
11.17.1	Saplings distribution at FSRD site, Padma-Char, Ishurdi, Pabna	38
11.18.1	Fruits and spice plant at FSRD site Baghabari, Sirajganj	39
11.21.1	Napier grass production at FSRD site Padma Char, Ishurdi, Pabna	40
11.26.1	Improved cropping pattern at FSRD site Padma Char, Ishurdi, Pabna	46
11.26.2	Improved cropping pattern at FSRD site Padma Char, Ishurdi, Pabna	47
11.27.1	Newly developed BSRI varieties in FSRD char land eco system	48
11.28.1	Cropping pattern at FSRD site, Baghabari, Sirajganj	49
11.28.3	Onion (BARI Piaj -1)- Sesame (BARI Til - 4)-T-Aman (BRRI dhan 51)	50
11.31.4	Under production program different crops (Jute, rice, maize, mustard, groundnut, banana) at FSRD Site, Nawvanger Char, Jamalpur.	55
11.35.1	Pictures of Vitamin ADE injection at FSRD Site, Padma Char, Ishurdi, Pabna	57
11.39.1	Vaccination programme of cattle at FSRD site Padma Char, Ishurdi	59
11.40.1	Vaccination programme of cattle at FSRD site. Baghabari, Sirajganj	59
11.45.1	Goat rearing at farmers household at FSRD site Baghabari, Sirajganj	62

Sl. No.	Title	Page No.
11.47.1	Sheep rearing at FSRD Site Baghabari, Sirajganj	63
11.51.1	Vaccination programme on poultry birds at FSRD site. Padma Char, Ishurdi, Pabna	65
11.52.1	Vaccination on Poultry birds at FSRD Site, Baghabari, Sirajganj	66
11.57.1	Duck Rearing at FSRD Site Baghabari, Sirajganj	69
11.59.1	Sonali chicken rearing at FSRD Site Nawvanger Char, Jamalpur	71
11.60.1	Rearing of Sonali chicken at FSRD Site Padma Char, Ishurdi, Pabna	72
11.61.1	Hilly chicken rearing at FSRD Site Baghabari, Sirajganj	73
11.62.1	Pigeon rearing at FSRD Site: Nawvanger Char	73
11.63.1	Pigeon rearing in the farmer's household at FSRD Site Padma Char, Ishurdi, Pabna	74
11.64.1	Pegion rearing at FSRD Site, Baghabari, Sirajganj	74
11.65.1	Growing fodder crop (Pakchong grasses) at FSRD Site Padma Char, Ishurdi, Pabna	75
11.67.1	Carp polyculture at FSRD site: Char Kharicha, Mymensingh	75
11.69.1	Harvesting of fishes at FSRD Site. Padma Char, Ishurdi, Pabna	78
11.71.1	Tilapia fish culture at Char Kharicha, Mymensingh	79
11.76.1	Vermicompost production at FSRD Site: NawvangerChar, Jamalpur	82
11.76.2	Sewing katha by women members at FSRD Site: Nawvanger Char, Jamalpur	82
11.77.1	Off farm activities at FSRD Site: Padma Char, Ishurdi, Pabna	82
B.3.3.1	Training for the char land farmers at FSRD site Nawvanger Char, Jamalpur	119
B.3.3.2	Meeting to exchange views with the farmers at FSRD site Nawvanger Char, Jamalpur	120
B.3.3.3	Field day organized at FSRD site NawvangerChar, Jamalpur	120
B.3.4.1	Field days and meeting with farmers at FSRD site Padma Char, Ishurdi, Pabna	120
I.2.3	Visitors at FSRD site Padma Char	153

Executive Summary

Char is a deposit of mud mostly sand as islands within the river. The char dwellers are often the poorest and most vulnerable people. A constant threat of riverbank erosion and flooding combined with a lack of physical infrastructure, government services and employment opportunities in the chars, make it dwellers to live a vulnerable, difficult and fragile way of life. The modern agricultural technologies are not properly disseminated in the char land due to scattered, isolated and disconnected transport network. To keep the above issues in the mind, the Farming Systems Research and Development activities under PBRG sub project “Improvement of Farm Productivity through Intervention with Improved Agricultural Technologies in Char land Eco-System” were undertaken to increase farm productivity of char land area intervening whole farm activities with efficient use of resources, modify/fine tune on-station technologies generated by NARS institutes and integrate component technologies (crops, livestock, fisheries, agro-forestry and homestead) with establish linkage with different stakeholders and thereby improve family income and livelihood of Char land farmers. The sub - project coordinated by Planning & Evaluation Division, Bangladesh Agricultural Research Council (BARC) and implemented by On-Farm Research Division (OFRD) of the Bangladesh Agricultural Research Institute (BARI), Gazipur ; Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh; Bangladesh Sugar crop Research Institute (BSRI), Ishurdi, Pabna and Bangladesh Livestock Research Institute (BLRI) Savar, Dhaka from February 2018 to January 2021. The PBRG sub-Project was financed by (PIU)-BARC, NATP: Phase- II. The FSRD activities of PBRG sub-project were implemented during February 2018 to January 2021 at two villages of each 5 FSRD sites of four component institute have been taken under this project. To fulfill the objectives of sub-project, a total of 60 farmers have been selected, 12 from each site, including 4 marginal farmers, 4 small farmers and 4 medium farmers were selected from two villages of FSRD site. About 78 different types of research and development activities have been continuing since February 2018 to January 2021. On the basis of farmer’s traditional practices, their needs and choices, several alternatives of technologies of crops, cropping pattern, livestock, fisheries, agroforestry, off-farm activities and other components were incorporated with active participation of the farmers. Integrated approach has been followed for income generation and livelihood improvement of the farmers. Marginal, small and medium farmers having major components of farming and sizable homestead under single ownership were targeted. A base line survey of individual households was carried out to implement the sub-project activities.

BARI: Year round vegetables and fruits production at homestead area was carried out at FSRD sites of Mymensingh and Bogura by following the Narekeli model and Goyeshpur model, respectively during the year of 2018-2021. The fallow and un-utilized homestead areas were brought into vegetables and fruits production considering time and space to increase farm productivity as well as to improve livelihood. Different niches viz. open sunny space, trellis, shady place, marshy land, tree support, fence, backyard, house boundary etc. were used scientifically for vegetables cultivation. Beside these, space utilization, some activities like chewing type sugarcane production, management of existing fruit trees, fodder production, vermicomposting etc. also done in homestead or nearby homestead. In most cases BARI developed crop varieties were used and recommended production package were imposed in both model in both sites. At FSRD Mymensingh, vegetables production in homestead were 259.50, 996.50 and 336 kg homestead⁻¹ year⁻¹ during Feb. 2018-Jan. 2019, Feb. 2019 - Jan.2020 and Feb. 2020 - Jan. 2021. However, average production was 530.7 kg homestead⁻¹ year⁻¹ that was 742% higher compare to 63 kg homestead⁻¹ year⁻¹ (as per base line) and the remarkable increment (742.3 kg homestead⁻¹ year⁻¹) was observed in vegetables production. After intervention, the average vegetables intake per farm family was 106.67 kg homestead⁻¹ year⁻¹. Distribution and selling of vegetables were recorded as 14.0 and 410.0 kg homestead⁻¹ year⁻¹, respectively and after selling the vegetables in local market, net return was recorded as Tk. 5693 homestead⁻¹ year⁻¹. Likewise, the fruit production trend was 135, 585 and 490 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 and Feb. 2020 - Jan. 2021 and however average production was 403.30 kg homestead⁻¹ year⁻¹ that was 102% higher compare to 200 kg homestead⁻¹ year⁻¹ (as per base line). The fruits intake per farm family per year was 140 kg after the program intervention, whereas it was only 100 kg before intervention and the distribution and selling of fruits were 26.67 kg and 236.67 kg,

return was Tk. 44834 homestead⁻¹ year⁻¹. At FSRD site, Bogura, by using all niches total vegetables production were 388.23, 483.40 and 555.04 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 & Feb. 2020 - Jan. 2021 and thus average production was 475.56 kg homestead⁻¹ year⁻¹ which was much higher than that of 117.39 kg homestead⁻¹ year⁻¹ at before intervention of model and the remarkable average increment of vegetables production (305.11%) was observed in vegetables cultivation at homestead. The average vegetables intake per farm family was 277.32 kg after the program intervention during the three-consecutive year. The distribution and selling were recorded as 67.87 kg and 130.36 kg and by selling in local market, the return were obtained as Tk. 3893 homestead⁻¹ year⁻¹. Similarly, after intervention of proven technology related to fruit tree management, fruit production were 42, 90 and 156 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 & Feb. 2020 - Jan. 2021. The average production was 96 kg homestead⁻¹ year⁻¹ which was much higher than that of 31 kg homestead⁻¹ year⁻¹ at before intervention of model and the remarkable average increment of fruit production (209.68%) was observed in this site. After intervention, fruits intake per farm family per year was 63.93 kg, whereas it was only 15.5 kg before intervention of project activities. The distribution and selling pattern were 11.63 kg and 20.43 kg homestead⁻¹ year⁻¹, respectively and income was Tk. 2873 homestead⁻¹ year⁻¹.

Development of alternate cropping pattern against existing cropping pattern to increase crop productivity and cropping intensity in the char lands ecosystem of Mymensingh and Bogura during 2018 - 20. In both sites, Boro - Fallow - T. Aman rice was the predominant cropping pattern and, in most cases, farmers were using local cultivars of those crops that were the key barriers for improvement of the existing cropping system. Adopting more crops with higher yield potentials having short lifespan according to the suitability of the local ecosystem along with better management practices play significant role in the development of the traditional systems. According to the suitability of the land, three crop based two cropping patterns viz. Mustard - Boro - T. Aman rice and Potato - Boro - T. Aman rice were studied against the existing cropping pattern Boro - Fallow- T. Aman rice at FSRD site, Mymensingh. Considering average of two years, REY in improved cropping pattern (Mustard - Boro - T. Aman rice) was 13.58 tha⁻¹ against 9.06 t ha⁻¹ in existing pattern that contributed higher gross margin (Tk. 111691 ha⁻¹), while Potato - Boro - T. Aman rice produced higher REY (35.68 tha⁻¹) over 9.20 tha⁻¹ in existing pattern that contributed higher gross margin (Tk. 414236 ha⁻¹). On the other hand, a 4-four crop based Mustard-Boro -T. Aus-T. Aman and a 3-crop based Wheat - Jute - T. Aman patterns were tested against Mustard - Boro- T. Aman rice and Boro - Fallow-T. Aman rice, respectively at FSRD site, Bogura. Average REY of 4 and 3 crop based improved cropping pattern were 16.23 and 15.35 tha⁻¹ and gross margin were Tk. 155645 and Tk. 188680 ha⁻¹, respectively. In case of production program, short duration as well as high yielding varieties of different crops were intervened at FSRD Site. Newly released high yielding crop varieties were got priority for production program. Because of such interventions farmers got significantly higher crop yields and economic return compared to their existing practices. Farmers have been stored seeds of different crops of HYV for next year.

Livestock is an integral part of a farm family and an important component of FSRD program which is executed by cattle, poultry and duck rearing, beef fattening, vaccination of livestock and poultry etc. A total of 9 and 5 different types of activities under livestock's component were conducted at FSRD sites of Mymensingh and Bogura, respectively during 2018-2021 to increase farm productivity as well as livelihood improvement of farm family. After deworming, Vitamin A, D and E containing injections were also being injected in cattle. After applying all sorts of intervention, the average body weight (40 g/day/cattle), disease incidence, lactation yield (up to 0.4 L/day) and the lactation period increased as compared to controlled cattle. A total of 220 cattle against major diseases (Anthrax and FMD) were vaccinated at FSRD site, Mymensingh, while a total of 670 cattle against Anthrax and FMD, 200 goat and 120 sheep against PPR were vaccinated at FSRD site, Bogura during 2018-21. After vaccination against major diseases, reduce mortality rate upto nil (0%) instead of 15%. Different types of vaccines (BCRDV, RDV, Fowl Pox, Fowl Cholera, and Duck Plague) were vaccinated on poultry birds. Irrespective of location, RDV and Fowl Cholera vaccine have reduced the mortality rate 78-86%, while BCRDV and Fowl pox vaccine reduced the mortality rate at about 80-88%. After vaccination of poultry, all of the diseases frequency reduced drastically and mortality rate was about less than 5-6%.

Different poultry birds viz. turkey, duck and Sonali chicken were reared to produce meat and egg purpose at FSRD site during 2018-20. After providing supplementary feeds and proven technology body weight of poultry bird gained significantly along with laid eggs per bird (on an average 120 -150 eggs per month) and consequently nutrient intake was increased in each farm family. On an average each sheep and goat produced 2 offspring (kids) after six month of rearing. From goat and sheep rearing each farmers earned gross margin Tk. 4333 and Tk.4500, respectively after one year. Under Beef fattening program farmers income increased about Tk.40500 after six months of rearing.

Fish culture in seasonal pond was undertaken at both FSRD sites to improve the livelihood of households by increasing farm income during 2018-21. Carp polyculture was conducted in both sites, but mono sex tilapia was grown only at FSRD site, Bogura to maximize farmers' income under adopting low cost management practices. A total of 4 and 12 ponds having pond size averagely 20 and 12 decimal areas were taken under the study by carp poly culture method at FSRD site, Mymensingh and Bogura, respectively during 2018-21. After intervention of improved feeds, technological support and modern pond management technique, it was produced 6020 fish kg ha^{-1} by carp poly culture method against 3507 kg fish ha^{-1} under farmer's traditional practice and the gross margin was Tk. 360767 ha^{-1} instead of Tk.187563 ha^{-1} at FSRD site, Mymensingh. On the contrary, fish production was 1588 kg fish ha^{-1} by adopting carp poly culture method against 454 kg fish ha^{-1} under farmer's traditional technique and income as gross margin was Tk. 190575 ha^{-1} by using improved method of fish culture at FSRD site, Bogura. The disposal patterns of fish were 89% selling in local market, 9% consumption by themselves and distributed about 2% among their neighbors, relatives and well-wishers at FSRD site, Mymensingh, while these were 25%, 65%, and 10% at FSRD site, Bogura, respectively. Three seasonal ponds were selected for fish culture with mono sex tilapia in FSRD site, Mymensingh during 2019-2021. The ponds were average 20 decimal sized with a 1.45 m depth. After imposing modern techniques in mono sex tilapia culture, the production and income both were increased as compare to that of farmer's traditional method. In the improved method, the fish production and gross margin were 3268 kg fish ha^{-1} and Tk. 206900 ha^{-1} , while these were 2507 kg fish ha^{-1} and Tk. 150750 ha^{-1} by farmer's existing method. The disposal patterns of tilapia fish were 79% selling in local market, 16% consumption by themselves and distributed about 3% among their neighbors, relatives and well-wishers.

BINA: Vegetables and fruits were grown at the homestead and adjacent to homestead following BARI developed vegetables production model. Cropping system at the char area was improved by developing cropping pattern and crop production through selecting suitable crop varieties and technologies to get higher production and better economic returns. Through integrated farming system, this sub- project has introduced livestock like poultry rearing-sonali chicken, pigeon rearing, beef fattening. Open water resource fish culture was practiced through net pen fish culture. On Farm composting and off-farm activities were also conducted as environment aspect and to improve family income. Results of the sub-project activities indicated that maximum income was incurred from Jute-T. Aman- Maize cropping pattern which was estimated Tk. 2, 44,526 ha^{-1} . Net income/profit was estimated Tk. 18,490 from homestead⁻¹ and Tk. 55,714 from land adjacent to homestead⁻¹ by growing vegetables and fruits. Livestock activities like beef fattening, chicken rearing, pigeon rearing incurred a total of Tk. 63,294. There is an ample scope to utilize backyard pond and open water resources to increase farm income and family consumption through fish culture during September to February of the year. Through other activities like composting and off-farm activities, each farmer earned on an average Tk. 4438. Net income earned by the farmer⁻¹ is Tk. 407962 after intervention whereas before intervention it was Tk. 113084. From economic analysis it was revealed that farm income was increased 261% compared to existing farming system. Effective and sustainable integration was observed in the Crop + Livestock + Poultry + Fisheries + Vermicompost + Household farming system which increased the net income and employment from the farm holding.

BSRI: Under homestead component, all together five trials were conducted viz., year-round vegetables and fruits production, green fodder production, distribution of fruit sapling and performance of chewing cane cultivation in homestead. Year-round vegetables and fruits production trials at homestead were conducted

following the Goyeshpur model. Average vegetables production per homestead/year was 465, 418 and 355 kg in Rabi, Kharif-1 and Kharif -2, respectively. A remarkable increase of production (300%), consumption (Avg. 348 kg) and gross margin (142%) of vegetables per homestead/year were observed after intervention. Average fruit production and gross margin from fruits were 246 kg and Tk. 2353 homestead⁻¹ year⁻¹, respectively while consumption and gross margin were increased 189% and 158%, respectively before and after intervention. A total of 1800 sapling of seventeen different fruit species such as Mango, Litchi, Guava, Lemon, Indian olive, Rose apple, Bael, Golden apple, Coconut, Custard apple (Sharifa), Carambola, Wood apple (kadbael), Bullocks heart (Ata), Papaya, Indian dillenia (Chalta), Pummelo and Sapota were distributed and overall survival percentage (83.76%) was found. It was observed that BSRI Akh 42 (Rang Bilash) performed better in respect of income (ave. TK. 5375/farm family). Under the component of crop and cropping system, two trials were conducted such as, replacement of existing sugarcane varieties and improvement of existing cropping pattern. Six sugarcane varieties (Isd 39, Isd 40, BSRI Akh 43, BSRI Akh 44, BSRI Akh 45 and BSRI Akh 46) were tested to replace traditional cultivated variety (Isd 34). Among the tested varieties BSRI Akh 46 performed better in three cropping seasons and average yield was obtained 98.51 t ha⁻¹ which was 20.67 t ha⁻¹ more than the traditional variety (Isd 34). Two new cropping patterns were found better over the existing cropping pattern. The new four crop base cropping pattern Radish (Mollica) - Radish (Mollica)-Carrot (orange king)-Wheat (BARI Gom-31) was superior to the existing cropping pattern (Aus-black gram-lentil). The rice equivalent yield (61.58 t ha⁻¹), gross margin (Tk.743400 ha⁻¹) and MBCR (3.16) was found from improved cropping pattern Radish (Mollica)-Radish (Mollica)-Carrot (orange king)-Wheat (BARI Gom-31). Second developed cropping pattern, Radish (Mollica)-Carrot (Orange king) - Ground nut (BARI Chinabadam - 8) gave higher rice equivalent yield (42.55 t ha⁻¹), gross margin (Tk. 8,83,250 ha⁻¹) and MBCR (3.61) than existing cropping pattern (Aus--Mustard - Fallow). The activities of livestock were deworming, Urea and Molasses treated Straw (UMS) and vitamin feeding of cattle, beef fattening, vaccination of cattle and poultry birds and chicken and pigeon rearing. Due to deworming and Vitamin ADE injection and supplemented feed both body weight (46.41%) and milk production (55.8%) in cattle increased over non-treated cattle. An average increase in body weight (49.18%) and market price (81.39%) recorded when both treated UMS and vitamin A, D and E were used. The average mortality rate was reduced to 0-3% by using vaccination against major four disease of cattle i.e. Anthrax, FMD, HS and Back quater. where as it was 7-18% before vaccination. Different types of vaccines as BCRDV, RDV, Fowl Pox and Fowl Cholera were used for vaccination of poultry. Before vaccination mortality rate of poultry birds due to different diseases was higher (17-39%). After vaccination of poultry, all the disease frequency were reduced drastically and mortality rate was recorded 1-11%. After six months rearing of average 0.57 kg of sized Sonali chicken pullets at farmer's level, average body weight increased to 1.15 Kg. The poultry started laying eggs at the age of 15-20 weeks. It revealed that by rearing 12 pullets for six months, a farmer could earn on an average Tk. 6,349. The average consumption of meat and egg were found 16.94 kg and 696 no. respectively, per house hold/year which was satisfactory as nutrition source for improvement of farmers' health. Carp poly culture was conducted to maximize farmers' income under adopting low-cost management practices. After intervention of improved feeds, technological support and modern pond management technique, it was observed that farmers could obtained 460 kg fishes and earned Tk. 68,520 from 41 decimal pond after 6 month of rearing. The calculated Benefit Cost Ratio (BCR) 2.91 indicates that a farmer could be benefited by Carp polyculture system in integrated farming system approach.

BLRI: Under homestead component, all together two trials were conducted viz., year-round vegetables and fruits production, Year round vegetables and fruits production at homestead area was carried out at FSRD sites of Baghabari by following the Goyeshpur model. At FSRD Site Baghabari, vegetables production in homestead were 756, 916 and 898 kg in homestead year⁻¹ during Feb. 2018-Jan. 2019, Feb. 2019 - Jan. 2020 and Feb. 2020 - Jan. 2021 After intervention, the average vegetables intake was 375 kg homestead⁻¹ year⁻¹. Distribution and selling of vegetables were recorded as 9.0 and 493. kg homestead⁻¹ year⁻¹, respectively. Gross margin was recorded as Tk. 13910 homestead⁻¹ year⁻¹. from vegetables production at homestead. Similarly, the fruit production trend were 525, 665 and 610 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 and Feb. 2020 - Jan. 2021. At the FSRD Site, Boro - Fallow - T.

Aman rice is the predominant cropping pattern and in most cases farmers are using local cultivar of those crop in the existing cropping pattern that are the key barriers for increase total productivity of the existing cropping pattern. Adopting more crops with higher yield potentials having short life span according to the suitability of the local ecosystem along with better management practices play significant role in the development of the traditional cropping systems. According to the suitability of the land, three crops based two cropping patterns viz. Mustard - Boro - T. Aman rice and Onion- Sesame-T.Aman patterns were tested against Boro - Fallow-T. Aman rice and Onion-jute-Fallow. In improved cropping pattern contributed higher gross margin than existing cropping pattern. The gross margins of improved cropping pattern were Tk. 60370 and Tk. 180700 ha⁻¹, respectively.

In livestock sector, after deworming, Vitamin A, D and E containing injections were also being injected in cattle. After applying all sorts of intervention, the average body weight, milk production and lactation period were increased 49.41% ,55.88% and 8.57% respectively, over controlled cattle. A total of 775 cattle against major diseases (Anthrax and FMD) and 238 goat and 180 sheep against PPR diseases were vaccinated. Vaccination against major diseases have reduced mortality rate (1-2%) instead of (10-15%). Different types of vaccines as BCRDV, RDV, Fowl Pox, Fowl Cholera, and Duck Plague were used for vaccination of poultry birds. It was found that before vaccination mortality rate of poultry birds due to different diseases were higher (8-25%). After vaccination all of the diseases frequency reduced drastically and mortality rate was recorded about 1-4%. Due to reared of different poultry birds' viz. turkey, duck, hilly chicken and pigeon production of meat and egg were increased which improve nutritional status as well as improvement of farmers' health. Farmer's income increased significantly from livestock sector which was Tk.14,17,043 house hold⁻¹ due to following modern management and used improved breeds. In fisheries program, carp polyculture was introduced in the seasonal small ponds which were usually not used for fish culture. The average fish production, 284 kg and gross margin Tk. 49020 were obtained following carp poly-culture system using modern technology. Though male participation for homestead production system is higher (61.5%) than women participation (38.85%) but women employment opportunities create at the FSRD site. The results of Farming system research and development activities is profitable and encrusting for better livelihood improvement farmers of Char land Ecosystem.

Inception workshop, program planning workshop, coordination meeting and progress review workshops were organized by BARC component as per sub-project proposal. All sorts of recruitment have been done by BARC as per sub-project proposal. BARC in collaboration with an agricultural economist developed a structured questionnaire for baseline survey for all sites and survey report published. Training on FSRD technologies were also organized in four batches with the participation of 125 Scientist and Scientific Assistant. Several field visits were organized by BARC to monitor the progress of FSRD activities at farmers' level. A training manual with 18 lecture notes related to FSRD was prepared and distributed among the trainees. During the sub-project extended period Annual Review Workshop, Project Completion Workshop and Technology Packaging Workshop were also organized.

Last of all it is anticipated that the sub-project have demonstrated and established effective ways of maximizing farm productivity through dissemination and adoption of farming systems technologies with efficient use of farm resources. Women employment has increased which ensured women participation in agricultural activities. Such as homestead production system, postharvest and processing, goat, sheep, chicken, duck, pigeon rearing, fruit and vegetables sapling production at nursery, Seed preservation and off farm activities, for higher income as well as livelihood improvements.

Keywords: Homestead production system. Cropping system. BCR, MBCR, REY, Goyeshpur model, Farming system, char land, farm productivity, integrated farming and livelihood.

PBRG Sub-sub-project Completion Report (PCR)

A. Sub-sub-project Description

- Title of the PBRG sub-sub-project** : Improvement of Farm Productivity through Intervention with Improved Agricultural Technologies in Char land Eco-System.
- Implementing organization** : Bangladesh Agricultural Research Institute
Bangladesh Institute of Nuclear Agriculture
Bangladesh Sugarcrop Research Institute
Bangladesh Livestock Research Institute
- Name and full address with phone, cell and E-mail of Coordinator, Associate Coordinator and PI/Co-PI (s)**
Coordinator:
 - : **Dr. Kabir Uddin Ahmed**
Chief Scientific Officer
Planning and Evaluation Division
BARC, Farmgate, Dhaka
Telephone: +02-222242633
Mobile: 01771-777993
E-mail: kabir@barc.gov.bd**Principal Investigator:**
 - BARI Component** : **Dr. Md. Faruque Hossain**
Senior Scientific Officer
On-Farm Research Division, BARI, Gazipur
Phone: 0249270164, Mobile: 01552-333851
E-mail: faruque1969@yahoo.com
 - BINA Component** : **Dr. Reema Ashrafi**
Senior Scientific Officer
Planning and Development Section
BINA, Mymensingh
Mobile : 01745749881
Email: reema_ashrafi@yahoo.com
 - BSRI Component** : **Dr. Md. Jahangir Alam**
Chief Scientific Officer (C.C.) and Head
Agronomy and Farming Systems Division
BSRI, Ishurdi, Pabna.
E-mail: alamjbsri@gmail.com
Phone: 07326-63579
Cell: +8801716229375.

- BLRI Component** : **Dr. Md. Abdul Jalil**
Director General
Bangladesh Livestock Research Institute
Savar, Dhaka, Cell: 01711155062,
Phone: +88027791696 (Office)
E-mail: jalilgene@gmail.com
- Co-Principal Investigator:**
- BARI Component** : **i. Dr. Md. Shahidul Alam**
Principal Scientific Officer (I/C)
OFRD, BARI, Bogura
Phone: 051-65365, Mobile: 01712-166150
Email: alamsrc84@yahoo.com
- ii. Dr. Nargis Sultana**
Senior Scientific Officer
OFRD, BARI, Mymensingh
Phone: 091-67784, Mobile: 01757-832644
Email: nargis_bari@yahoo.com
- BINA Component** : **Dr. Md. Mahbubur Rahman Khan**
Senior Scientific Officer and Officer in charge
BINA Sub-station, Jamalpur
Mobile: 01711351652
Email: binamunna@yahoo.com
- BSRI Component** : **Dr. Md. Abu Taher Sohel**
Principal Scientific Officer
Agronomy and Farming Systems Division
BSRI, Ishurdi, Pabna
E-mail: atsohel@yahoo.com
Phone: 07326-63342
Cell: +8801711070740
- BLRI Component** : **Dr. Kamrun Nahar Monira**
Principal Scientific Officer
Bangladesh Livestock Research Institute
Savar, Dhaka, Mobile: 01718237143
E-mail: monirablri@yahoo.com

4. Sub-project budget (Tk.)

4.1 Total (in Tk. as approved): 3,70,00000

4.2 Latest Revised (if any): Tk. 3,39,50001

5. Duration of the sub-project:

5.1 Start date (based on LoA signed): 4 February 2018

5.2 End date: January 2022

6. Background of the sub-sub-project:

Char is a deposit of mud mostly sand as islands within the river, face the flash flood along with other natural disasters due to climate change (Islam *et al.*, 2018). In the char land, soils are light textured, low to very low in organic matter content, low soil fertility and low moisture content (SRDI, 2001). Fresh sediments are also deposited in every year. Flooding in the wet and summer season, low soil fertility and organic matter and low moisture holding capacity, river bank erosion and flood are the main constraints for agricultural development. Agricultural land use (65%) is the dominant land use of the area and population is dependent on share cropping. Though the mainland agriculture lands are decreasing, the char lands are increasing (Rahman, 2010). Approximately 4-5% of the population in Bangladesh lives in the Char lands which cover almost 7200km² (Paul and Islam, 2015). Rice and jute are principal crops though pulse, water melon, chilli, peanut etc. are also produced (Karim, *et al.*, 2017). The area is acutely vegetables deficit; malnutrition is widespread among the landless and marginal groups of farmers. According to the “National Conservation Strategy Papers” Char lands are mostly distributed in 11 districts of Bangladesh covering a land area of about 0.82 million hectares (EGIS, 2000). The modern agricultural technologies are not properly disseminated in the char land due to scattered, isolated and disconnected transport network. Char dwellers are considered as the most disadvantage group of people in Bangladesh. Char dwellers inhabit the extremely marginal environments out of necessity, moving from one char to another in the face of river and island erosion. Flood damage further burdens many already vulnerable families with debt (Baqee, 1993). Access to markets and wage employment is limited; agricultural work is especially scares during unpredictable floods and the period between planting and harvesting of rice. Families suffer “monga” or “seasonal hunger” when many are able to eat once a day, some spending over 90% of their income on food. During “monga”, jobless households are found to borrow money and sell profession for food. Despite of this, a large number of people stay in the chars taking high risk of natural vulnerability. According to the 7th Five Year Plans and SDGs, poverty alleviation, end hunger, achieve food security and improved nutrition and promote sustainable agriculture is the new challenge for researchers, extension personnel and farmers. Considering the complex factors, the char dwellers often could not choice the best farming practices to be followed in their lands. As a result, their income becomes lower. A single enterprise is not enough to income generation of small and marginal farmers or meet up the employment year round other than the integrated farming system research (Behera *et al.*, 2013). From the activities of some sub-projects and NGOs, it is clearly understood that, integrated farming approach is one of the best ways for income generation of Char dwellers. But this integrated farming system approach may play a vital role to overcome the above-mentioned situation in Char land eco-system.

7. Sub-sub-project general objective

To increase Farm Productivity of Char land area intervening whole farm activities.

8. Sub-sub-project specific objectives

BARC Component

- i) To coordinate, planning, monitoring and evaluate the Farming Systems Research and Development activities within involved organizations by BARC (Coordination Unit)
- ii) To establish linkage with the stakeholders in terms of development activities

BARI Component

- i) To generate system-based technologies for the char land
- ii) To maximize the farm productivity with efficient utilization of resources
- iii) To create awareness about modern Agricultural Technology (ies) among the participating farmers.

BINA Component

- i) To develop system based technologies for the char land.
- ii) To integrate component technologies (Crops, livestock, fisheries, agro-forestry and homestead, etc.) for improving farm productivity & establish linkage with different stakeholders.

- iii) To create awareness about modern agricultural technology among the participating farmers.
- iv) To improve family income and livelihood.

BSRI Component

- i) Disseminating component based technologies for the improvement of farm productivity of char land ecosystem.
- ii) Creating awareness on system based agricultural technologies among the participating farmers.
- iii) Improving family income and livelihood of the participating households.

BLRI Component

- i) To maximize the farm productivity with efficient use of farm resources in the char land ecosystem.
- ii) To create awareness about modern Agricultural Technology (ies) among the participating farmers.
- iii) To improve family income and livelihood

9. Implementing locations (S)

Implementing locations were selected based on climatic, edaphic, social, vegetation and economic conditions of the regions. Two villages were selected for each FSRD site. The FSRD Sites of each implementing institute as follows i.e., Char Kharicha, Mymensingh (BARI), Char para Sonatola, Bogura (BARI), Nawvangan Char, Jamalpur (BINA), Padma-Char Ishurdi, Pabna (BSRI) and Baghabari, Sirajganj (BLRI).

FSRD Site: Charkharicha. Mymensingh (BARI)

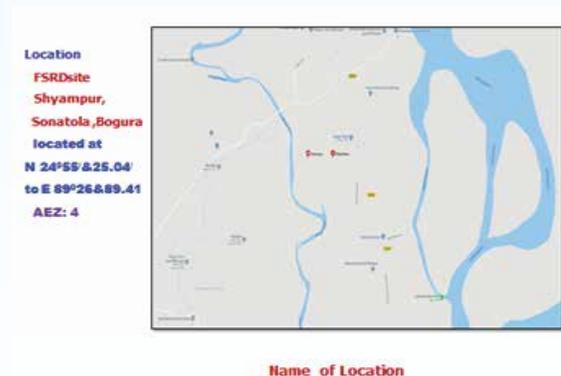
Location of the study area is the Char land named Char Kharicha, under sadar upazila of Mymensingh district. Two villages named Char Kharicha and Char Anandipur village were selected for sub-project activities. This area is located under old Brahmaputra Floodplain (AEZ- 9).



Map 9.1. FSRD site Char Kharicha. Mymensingh

FSRD Site: Char para, Sonatola, Bogura (BARI)

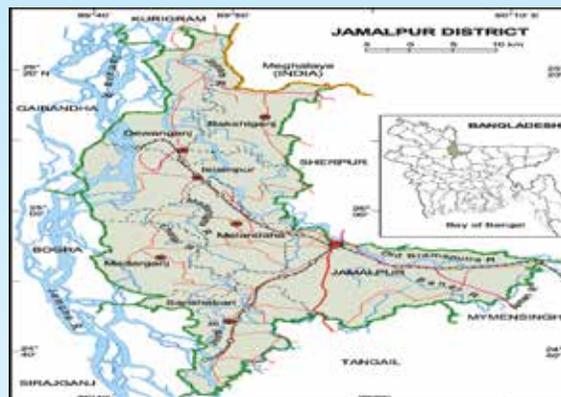
Charpara, Sonatola, Bogura FSRD site is located at N 24°55' and 25.05" to E 89°26' and 89.40". The area is located under Karatoya- Bangali Floodplain (AEZ-4). EAZ-4 is Eastern part of Bogura district and most of Sirajganj district.



Map 9.2. FSRD site Charpara, Sonatola, Bogura

FSRD Site: Nawvanger Char, Jamalpur (BINA)

Location of the study area is the Char land of Brahmaputra river (Nawvanger Char) under sadar upazila of Jamalpur district. Two villages named Guabari and Pathalia were selected for sub-project activities. This area located under Young Brahmaputra and Jamalpur Floodplain (AEZ- 8). It is located between 24° 42' and 24° 58' north latitudes and between 89° 52' and 90° 12' east longitudes. The upazila is bounded on the north by old Brahmaputra River east by Mymensingh district, south by Tangail district west by Melandaha Upazila of Jamalpur district.



Map 9.3. FSRD site Nawvanger Char , Jamalpur

FSRD Site : Padma-Char Ishurdi, Pabna (BSRI)

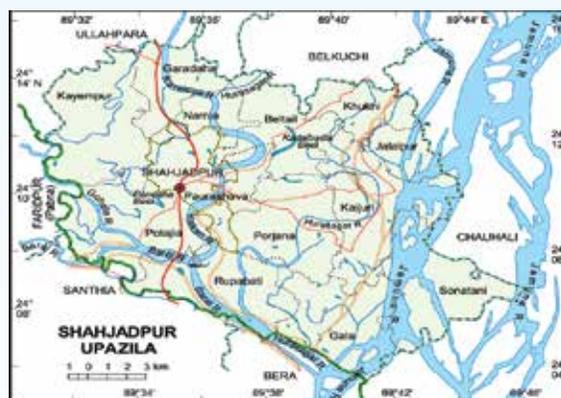
Location of the study area is the Char land of Padma river under Ishurdi upazila of Pabna district. Two villages named Juktitola and Pakshi were selected for sub-project activities. This area is located at 24.15°N 89.7°E. Ishurdi Upazila is bounded north and west side by Ganges River, south by Kushtia district and east by Pabna sadar.



Map 9.4. FSRD site Padma-Char Ishurdi, Pabna

FSRD Site: Baghabari, Sirajganj (BLRI)

Location of the study area is the Char land of Jumana river at Baghabari under Shahazadpur Upazila of Sirajganj district. Two villages named Jugnidhaho and Khamarsanila were selected for sub-project activities. Sirajganj district is bordered on the north by Bogura district, on the south by Rajbari district, on the east by Tangail, and on the west by Pabna district. The soil composition is mainly clay-loam soil (80%) of the Jamuna river basin.



Map 9.5. FSRD site Baghabari, Sirajganj

10. Methodology in brief

The Farming Systems Research and Development Programme (FSRDP) have been working with slightly modified methodology of the Asian Farming Systems Network, the successor of the Asian Cropping Systems Network. The modification has been made to adopt and make it more applicable to Bangladesh condition. For the successful implementation of the proposed integrated farming systems research and development program, the following methods were considered:

Specific Methodology

The integrated farming research and development activities were executed at Char land ecosystem at five

FSRD sites of four implementing institutes BARI, BINA, BSRI and BLRI with the coordination of BARC during February 2018 to January 2021 to improve livelihood of rural households through generation and adoption of Farming System Technologies especially integrated farming technologies and the technologies generated by NARS institutes. The selected FSRD sites of different NARS institutes are presented in the Table 10.1.

Table 10.1. Sub-project locations/sites

3	Implementing organization	District	Upazila	FSRD Site
1.	OFRD, BARI, Mymensingh	Mymensingh	Sadar	Char Kharicha
2.	OFRD, BARI, Bogura	Bogura	Sonatola	Charpara
3.	BINA, Jamalpur	Jamalpur	Sadar	Nawvanger char
4.	BSRI, Ishurdi Pabna	Pabna	Ishurdi	Padma-Char
5	BLRI, Baghabari, Sirajganj	Sirajganj	Shahjatur	Baghabari

For the successful implementation of the integrated farming system research and development program, the following methods were considered: Site selection and description, Identification and prioritization of problems, Preparation of research and development program, Discussion on the program, Selection of cooperator farmers, Program execution and recommendation domain and Follow-up evaluation. Site selection was done on the basis of climatic, edaphic, social, vegetation and economic conditions of the regions so that the site was representative. Site includes geographical location, physical, biological, social and economic conditions, infra-structural condition, existing farming systems, resource situation, general problems etc. Detailed survey, case studies, participatory rural appraisal, exploratory survey, participation in different meetings/workshops of extension organizations like UECC/DTC/DECC/ATC. DAE and in different regional and central review meetings and workshops of research institutes, personal observations etc.

The program was executed in a participatory approach, where critical inputs and technological suggestions were provided by BARI, BINA, BSRI and BLRI personnel and other commodities were used from farmer's own sources. Based on farmer's traditional practices, their needs and choices, several alternatives of technologies of crops, livestock, fisheries, off-farm activities and other components were incorporated with active participation of the farmers. According to the aim of the program resource poor farmers-marginal, small and medium having major components of farming and sizeable homestead under single ownership were targeted and twelve farm households from two villages were selected at each site (Table 10.2).

Table 10.2. Category-wise selected farmer's information of different FSRD Sites

FSRD site	Categories	No. of Farmer	Avg. family size (no.)	Av. crop land size (ha)	Avg. homestead area (ha)	Avg. pond area (ha)
Char Kharicha, Mymensingh	Marginal	4	4.5	0.18	0.057	0.032
	Small	4	4.25	0.44	0.058	0.034
	Medium	4	5.25	0.97	0.048	0.054
Charpara, Bogura	Marginal	4	5.0	0.435	0.084	0.03
	Small	4	5.75	0.891	0.126	0.04
	Medium	4	5.5	1.188	0.195	0.04
Naovanger char, Jamalpur	Marginal	4	4.50	0.17	0.047	0.028
	Small	4	5.00	0.64	0.103	0.037
	Medium	4	4.25	1.12	0.11	0.06
Padma-Char, Ishurdi Pabna	Marginal	4	6.5	0.19	0.11	-
	Small	4	4.66	0.58	0.13	0.05
	Medium	4	5.0	1.05	0.16	0.05
Baghabari, Sirajganj	Marginal	1	4.00	0.06	0.06	-
	Small	8	4.38	0.45	0.064	0.048
	Medium	3	5.33	1.12	0.08	0.08

Training program was arranged to build up farmers capacity and to develop awareness regarding nutrition and crop production. An individual household survey (Benchmark survey) was carried out before starting the sub-project activities. The detail information regarding livelihood patterns were documented. Total resources inventory, liabilities, technology used, level of input used, output obtained, income and expenditure status, labor availability of the farms of previous year were accounted by detail households' case study with intensive visit and cross examinations for authentication of the data before intervention. Based on the potentials suitable technological options were addressed to the farmers and accordingly farmers selected suitable technologies adjusting with their need for livelihood improvement. Year-round vegetables production followed by respective location-wise model in each homestead, fruit tree management and new plantation, crops and cropping system improvement through improved cropping pattern development and promising variety piloting, vaccination of poultry and livestock, rearing of turkey, poultry, pigeon and calf, green fodder production, fish culture and some off-farm activities were identified as their major potential area.

During the implementation period of sub-project activities, site working group meeting, PRA, base line survey, field visit were done, and field staffs were organized. FSRD team facilitated the cooperators for technological intervention to maximize the productivity of the components. However, season-wise (Rabi= October-March, Kharif I= April-June and Kharif II= July-September) data on production, farm level utilization with disposal pattern, possible integration among the components, economic return focusing income and expenditure and other socio-economic information were collected and tabulated accordingly.

A. Homestead Production System

A homestead is a farmhouse, together with the land around it. The area under a homestead is a valuable asset for the resource poor farm household and suitable for production of different kinds of vegetables and fruits. The fallow and un-utilized homestead areas were brought into vegetables and fruit production considering time and niches (Ali, *et al.*, 2008) Before going to implement the program, a benchmark survey was carried out to know the existing agricultural situation for technology intervention of the pilot areas. Twelve different categories farmers were selected on the basis of available resources and potentials for homestead farming and averaged shown here. Each farm families consist of average 5 members. The selected farmers were provided training and suggestion by the FSRD team on year-round vegetables and quick growing fruits production following respective site wise production model. Thereafter, the trained farm families produced vegetables and fruits in their homestead area following respective site-wise model. In each FSRD site, two villages were considered to conduct the activities of the sub-project and 12 cooperator farmers were selected on the basis of their available resources and potentials for homestead farming under small farm category.

Based on farmers' choice and agro-ecological suitability, the vegetables fruit production models of different locations were determined and followed accordingly under Char land ecosystem. Narekeli model was followed at Mymensingh and Goyeshpur model with some modification were followed at the FSRD site: Charpara Bogura (BARI), Nawvanger char, Jamalpur (BINA), Padma char, Ishurdi Pabna (BSRI) and Baghabari, Sirajgang (BLRI) for year round vegetables and fruits production at the FSRD sites during the year of 2018-2021 (Table 10.3, 10.4, 10.5, 10.6 and 10.7). A total of eight production units were considered in Narekeli Model while nine production units were used in Goyeshpur Model. In both models, five beds were considered in sunny places where vegetables were cultivated round the year and the unit plot size 5m×1m was maintained. Each farm families consist of average 5 members. The recommended seed rate, plant spacing, fertilizer dozes and sowing dates were followed for all crops accordingly in all niches. Vegetables from different beds and niches were harvested according to their maturity and the recorded data were converted in to average. The selected farmers were provided training and suggestion by the FSRD team on year round vegetables and quick growing fruits production. Vegetables from different beds and niches were harvested according to their maturity and the recorded data were converted in to average. The produce values were calculated with the local market price for all crops.

1. Year-round vegetable and fruits production in the homestead

Table 10.3. Narekeli model (eight niches) was followed at FSRD site: Char Kharicha, Mymensingh (BARI)

Space		Rabi		Kharif-1		Kharif-2		
		October-March		April-June		July-September		
1	Open sunny space	Bed-1	Tomato *Red amaranth + Red amaranth (BARI Lalshak-1)		Indian spinach (BARI Puishak-1)		Stem amaranth (BARI Danta-1)	
		Bed-2	Lalshak+cabbage *Radish (BARI Mula-1) + Spinach (BARI Palongshak-1)		Kangkong *Pat shak (Desi tosha)		Kangkong *Indian spinach (BARI Puishak-1)	
		Bed-3	Coriander+onion *Carrot (New Kuroda-35)		Okra *Kangkong (BARI Gimakalmi-1)			
		Bed-4	Spinach+Garlic (BARI Rashun-1)		Chilli *Latirajkachu (BARI Panikachu-1)			
		Bed-5	Carrot + Bitter gourd *Onion (BARI Piaj-1)		*Stem amaranth (BARI Danta-1)		*Red amaranth (BARI Lalshak-1)	
2	Roof top	Country bean (BARI Sheem-1)		*Sweet gourd (Local cultivar)		-		
3	Trellis							
		Trelly-1	Bottle gourd (Hybrid)		*White gourd (BARI Chalkumra-1)		Yard long bean (Local cultivar)	
		Trelly-2	Country bean (BARI Sheem-1)		*Bitter gourd (Hybrid)		*Snake gourd (BARI Chichinga-1)	
		Trelly-3	Country bean (BARI Sheem-1)		*Sweet gourd (BARI Mistikumra-1)		White gourd (BARI Chalkumra-1)	
4	Fence	Bitter gourd (Hybrid)		*Sponge gourd (BARI Dhundol-1)				
5	Marshy land	Latirajkachu (BARI Panikachu-1)						
6	Shady Place	Turmeric, Ginger, *Moulovikachu (Locally collected)						
7	House Boundary	Papaya /Drumstick *Chewing type sugarcane (Local cultivar)		Papaya /Drumstick *Chewing type sugarcane (Local cultivar)		Papaya /Drumstick *Chewing type sugarcane (Local cultivar)		
8	Unused tree							
		Creper-1	Potato yam (Local)		Potato yam (Local)		Potato yam (Local)	
		Creper-2	*Country bean (BARI Sheem-1)		*Sponge gourd (BARI Dhundol-1)		*Sponge gourd (BARI Dhundol-1)	

*Newly introduced crop in home garden. Text in the parenthesis is the variety name of respective crop.

Table 10.4. Goyeshpur model (nine niches) was followed at FSRD site: Charpara, Sonatola, Bogura (BARI)

Niches		Rabi		Kharif-1		Kharif-2		
		October- March		April-June		July-September		
1.	Open sunny space	Bed-1	Radish (BARI Mula-2)		Stem Amaranth (BARI Danta-1)		Indian spinach (BARI Puishak-1)	
		Bed-2	Cabbage/Lalshak (BARI Patakopi-1)		Brinjal/*Corriander (BARI Bt Begun-4)		Indian Spinach (BARI Puishak-1)	
		Bed-3	Tomato (BARI Tomato-16/17)		Okra/Gimakolmi (BARI Dherosh-1)		Okra (BARI Dherosh-1)	
		Bed-4	*Onion/lalshak onion (BARI Piaj-1/4)		Red Amaranth (BARI Lalshak-1)		Gimakolmi (BARI Gimakolmi-1)	
		Bed 5	*Garlic (BARI Rashun-1/2)		Sweet Gourd *Pat shak (Local)		Red Amaranth (BARI Lalshak-1)	

Niches	Rabi	Kharif-1	Kharif-2
	October- March	April-June	July-September
2. Roof top	Bottle gourd/Sweet gourd/Ashgourd (BARI Chalkumra-1)	Sweet Gourd/ Ash gourd (BARI Chalkumra-1)	Bottle Gourd/ Ash gourd (BARI Chalkumra-1)
3. Trellis	Bottle gourd (BARI Lau-4/local)	Sweet Gourd/ Ash gourd (BARI Mistikumra-1)	Sweet Gourd/ Ash gourd (BARI Mistikumra-1)
4. Shady Place	Turmeric/Ginger/ Olkachu (Local)	Turmeric/Ginger/ Olkachu (Local)	Turmeric/Ginger/ Olkachu (Local)
5. Marshy Land	PaniKachu (Local)	Panikachu (Local)	Panikachu (Local)
6. Unproductive Tree	Country bean (BARI Sheem-1/2)	Bottle gourd (BARI Lau-4/local)	Potato yam (Local)
7. Fence	Yard long bean (Local)/Country bean	Bitter gourd (BARI Korola-1)/Country bean	Sponge gourd/Ridge gourd (Local)
8. Backyard	Banana (Local), Guava (BARI Peyara-2)	Banana, Mango (BARI Aam-3/4), Jackfruit, Drumstick	Banana, Lemon, Moringa (Local)
9. House Boundary	*Dragon fruit (BARI Dragon Fruit-1), Papaya/lemon (Local)	*Dragon fruit (BARI Dragon Fruit-1), Papaya/lemon (Local)	*Dragon fruit (BARI Dragon Fruit-1), Papaya/lemon (Local)

*Newly introduced crop in home garden. Text in the parenthesis is the variety name of respective crop.

Table 10.5. Modified Goyeshpur model (nine niches) was followed at FSRD site: Nawvanger Char, Jamalpur (BINA)

Sl No.	Space		Rabi	Kharif-I	Kharif-II
			October – March	April – June	July – September
1.	Open land	Bed-1	Tomato (Hybrid)	Onion (BARI Piaj-2)	Water spinach (Hybrid)
		Bed-2	Chilli (Hybrid)	Lady's finger (Hybrid)	Indian spinach (Hybrid)
		Bed-3	Cauliflower (Hybrid)	Carrot (Hybrid)	Stem amaranth (Hybrid)
		Bed-4	Brinjal (Islampuri) +Red amaranth (Hybrid)	Indian spinach (Hybrid)	Lady's finger (Hybrid)
2.	Roof		White gourd (Hybrid)	White gourd (Hybrid)	White gourd (Hybrid)
3.	Trellis:	Trelly-1	Country bean (BARI Sheem-1)	Cucumber (Hybrid)	White gourd (Hybrid)
		Trelly-2	Bitter gourd (Hybrid) + Spinach (Hybrid)	Sponge gourd (Hybrid)	Bitter gourd (Hybrid)
		Trelly-3	Bottle gourd (Hybrid)	Snake gourd (Hybrid)	Sponge gourd (Hybrid)
4.	Tree support		-	-	-
5.	1. Partial shady area		Spinach (Hybrid)/Red amaranth (Hybrid)/Jute leaves (Binapatshak-1)	Turmeric (BARI Halud-1) Leaf aroid (Moulavi kachu)	
6.	Marshy land:		Latiraj (BARI Panikachu-1)		
7.	Fence		Bitter gourd (Hybrid)	Bitter gourd (Hybrid)	
8.	Homestead boundary		a. Papaya (Red lady) b. Guava (Thai Guava-7) c. Lemon (Binalebu-1)		
9.	Back yard/waste land		1. Drumstick 2. Chewing type sugarcane (Amrita)		

Table 10.6. Modified Goyeshpur model (nine niches) was followed at FSRD site: Padma Char, Ishurdi, Pabna (BSRI)

Sl No.	Space		Rabi	Kharif-I	Kharif-II
			October – March	April – June	July – September
1	Open land	Bed-1	Tomato (Hybrid)	Onion (BARI Pijaj-2)	Water spinach (Hybrid)
		Bed-2	Chilli (Hybrid)	Lady's finger (Hybrid)	Indian spinach (Hybrid)
		Bed-3	Cauliflower (Hybrid)	Carrot (Hybrid)	Stem amaranth (Hybrid)
		Bed-4	Brinjal (Islampuri) +Red amaranth (Hybrid)	Indian spinach (Hybrid)	Lady's finger (Hybrid)
2	Roof		White gourd (Hybrid)	White gourd (Hybrid)	White gourd (Hybrid)
3	Trellis:	Trelly-1	Country bean (BARI Sheem-1)	Cucumber (Hybrid)	White gourd (Hybrid)
		Trelly-2	Bitter gourd (Hybrid) + Spinach (Hybrid)	Sponge gourd (Hybrid)	Bitter gourd (Hybrid)
		Trelly-3	Bottle gourd (Hybrid)	Snake gourd (Hybrid)	Sponge gourd (Hybrid)
4	Tree support		-	-	-
5	Partial shady area		Spinach (Hybrid)/ Red amaranth (Hybrid)/ Jute leaves (Binapatshak-1)	Turmeric (BARI Halud-1) Leaf aroid (Moulavi kachu)	
6	Marshy land:		Latiraj (BARI Panikachu-1)		
7	Fence		Bitter gourd (Hybrid)	Bitter gourd (Hybrid)	
8	Homestead boundary		a. Papaya (3-5 plant) (Red lady) b. Guava (1-2 plant) (Thai Guava-7) c. Lemon (1-2 plant) (Binalebu-1)		
9	Back yard/waste land		1. Drumstick 2. Chewing type sugarcane (Amrita)		

10.7. Modified Goyeshpur model (nine niches) was followed at FSRD site: Baghabari, Sirajganj (BLRI)

Sl. No.	Spaces		Cropping patterns
1.	Open space	a.	Radish - Stem Amaranth - Indian spinach
		b.	Cauliflower - Brinjal - Red Amaranth
		c.	Tomato - Spinach – Okra
2.	Roof	a.	Bottle gourd - Wax gourd
3.	Trellis	a.	Bottle gourd - Sweet gourd
4.	Tree support	a.	Bitter gourd - Ridge gourd - Sponge gourd
		b.	Snake gourd - Potato yam
		c.	Country bean - Yard long bean
5.	Partial shady area	a.	Elephant foot yam
		b.	Leaf aroid (Moulavikachu)
		c.	Turmeric
		d.	Perennial chilli
6.	Marshy land	a.	Panikachu (Latiraj)
7.	Fence	a.	Bitter gourd - Yard long bean - Bitter gourd

Sl. No.	Spaces		Cropping patterns
8.	Homestead boundary (fruit)	a.	Papaya
		b.	Guava
		c.	Lemon
9.	Back yard/waste land	a.	Drumstick
		B	Banana

2. Year round fruit production at homestead:

Fruits have key role to provide necessary nutrient to boost up the immunity of human beings and thus several activities was done to produce fruits round the year in the homestead under this sub-project tenure in both sites. The available and unutilized niches of the homestead area have been brought into fruit production with the recommendation of the program. The fallow and underutilized homestead areas were utilized scientifically considering the time and space. Improved management practices such as fertilization, irrigation, pest control and pruning was suggested to some of quick growing fruits (Papaya, Lemon, Ber, Banana etc.) along with some existing fruit trees (Mango, Jackfruit, Coconut, Indian olive, Indian dellenia, Wood apple etc.) for higher yield and quality fruit production.

3. Year round vegetables production nearby homestead

In the Nawvanger char there was found fallow and un-utilized land near the farmer's household. The area was about 35 - 36 decimal. Vegetable production has been started from Kharif-I 2018-19. As a result three vegetables production cycle has completed after finishing the vegetables production of Rabi season of the year 2021. Data on yield, consumption, distribution and selling of different types of vegetables were collected by using a pre-designed schedule and through continuous monitoring. The produce values were calculated with the local market price for all crops. The average data were used for interpretation of the data. Cost and returns were analyzed.

4. Raised mini nursery of vegetables seedling using vermicomposting in seed starting cell tray

Flash flood is a regular phenomenon for char land people. Every year flash flood comes between the times from June-August. During flood, farmers could not produce seedling for their homestead garden. After recession of flood water, farmers have to buy seedling by higher price. To solve this problem a mini nursery was established where farmers can grow their seedlings by themselves timely even during flood to grow vegetables at their homestead just after removal of flood water. It also ensures healthy seedling and reduce cost of production in sustainable way. Vermicomposting technology was disseminated among the woman farmers of the households. By utilizing the compost prepared by vermicomposting, farmers are growing vegetables seedlings using seed starter tray on the raised seed bed.

Table 10.8. Different activities other than vegetables and fruits production in the homestead at FSRD during February 2018-January 2021

Sl. No.	Activity
1	Chewing type sugarcane production in house boundary
2	Production of vermicompost
3	Establishment of mini orchard
4	Plantation and management of fruit trees
5	Fodder production near homestead

B. Improvement of crops and cropping System

1. Improvement of Cropping Pattern

The experiment was laid out in RCB design with six dispersed replications in both the years. Unit plot size was 400 m². All agronomic activities including sowing/transplanting and harvesting dates, seed rate, plant spacing, fertilizer management, etc. are mentioned in Table 10.9. Recommended fertilizer packages (BARC, 2018) following the application methods were used for all the crops. Irrigation, pest managements and other intercultural operations were done as and when necessary. Crop cut was done from an area of 3m² at three spots from each plot for yield samples in all cases.

Table 10.9. Management practices followed in improved and existing cropping pattern at FSRD Site: Char Kharicha, Mymensingh (BARI) during 2018-2020

Observation	Improved cropping pattern			Existing cropping pattern		
Cropping Pattern-I						
Crop	Mustard	Boro	T. Aman	Boro	Fallow	T. Aman
Variety	BARI Sarisha-14	BRRRI dhan28	BRRRI dhan56	BRRRI dhan29		BRRRI dhan49
Date of sowing/ Transplanting	12-14 Nov	05-07 Feb	08-12 Aug	12-18 Jan		09-13 Aug
Seed rate (kg ha ⁻¹)	7.5	40	40	50		50
Spacing (cm)	Broadcast	20×15	20×15	20×15		20×15
Fertilizer dose (N-P-K-S-Zn-B, kg ha ⁻¹)	115-34-40-24-2-1	135-20-60-18-4	80-22-35-1	115-19-60-17-2		70-16-30-0-0
Date of harvesting	25-30 Jan	2-6 June	18-31 Oct	15 June		12-16 Nov
Field duration (days)	74-77	119-121	72-80	148-154		95
Turnaround time (days)	14-25	7-10	36	61-63		40-50
Cropping Pattern-II						
Crop	Potato	Boro	T. Aman	Boro	Fallow	T. Aman
Variety	BARI Alu-25	BRRRI dhan28	BRRRI dhan56	BRRRI dhan29		BRRRI dhan49
Date of sowing/ Transplanting	14-18 Nov	05-07 Feb	08-12 Aug	12-18 Jan		09-13 Aug
Seed rate (kg ha ⁻¹)	1600	40	40	50		50
Spacing (cm)	60×25	20×15	20×15	20×15		20×15
Fertilizer dose (N-P-K-S-Zn-B, kg ha ⁻¹)	120-50-110-24-4-2	135-20-60-18-4	80-22-35-1	115-19-60-17-2		70-16-30-0-0
Date of harvesting	25-30 Jan	6 June	28-31 Oct	15 June		12-16 Nov
Field duration (days)	72-73	122-124	80-81	144-148		95
Turn around time (days)	10-17	8-11	69	61-65		53-57

Table 10.10. Management practices followed in improved and existing cropping patterns at FSRD Site: Charpara, Sonatola, Bogura (BARI) during 2018-2020

Observation	Improved cropping pattern				Existing cropping pattern		
Cropping pattern-I							
Crop	Mustard	Boro	T. Aus	T. Aman	Mustard	Boro	T. Aman
Variety	BARI Sarisha-14	BRRRI dhan-28	BRRRI dhan-48	BRRRI dhan-52	Tori-7	BRRRI dhan-28	Sharwna

Observation	Improved cropping pattern				Existing cropping pattern		
Cropping pattern-I							
Date of sowing/ Transplanting	26-28 Oct (relay)	20-22 Jan	13-16 May	04-14 Aug	20-22 Oct	20-24 Jan	25-29 July
Seed rate (kg ha ⁻¹)	6	40	40	40	8	40	40
Spacing	Broadcast	15-20	15-20	15-20	Broadcast	15-20	15-20
Fertilizer dose (N-P-K-S-Zn-B kg ha ⁻¹)	120-70-50- 30-3-1	138-21-82- 20-4-0	65-11-41-0- 0	90-12-53- 12-0-0	95-50-40-0- 0	125-18-70- 15-2-0	102-20-60- 16-0-0
Date of harvesting (range)	10-12 Jan	08-10 May	01-05 Aug	06-16 Nov	10-15 Jan	25-27 April	15-17 Nov
Cropping pattern-II							
Crop	Wheat	Jute	T. Aman		Boro	Fallow	T. Aman
Variety	BARI Gom- 30	O-9897	BRRI dhan75		BRRI dhan28	-	Sharwna
Date of sowing/ Transplanting	20-22 Nov	10-14 April	5-7 Aug		14-16 Jan	-	21-23 July
Seed rate (kg ha ⁻¹)	18	7	40		40	-	40
Spacing (cm)	Broadcast	15×20	15×20		15×20	-	15×20
Fertilizer dose (N-P-K-S-Zn-B kg ha ⁻¹)	115-32-45- 22-0-1.5	104-12.5- 15-0-0	90-12-53-12-0-0		138-21-82- 20-4-0	-	102-20-60- 16-0-0
Date of harvesting	28-30 March	27-29 July	10-12 Nov		22-23 April	-	6-10 Nov

Table 10.11. Crop managements of improved and existing cropping pattern at FSRD site: Nawvanger Char, Jamalpur (BINA) during 2018-2020

Observation	Improved cropping pattern			Existing cropping pattern		
Cropping pattern-I						
Crop	Jute	T. Aman	Maize	Jute	T. Aman	Grass pea
Variety	JRO 524	Binadhan-11	Hybrid 981.	JRO 524	Sharwna	BARI Ksheshari-3
Date of sowing/ Transplanting	05 - 10 April	10 July- 05 August	08-12 November	05-10 April	10 July- 05 August	15-20 November
Seed rate (kg ha ⁻¹)	7.5	30	20	7.5	30	40
Spacing	30cm x 5cm	20cm x 15cm	75cm x 25cm	30cm x 5cm	20cm x 15cm	Broadcast
Fertilizer dose (urea-TSP-Mop- Gyp-Zn-B (kg ha ⁻¹))	225-150-112- 75-7.5-7.5	160-120-80- 60-7.5-7.5	512-275-200- 222-14-6	220-150-115- 75-7.5-7.5	150-100-120- 80-7.5-7.5	50-80-30
Date of harvesting	10 July	30 October	30 March	10 July	08 November	25 March
Field duration (days)	95	85	142	95	93	130
Turned around time	25	8	5	25	7	10

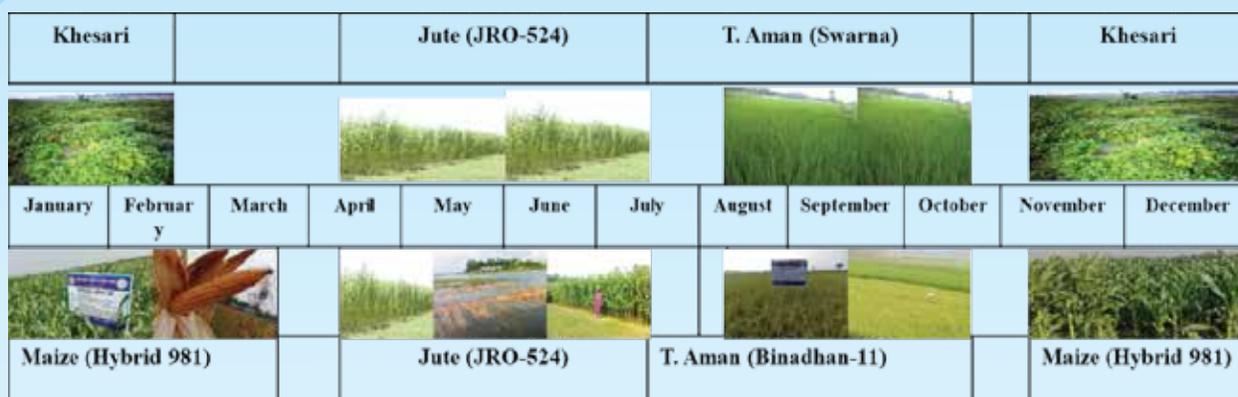


Figure 10.1. Existing cropping pattern with improved cropping pattern Cropping pattern-2

Table 10.12. Crop managements of improved and existing cropping pattern at FSRD site: Nawvanger Char, Jamalpur (BINA) during 2018-2020

Observation	Improved cropping pattern					Existing cropping pattern	
Cropping pattern-II							
Crop	Aus	T. Aman	Mustard	Mungbean	Fallow	T. Aman	Boro
Variety	Binadhan-19	Binadhan-7	Binasarisha-9	Binamoog-8	-	Sharwna	BRRRI dhan28
Date of sowing/ Transplanting	02 April- 25 April	20 July/-5 August	10-15 November	13-15 February	-	10 July- 05 August	25 December- 25 January
Seed rate (kg ha ⁻¹)	30	30	7.5	30	-	30	30
Spacing	20cm x 15cm	20cm x 15cm	30cm x 5cm	30cm x 5cm	-	20cm x 15cm	20cm x 15cm
Fertilizer dose (urea-TSP-Mop- Gyp-Zn-B kg ha ⁻¹)	174-87-70- 77-5-0	160-120-80- 60-7.5-7.5	85-75-50-55- 4-3	35-60-37-0- 0-0	-	150-100- 120-80-7.5- 7.5	104-12-5-38- 20-5
Date of harvesting (range)	07 July	30 October	02 February	17 April	-	08 November	01 May
Field duration (days)	72	85	82	64	-	93	95
Turned around time	38	10	11	8	-	77	94

Table 10.13. Crop managements of improved and existing cropping pattern at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI) during 2018-2020

Observation	Improved cropping pattern				Existing cropping pattern		
Crop	Radish	Radish	Carrot	Wheat	Aus	Blackgram	Lentil
Variety	Mollica	Mollica	Orange king	BARI Gom 31	BRRRI dhan48	BARI Mash- 3	BARI Moshur-6
Date of sowing/ Transplanting	15-17 May	06-08 July	28-29 Aug	28-30 Nov	15-16 April	20-22 Aug	01-02 Nov
Seed rate (kg ha ⁻¹)	4	4	3.5	120	60	35	30
Spacing	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast
Fertilizer dose (N-P- K-S-Zn kg ha ⁻¹)	45-15-40-6	45-15-40-6	40-13-30-6	40-8-30-5	32-4-20-3	6-5-6-3	7-6-7-3
Date of harvesting	28-30 June	21-23 Aug	25-27 Nov	28-30 Mar	14-16 Aug	25-26 Oct	18-20 Feb
Field duration (days)	45	45	90	120	121	76	111

Table 10.14. Crop managements of improved and existing cropping pattern at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI) during 2018-2020

Observation	Improved cropping pattern			Existing cropping pattern		
Crop	Radish	Carrot	Ground nut	Aus	Mustard	Fallow
Variety	Mollica	Orange king	BARI Chinabadam-8	BRR1 dhan48	Local	-
Date of sowing/ Transplanting	15-20 May	06-10 July	10-12 Oct	15-20 April	28-30 Oct	-
Seed rate (kg ha ⁻¹)	4	3.5	100	120	7	-
Spacing (cm)	Broadcast	Broadcast	15 × 30	Broadcast	45 × 100	-
Fertilizer dose (N-P-K-S-Mn kg ha ⁻¹)	45-15-40-6	40-13-30-6	12-12-15-12	40-8-30-5	60-20-45-15-10	-
Date of harvesting	29-30 June	04-05 Oct	08-10 March	14-16 Aug	20-22 Dce	-

Table 10.15. Crop management practices of improved and existing cropping pattern at FSRD Site: Baghabari, Sirajganj (BLRI) during 2018-2020

Observation	Improved cropping pattern			Existing cropping pattern		
Crop	Mustard	Boro	T. Aman	Fallow	Boro	T. Aman
Variety	BARI Sarisha-14	BRR1 dhan 74	BRR1 dhan51	-	BRR1 dhan28	Local
Date of sowing/ Transplanting	17-20 November	4-10 February	15-20 July	-	5-10 February	16-25 July
Seed rate ((kg ha ⁻¹)	8.0	40.0	40.0	-	50.0	50.0
Spacing (cm)	Broadcast	20 × 15	20 × 15	-	20 × 15	Broadcast
Fertilizer dose (N-P-K-S-Zn-B kg ha ⁻¹)	115-34-40-24-2-1	135-20-60-18-4	80-22-35-1	-	115-19-60-17-2	70-16-30-0-0
Date of harvesting (range)	6-10 February	15-22 May	12-15/15 November	-	10-17 May	10-18 November

Table 10.16. Crop managements of improved and existing cropping patterns at FSRD Site: Baghabari, Sirajganj (BLRI) during 2018-2020

Observation	Improved cropping pattern			Existing cropping pattern		
Crop	Onion	Til	T. Aman	Onion	Jute	Fallow
Variety	BARI Piaj-4	BARI Til -4	BRR1 dhan51	Taherpuri	Local	-
Date of sowing/ Transplanting	15-30 December	5-15 April	15-20 July	10-15 December	10-15 April	-
Seed rate ((kg ha ⁻¹)	7.5	7.0	40	-	7.0	-
Spacing (cm)	5 × 4	Broadcasting	Broadcasting	5 × 4	20 × 15	-
Fertilizer dose (N-P-K-S-Zn-B kg ha ⁻¹)	120-50-110-24-4-2	135-20-60-18-4	80-22-35-1	120-50-110-24-4-2	115-19-60-17-2	-
Date of harvesting (range)	20-25 March	15-20 July	12-20 November	25-30 March	15-20 July	-

2. On-firm verification/Production Program

Replacement of existing Sugarcane varieties by newly developed BSRI varieties at FSRD site Padma Char, Ishurdi, Pabna (BSRI) during 2018-2020

The experiment was undertaken to replace the existing traditional sugarcane varieties by high yielding new varieties developed by BSRI. To observe yield performance as well as income from newly released variety.

Seven varieties of sugarcane were tested at 12 farmer's field at FSRD site during 2018-2021. The tested varieties were Isd 34, Isd 39, Isd 40, BSRI Akh 43, BSRI Akh 44, BSRI Akh 45 and BSRI Akh 46.

Table 10.17. Crop managements of newly developed sugarcane varieties by BSRI at FSRD site Padma Char, Ishurdi, Pabna during 2018-2020

Items	Description
Number of farmers (no)	12
Land area (ha)	0.133
Crop	Sugarcane
Seed rate tha^{-1}	6.50-7.00
Variety (7)	Isd 34, Isd 39, Isd 40, BSRI Akh 43, BSRI Akh 44, BSRI Akh 45 and BSRI Akh 46.
Fertilizer dose (N-P-K-S- Zn and B kg ha^{-1})	180-60-90-30-2-2
Spacing	100 cm x 45 cm
Date of Transplanting	20-30 October
Date of harvesting	15-20 November

i. Production program on high yielding varieties at FSRD site: Char Kharicha, Mymensingh (BARI)

BARI developed different crop varieties viz. BARI Dherosh-2 for Okra, BARI Lau-3 for Bottle gourd, BARI Chichinga-1 for Snake gourd, BARI Danta-1 for Stem amaranth, BARI Korolla-2 for Bitter gourd, BARI Alu-25 for Potato and BARI Sarisha-14 for Mustard, were included in the production program at FSRD site, Mymensingh to popularize those varieties among the farmers of this area and thus improved the existing cropping system of that area. Agronomic activities imposed in crop production program are mentioned in Table 10.18.

Table 10.18. Management practices, variety, number of farmers, area covered by different crops at FSRD site, Mymensingh and Bogura during 2018-2021

Name of crops	Variety	Farmers (no)	Area (ha)	Date of sowing	Date of harvesting
Year-I: 2018-19					
Okra	BARI Dherosh-2	5	0.40	15-20 Mar. 2018	20 Apr-15 June 2018
Bottle gourd	BARI Lau-3	6	0.53	7-10 Sep. 2018	20 Nov-30 Dec 2018
Snake gourd	BARI Chichinga-1	7	0.40	10-15 Apr. 2018	2-30 June 2018
Stem amaranth	BARI Danta-1	10	1.05	10-12 Apr. 2018	20-30 May 2018
Bitter gourd	BARI Korolla-2	4	0.32	14-20 Mar. 2018	20 May-30 June 2018
Potato	BARI Alu-25	6	0.61	10-15 Nov. 2018	25-30 January 2019
Mustard	BARI Sarisha-14	8	1.01	10-15 Nov. 2018	25-30 June 2019
Year-II: 2019-20					
Bottle gourd	Hybrid lau	6	0.53	12 th July 2019	15 Sep-30 Nov, 2019
Snake gourd	BARI Chichinga-1	7	0.40	24 Feb. 2019	15 th March-07 May, 2019
Stem amaranth	BARI Danta-1	10	1.05	5-8 Feb. 2019	20 th Feb-30 March. 2019
Bitter gourd	Hybrid Korola	4	0.32	20 Feb. 2019	28 March-20 May. 2019
Potato	BARI Alu-25	6	0.61	20-25 Nov. 2019	15-20 Feb. 2020
Mustard	BARI Sarisha-14	8	1.01	07-21 Nov. 2019	05-21 Feb. 2020
Year-III: 2020-21					
Mustard	BARI Sarisha-14	15	3.0	7-21 Nov. 2019	26 Jan to 10 th Dec, 20
Potato	BARI Alu-25	9	1.15	22-26 Nov. 2019	20-25 Feb, 2020
Okra	BARI Dherosh-1	2	0.08	10 Feb. 2020	20 Apr. to 10 June 2020
Papaya	Hybrid papaya	1	0.05	20 Feb. 2020	24 June 2020
Brinjal	Local	1	0.04	14 April 2020	20 June to 25 Sep. 2020
Bottle gourd leaf	Hybrid	3	0.12	16 Aug. 2020	20 Sep. to 20 Oct. 2020

ii. Production program on HYV developed varieties at FSRD Site: Sonatola Bogura (BARI)

Table 10.19 Management practices, variety, number of farmers, area covered by different crops at FSRD site, Bogura during 2019-2021

Name of crops	Variety	Farmers (no)	Area (ha)	Date of sowing	Date of harvesting
Year-II: 2019-20					
Potato	BARI Alu-25 and BARI Alu-36	7	0.53	6-18 Nov, 2019	6 -13 February, 2020
Mustard	BARI Sarisha-14	12	0.40	3-12 Nov, 2019	25 Jan-10 Feb, 2020
Sweet potato	BARI Misti Alu-8	2	1.05	10-15 Nov, 2019	10-15 Feb, 2020
Wheat	BARI Gom-30 & BARI Gom-33	8	0.32	14-25 Nov, 2019	28 Feb-8 Mar, 2020
Maize	BARI Hybrid Maize-9 & 16	4	0.61	15-22 Nov, 2019	20-27 Apr, 2020
Year III: 2020-21					
Potato	BARI Alu-36, BARI Alu-41, BARI Alu-53 and BARI Alu-78	12	1	10-20 Nov, 2020	10 -15 February, 2021
Mustard	BARI Sarisha-14, 17	40	8	1-15 Nov, 2020	28 Jan-12 Feb, 2021
Sweet potato	BARI Misti Alu-8	2	0.13	15-16 Nov, 2020	15-20 Feb, 2021
Wheat	BARI Gom-33	6		15-24 Nov, 2020	26 Feb-10 Mar, 2020
Maize	BARI Hybrid Maize-16	1	0.12	28 Nov, 2020	25-30 Apr, 2020

* Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Dec.2020, BHM= BARI Hybrid Maize

iii. Production programme of jute, rice, groundnut and mustard at FSRD site: Nawvanger Char, Jamalpur (BINA)

Table 10.20. Production programme of jute, rice, groundnut, mustard and banana at FSRD site: Nawvanger Char, Jamalpur

Name of crops	Variety	Farmers (no)	Area (ha)	Date of sowing	Date of Harvesting
Jute	JRO 524	8	5.6	04 April 2020	10 July 2020
Rice	Binadhan-11	4	5.6	20 July 2020	12 November 2020
Groundnut	Binachinabadam-4	2	1	15 September 2020	3-5 April, 2021
Mustard	Binasarisha-4	4	1.4	10 November 2020	14-16 February, 2021
	Binasarisha-9	4	2.0	10 November 2020	18-22 February, 2021
Banana	Sabri	6	5 dec./ farmer	20 September 2018	October 2019 and July 2020

C. Livestock Component

Productivity and profitability of livestock sector mostly depend on farm animal health and maintaining of livestock health is an integral part of integrated farming. Cattle health may be improved through deworming which may make the farmer economically benefitted. More than 10 faces sample of cattle were selected from different location by the symptomatic parasitic infection and then investigated the parasites through faeces fices sample analysis for the confirmation. After confirmation of parasitic infestation, the tested animal was de-wormed by broad spectrum anthelmintics i.e., Trilev-vet (Livamisole and Triclabendazole) for round worm and liver fluke as per recommendation for the body weight. After deworming, Vitamin A, D and E containing injections were also being injected in cattle. Proper vaccination against four major diseases may reduce the mortality rate of cattle. For this purpose a short FGD was conducted to identify the disease severity and mortality after vaccination. In the vaccinated group Anthrax vaccine, Foot and mouth disease (FMD) vaccine, Black quarter (BQ) vaccine and Hemorrhagic septicemia (HS) vaccine were injected as per recommended schedule. Cattle fattening and Calf rearing programs were also continued at some areas. For beef fattening, cattle were selected based on their age, size and shape. On an average each

animal was 2 years old with squire shaped. After selection, animals went under deworming treatment as per suggestion of Department of Livestock Services (DLS). Thereafter, the cattle were fed with urea molasses straw, green grass, granular feed, @ 2-3, 5-6, 1 kg and water @10-15 L as per 100 kg body weight. The composition of urea molasses straw was dry straw 82%, 22% molasses, urea 3% and water 70%. To make 1 kg granular feed, 250g wheat bran, 150 g rice bran, 200g mustard oilcake, 150 g boiled broken rice grain, 200 g milled pulses husk, 20 g salt, 25 g DCP and 0.05 g vitamins were mixed. The animals were vaccinated against FMD and Anthrax. The animals were reared in confined condition. Water was given just after supply of granular feed. Vitamin-B was supplied as regular basis with the increased body weight. Initially the animals were fed with 2kg sliced straw, 6 kg green grass and 1.5 kg granular feed. Molasses mixed water at the ratio of 20:1 was provided to the animals.

Besides of cattle product, cowdung is very important by-product for integrated farming and farmers were motivated to use it for preparation of farm yard manure (FYM) including other homestead wastage instead of using the cowdung as fuel.

Napier grass was identified as a suitable and profitable green fodder to produce in the homestead and its surrounding areas especially on pond bank. Farmers were advised to apply FYM after every cut of grass. It was introduced among the farmers under the program to produce for feeding their cattle. Some farmers were also selling their produced Napier grass in the market besides of feeding their cattle.

Poultry rearing is a common practice in rural Bangladesh. Poultry disease is the main problem faced by the farmers for poultry rearing. Only proper vaccination can reduce the mortality rate of poultry. To reduce mortality rate and investigating effectiveness of poultry vaccine at farmers' level this program was conducted at the farmer's field. A good number of poultry birds were vaccinated during the sub-project period. In the vaccinated group BCRDV, RDV, Fowl pox, Fowl cholera and Duck plague vaccine were used as per recommended schedule. Regular contact was done by the facilitator team for providing necessary suggestions to solve their specific problems. Chick rearing, Pigeon rearing, Duck rearing and Turkey rearing programs were also conducted at some locations.

Table 10.21. Livestock activities in the FSRD sites

Sl. No.	Activities
1	Deworming of cattle
2	Vaccination of cattle/goat/sheep
3	Vaccination of poultry
4	Beef fattening
5	Artificial insemination on cattle
6	Calf rearing
7	Goat rearing
8	Sheep rearing
5	Turkey rearing
6	Duck rearing
7	Sonali chicken rearing for egg and meat purpose
8	Pigeon rearing



Picture 10.1. Vaccination Program



Picture 10.2. Cattle fattening Program

D. Fisheries Component

Improper management is the major hindrance against profitability of fish culture in pond under homestead area. The carp polyculture, monoculture of monosex tilapia and net pen fish culture in open water sources etc. programs in perennial, seasonal ponds and open water body were undertaken at the FSRD sites with the objectives of increasing farmer's income and removing protein deficiency of rural people. Before conducting the fish culture in pond, following activities were done chronologically.

Pond selection: The success of fish farming depends largely on pond selection and pond preparation and management. The ponds were made free from weeds. Farmers were suggested not to keep large trees on the banks of the pond and remove fallen leaves from the ponds. The location of the pond was close to the homestead for the suitability of overall management.

Pond preparation: The ponds were well prepared before stocking the fingerlings. For suitable physical growth of the fish species, it was ensured that the required amount of natural food was produced in the pond. The various stages in the preparation of the pond were- control of aquatic weeds, control of giant fish and unwanted animals, application of lime and fertilizer etc.

Lime application: Lime application was essential to decontaminate soil and water in ponds, to destroy fish disease germs and parasites, to increase immunity and calcium in water and to increase the productivity of ponds. The soil pH was maintained 6.4 to 7.2 and thus, lime @ 2 kg per decimal area were applied before release the fingerlings in ponds.

Stocking density: The success of fish farming depends largely on the right level of fingerlings stocks mostly based on water and soil quality as well as fingerlings size, species, pond depth and feed availability (Miah *et al.*, 1997) However, Silver carp, Catla, Rui, Mrigel, Common and Mirror carp may from 20–30%, 10–15%, 15–20%, 10–15% and 15–20%, respectively maintaining 50-60 fingerlings per decimal area. In case of mixed cultivation, fingerlings having the size of 3-5 inches were released at the number of Rui 10-15, Katla 8-10, Mrigel 8-10, Rajputi 5-6, Silver carp 6-8 and Grass carp 3-4 per decimal.



Picture 10.3. Fingerlings stocking in the pond

Fertilizer and manure management: After stocking of fingerlings of fish in the pond, fertilizers were applied regularly on weekly basis. In this case organic manure such as dung was applied in the pond at the rate of 1 kg every 15 days. In addition, 40 gm urea and 20 gm TSP were mixed with 30 times water in a container, soaked for at least 12 hours and sprayed all over the pond during the sunny days.

Supplementary food: Supplementary food was provided for the rapid physical growth of the fishes. From the day after release of fish, supplementary food was applied every morning and afternoon at the rate of 5-6% of the total body weight of the stored fish. For every 20 kg of fish, at least 1 kg of food was applied. Once every 15 days or every 1 month, some fishes were caught by pulling the net and the average weight

was taken out and subsequently fed in proportion to the total weight. For low-cost management wheat husk or rice husk at the rate of 50 gm in 1st month, 100 gm in 2nd month, 180 gm in 3rd month, 220 gm in 4th month, 270 gm in 5th month and 300 gm in 6th month were given. For making supplementary food, fishmill 10%, rice husk 53%, mustard oil 30.50%, vitamin and mineral mixture 0.5% and molasses 6% were mixed and fed to the fingerlings (Miah *et al.*, 1993)

E. Off-Farm Activities

Off-farm income refers to the portion of farm household income obtained off the farm, including nonfarm wages and salaries, pensions, and interest income earned by farm families. Since the last three decades or so, there has been increasing evidence showing that small-holder farm households in developing countries rarely rely on agriculture alone, but often maintain a portfolio of income activities in which off-farm activities are an important component (Barrett *et al.*, 2001). Some farm families' especially the women were engaged with off-farm activities. Some farmers had small grocery shop and opened at his off-time and also had practice of weaving Katha and cloth sewing with machine. Commercially cooking is also practiced in some cases by the men. The women were also engaged in making Kumra bora, Pilo cover, making handicrafts with rope, plastic ball etc. during their leisure periods and men were engaged with basket making and van/rickshaw pulling.

11. Results and discussion

A. Homestead Production System

11.1 Year round vegetables and fruits production and its disposal pattern at FSRD Site: Char Kharicha, Mymensingh (BARI)

Vegetables production:

After intervention of Narkeli model along with proven and improved technologies in the homestead, the results of vegetables production are presented in Table 11.1.1. In open sunny space, the average vegetables production of both villages of Mymensingh was maximum (54.5-388.5 kg homestead⁻¹) in Kharif-II season followed by Kharif-I (51-311 kg homestead⁻¹). In Rabi season, the vegetables production was some how found to be lower (87.0 kg homestead⁻¹) than in Kharif-I and Kharif-II season might be due to crop variety for vegetables production when production was mostly affected by leafy vegetables. Vegetables production in homestead was 259.50, 996.50 and 336 kg homestead⁻¹ year⁻¹ during Feb.2018-Jan.2019, Feb.2019-Jan.2020 and Feb.2020-Jan.2021 and thus average production was 531 kg homestead⁻¹ year⁻¹ that was 742% higher compare to 63 kg homestead⁻¹ year⁻¹ (as per base line). However, the remarkable increment (742 kg homestead⁻¹ year⁻¹) was obtained in vegetables production of Char land ecosystem at Mymensingh might be enhanced by using improved technologies and judicious time management and so far the enhancement of labor utilization pattern. The results are in close confirmatory with the findings of Ishtiaque *et al.*, (2017).



Picture 11.1.1. Vegetables production at FSRD site: Char Kharicha, Mymensingh

Utilization of vegetables:

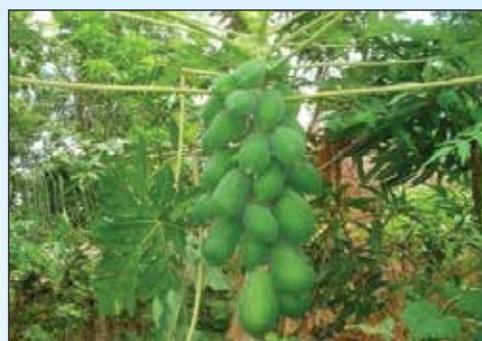
The disposal pattern of different vegetables produced in the homestead area was recorded regularly through the help of the co-operator farmers. Disposal pattern of vegetables and amount of total vegetables production are presented in Table 11.1.3. After intervention, the average vegetables intake per farm family

was 106.67 kg homestead⁻¹ year⁻¹. Distribution of vegetables was recorded as 14.0 kg and selling of vegetables per year was 410.0 kg. Increased production of vegetables encouraged the farm families to distribute relatively more vegetables to their relatives and neighbor, which might be helpful to increase their relationship. After intervention of program, encourage the farmers to consume more vegetables as it's an earning source of cash income from more selling of vegetables. The better utilization of homestead area with optimum management by effective farm family labor can be achieved for optimum vegetables production and subsequent intake, distribution and sell.

Income from vegetables cultivation: After intervention of the program, the gross margin from vegetables per farm was recorded as Tk. 7960 with variable cost of Tk. 2266 from which Tk. 5693 could be benefitted as cash income per family per year (Table 11.1.3).

Fruits production:

The available and unutilized niches of the homestead area have been brought into fruit production with the recommendation of the program. The fallow and underutilized homestead areas were utilized scientifically considering the time and space. Improved management practices such as fertilization, irrigation, pest control and pruning were suggested to some of quick growing fruits (Papaya, Lemon, Ber, Banana etc.) along with some existing fruit trees (Mango, Jackfruit, Coconut, Indian olive, Indian dillenia, Wood apple etc.) for higher yield and quality fruit production in FSRD site, Mymensingh. It was observed that after intervention of improved technologies, the



Picture 11.1.2 Fruit production at FSRD Site: Char Kharicha, Mymensingh

fruit production was increased significantly. Higher amount of fruit was found to be produced at homestead area after implementation of the program (Table 11.1.2). However, the produced highest amount of fruits were observed in Kharif-I and it was (1000 kg per homestead) during the three consecutive year which was followed by Kharif-II (110 kg homestead⁻¹) and Rabi (100 kg homestead⁻¹). Minimum fruits production was observed in Rabi season and it is actually due to less availability of winter fruits species and variety in Bangladesh aspects, which might be a priority research area to developing winter fruits varieties. The fruit production trend was 135, 585 and 490 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 and Feb. 2020 - Jan. 2021 and however average production was 403.30 kg homestead⁻¹ year⁻¹ that was 102% higher compare to 200 kg homestead⁻¹ year⁻¹ (as per base line). Using of improved technologies including judicious fertilizer management in fruit trees might be increased the fruit yield tremendously.

Table 11.1.1. Year round vegetables and fruits production from different niches of homestead at FSRD site, Mymensingh during 2018 to 2021

Niches	Season wise vegetables production (kg)									Total Production (kg)		
	Rabi (Oct. - March)			Kharif-1 (April-June)			Kharif-2 (July-Sept.)			Year I	Year II	Year III
Open sunny space	Year I	Year II	Year III	Year I	Year II	Year III	Year I	Year II	Year III	Year I	Year II	Year III
Bed-1	10	25.5	9	13	70	10	9.5	85.5	10	32.5	181	29
Bed-2	18	7.0	-	7	80	12	10.5	99	12	35.5	186	24
Bed-3	20	17.0	-	10	86	13	11.0	103	13	41	206	26
Bed-4	4	14.0	-	7	35	8	12.0	54	11	23	103	19
Bed-5	6	23.5	-	14	40	15	11.5	47	12	31.5	110.5	27
Total	58	87	9	51	311	58	54.5	388.5	58	163.5	786.5	125
Trellis	-	12	25	-	12	35	4	13	20	4	37	80
Shady Place	-	5	5	-	10	20	8	10	25	8	25	50
Tree support	-	30	-	20	25	10	15	20	15	35	75	25
Fence	-	8	5	15	20	15	20	25	12	35	53	32

Niches	Season wise vegetables production (kg)									Total Production (kg)		
	Rabi (Oct. - March)			Kharif-1 (April-June)			Kharif-2 (July-Sept.)			Year I	Year II	Year III
Open sunny space	Year I	Year II	Year III	Year I	Year II	Year III	Year I	Year II	Year III			
House Boundary	-	5	5	6	5	7	8	10	12	14	20	24
Total (vegetables)	58	147	49	92	383	145	109.5	466.5	142	259.5	996.5	336
Fruits	10	40	50	100	500	400	25	45	40	135	585	490
Total (vegetables +fruit)	68	187	99	192	883	545	134.5	511.5	182	394.5	1581.5	826

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021

Utilization of fruits: The disposal pattern of different fruits produced under homestead area was recorded timely. The fruit intake per farm family per year was 140 kg after the program intervention, whereas it was only 100 kg before intervention and it was observed that after intervention 40% increment was shown mainly due to increment of total production and motivation (Table 11.1.3). After implementation of the program, the distribution and selling tendency of fruits was increased and it was recorded as 27 kg and 237 kg, respectively per year. Increased production of fruits encouraged the farm families to distribute towards their relatives and neighbors, but the farmers were more interested to sell for getting some cash money.

Income from fruits cultivation: In fruit sector, after intervention, gross margin per homestead was recorded as Tk. 4483 year⁻¹ with the variable cost of Tk. 1566 year⁻¹, which was only Tk. 445 year⁻¹ of gross margin before intervention (Table 11.1.3).

Table 11.1.2. Year round vegetables and fruits production from different niches of homestead during 2018 to 2021

Niches	Before intervention		After intervention									
			Year I		Year II		Year III		Average of three years		Avg. increment over before intervention	
	Production (kg)	Income (Tk.)	Production (kg)	Income (Tk.)	Production (kg)	Income (Tk.)	Production (kg)	Income (Tk.)	Production (kg)	Income (Tk.)	Production (%)	Income (%)
Open sunny place	0	0	163.5	2452.5	786.5	11797.5	125	1875	358.3	5375	100	100
Trellis	20	300	4	60	37	555	80	1200	40.3	605	101.7	101.7
Shady place	10	150	8	120	25	375	50	750	27.7	415	176.7	176.7
Tree support	10	150	35	525	75	1125	25	375	45	675	350.0	350.0
Fence	8	120	35	525	53	795	32	480	40	600	400.0	400.0
House boundary	15	225	14	210	20	300	24	360	19.3	290	28.9	28.9
Total	63	945	259.5	3892.5	996.5	14947.5	336	5040	530.7	7960	742.3	742.3
Fruit (other places)	200	3000	135	2025	585	8775	490	7350	403.3	6050	101.7	101.7
Total	326	4890	394.5	5917.5	1581	23722.5	826	12390	934.0	14010	186.5	186.5

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020- Jan.2021, Market price (Tk. kg⁻¹)=15

Table 11.1.3. Year round vegetables and fruits production and its utilization pattern at before and after intervention during 2018 to 2021

Description	Before intervention		After intervention							
	Vegetables (kg)	Fruits (kg)	Vegetable's production (kg)				Fruits production (kg)			
			Year I	Year II	Year III	Avg.	Year I	Year II	Year III	Avg.
Consumption	10	100	50	200	70	107	70	200	150	140
Distribution	3	20	91	16	16	14	5	35	40	27
Selling	50	80	200	780	250	410	60	350	300	237
Total production	63	200	259	996	336	531	135	585	490	403
Gross return (Tk.)	945	3000	3892	14947	5040	7960	2025	8775	7350	6050
Variable cost (Tk.)	500	500	800	4000	2000	2267	700	2000	2000	1567
Gross margin (Tk.)	445	2500	3092	10947	3040	5693	1325	6775	5350	4483

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021

11.2. Year round vegetables and fruits production and its disposal pattern at FSRD Site: Charpara, Sonatola, Bogura (BARI)

Vegetables production:

After intervention of the proven and improved technologies in the homestead vegetables production trend are presented in the Table 11.2.1. In open sunny space, the average vegetables production of Bogura was maximum in Rabi season (52 - 87 kg homestead⁻¹year⁻¹) followed by Kharif-II (47-64 kg homestead⁻¹ year⁻¹). In Kharif-I season the vegetables production was somehow found to be lower (47-51 kg homestead⁻¹ year⁻¹). Higher vegetables production in Rabi season might be due to HYV of vegetables used. By using all niches total vegetables production were 388.23, 483.40 and 55.04 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 and Feb. 2020 - Jan. 2021 and thus average production was 475.56 kg homestead⁻¹ year⁻¹ which was much higher than that of 117.39 kg homestead⁻¹ year⁻¹ at before intervention. It might be due to followed of year round vegetables and fruit production model. The remarkable average increment of vegetables production (305.11%) over before intervention was observed at Bogura (Table 11.2.2). It might be enhanced by using improved technologies and judicious time management and so far, the enhancement of labor utilization pattern. The results of the study are confirmatory with the findings of Ishtiaque *et al.*, (2017).

Utilization of vegetables:

The disposal pattern of homestead production was recorded regularly through the help of the co-operator farmers. The results indicated that disposal pattern of vegetables varied with two char areas of Bogura (Table 11.2.3). The average vegetables intake per farm family was 277.32 kg after the program intervention during the three-consecutive year. After program intervention the distribution of vegetables was recorded as 67.87 kg and selling of vegetables per year was 130.36 kg in both the sites of FSRD site of Bogura. Increased production of vegetables encouraged the farm families to distribute relatively more vegetables to their relatives and neighbors, which might be helpful to increase their relationship. After intervention of the program, farmers consumed more vegetables and earned more income from selling of vegetables. The better utilization of homestead area with optimum management by effective farm family labor can be achieved for optimum vegetables production and subsequent intake, distribution and sell.

Income from vegetables cultivation:

After intervention of the program, the gross return from vegetables farm-1 was recorded as Tk. 6003 with the variable cost of Tk. 2110 from which Tk. 3893 could be benefitted as cash income family⁻¹ year⁻¹ (Table 11.2.3).

Fruits production:

After intervention of improved technology, the fruit production was increased significantly (Table 11.2.1 & Table 11.2.2). Considering whole sub-project tenure, the highest amount of fruits (141 kg homestead⁻¹) produced in Kharif-I followed by Kharif-II (104 kg homestead⁻¹) and Rabi (43 kg homestead⁻¹). Minimum fruits production was observed in Rabi season might be due to less availability of winter fruits species and variety in Bangladesh aspects, which might be a research area for scientist to emphasis in developing winter fruits varieties. After intervention of proven technology related to fruit tree management, fruit production was 43, 90 and 156 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 and Feb. 2020 - Jan. 2021 and thus average production was 96 kg homestead⁻¹ year⁻¹ which was much higher than that of 31 kg homestead⁻¹ year⁻¹ at before intervention of model. The remarkable average increment of vegetables production (209.68%) was observed at Bogura (Table 11.2.1 and Table 11.2.2). Using of improved technologies including judicious fertilizer management in fruit trees has increased the fruit yield tremendously year after year.

Utilization of fruits:

The disposal pattern of different fruits produced under homestead area was recorded timely. The fruit intake per farm family per year was 63.93 kg after the program intervention, whereas it was only 15.5 kg before intervention and it was observed that after intervention 312.45% increment was shown mainly due to increment of total production and motivation (Table 11.2.3). After implementation of the program, the distribution and selling tendency of fruits were increased and it was recorded as 11.63 kg and 20.43 kg, respectively per year. Increased production of fruits encouraged the farm families to distribute towards their relatives and neighbors, but the farmers were more interested to sell for getting some cash money.

Income from fruits cultivation:

After program intervention, gross return per farm was recorded as Tk. 3550 with the gross margin of Tk. 2873 per year, which was only Tk. 930 and Tk. 680, respectively farm⁻¹ year⁻¹ before intervention. The increment of gross margin was 322.5% (Table 11.2.3).

Table 11.2.1. Year round vegetables and fruits production from different niches of homestead at FSRD site, Bogura during 2018 to 2021

Niches	Season wise vegetables production (kg)									Total Production (kg)			
	Rabi (Oct. - March)			Kharif-I (April-June)			Kharif-2 (July-Sept.)			Year I	Year II	Year III	
	Year I	Year II	Year III	Year I	Year II	Year III	Year I	Year II	Year III				
Open sunny space	Bed-1	12	21.5	25.5	11.96	11	13	15	9.5	12.3	38.96	42.00	50.80
	Bed-2	16	5	7	6.44	8	7	12	10.5	13.9	34.44	23.50	27.90
	Bed-3	12	15	17	9.20	7	10	9	11	11.7	30.20	33.00	38.70
	Bed-4	7	12	14	6.44	9	7	7	12	12.7	20.44	33.00	33.70
	Bed-5	5	19	23.5	12.88	12	14	4	11.5	13.4	21.88	42.50	50.90
Sub-total	52.00	72.50	87.00	46.92	47.00	51.00	47.00	54.50	64.00	145.92	174.00	202.00	
Roof top	77	80	82	11.04	9	12	18	26	12.2	106.04	115.00	106.20	
Trellis	55	51	62.5	11.59	10.5	12.6	14	36	31	80.59	97.50	106.10	
Shady Place	0	4	6	2.76	4	3	0	4	39	2.76	12.00	48.00	
Marshy land	0	2	0	8.28	7	9	0	5	4	8.28	14.00	13.00	
Unproductive Tree	0	3.5	5.5	9.66	11.3	10.5	6	4	6	15.66	18.80	22.00	
Fence	9	5	3	3.68	5	4	7	6	3.1	19.68	16.00	10.10	
Backyard	0	3.1	2.54	4.10	4	5	0	4	8.6	4.10	11.10	16.14	
House Boundary	0	13	15	5.20	6	5	0	6	11.5	5.20	25.00	31.50	
Total (vegetables)	193	234.1	263.54	103.23	103.8	112.1	92	145.5	179.4	388.23	483.40	555.04	
Fruits	9	15	19	20	45	76	13	30	61				
Total (fruit)	43			141			104			42	90	156	

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

Table 11.2.2. Year round vegetables and fruits production from different niches of homestead during 2018 to 2021 (Comparative data).

Niches	Before intervention		After intervention									
			Year I		Year II		Year III		Average		Avg. increment over before intervention	
	Production (kg)	Income (Tk.)	Production (kg)	Income (Tk.)	Production (kg)	Income (Tk.)	Production (kg)	Income (Tk.)	Production (kg)	Income (Tk.)	Production (kg)	Income (%)
Open sunny place	0	0	145.92	1459.2	174.00	2088	202.00	3030	173.97	2192	100	100
Roof top	55	550	106.04	1060.4	115	1380	106.20	1593	106.04	1344	98.33	144.45
Trellis	42	420	80.592	805.92	97.5	1170	106.10	1592	75.36	1189	125.55	183.13
Shady place	1	10	2.76	27.6	12	144	48.00	720	9.25	297	1992.0	2872.0
Marshy land	3	30	8.28	82.8	14	168	13.00	195	14.76	149	292.00	395.33
Unproductive Tree	2.5	25	15.66	156.6	18.8	225.6	22.00	330	14.85	237	652.80	849.60
Fence	0	0	19.68	196.8	16	192	10.10	152	17.27	180	100	100
Backyard	6.89	68.9	4.1	41	11.1	133.2	16.14	242	15.57	139	51.62	101.40
House Boundary	7	70	5.2	52	25	300	31.50	473	5.2	275	193.81	292.62
Sub-Total	117.39	1174	388.23	3882	483.40	5800	555.04	8325	475.56	6003	305.11	411.32
Fruit (other places)	31.0	930	42	1260	90	3150	156	6240	96	3550	209.68	281.72
Total	148.39	2104	430.23	5142	573.4	8950	711.04	14565	571.56	9553	285.17	354.03

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

Table 11.2.3. Year round vegetables and fruits production and its utilization pattern at before and after intervention during 2018 to 2021

Description	Before intervention		After intervention							
	Vegetables (kg)	Fruits (kg)	Vegetables production (kg)				Fruits production (kg)			
			Year I	Year II	Year III	Avg.	Year I	Year II	Year III	Avg.
Consumption	60.06	15.5	270.23	279.42	282.32	277.32	37.0	60.3	94.5	63.93
Distribution	24.18	4.0	42.5	67.33	93.79	67.87	5.0	9.9	20	11.63
Selling	33.16	11.5	75.5	136.65	178.93	130.36	0	19.8	41.5	20.43
Total production	117.4	31	388.23	483.4	555.04	475.56	42	90	156	96.00
Gross return (Tk.)	1174	930	3882	5801	8326	6003.0	1260	3150	6240	3550.00
Variable cost (Tk.)	650	250	1320	2180	2830	2110.0	350	450	1250	683.33
Gross margin (Tk.)	524	680	2562	3621	5496	3893.0	910	2720	4990	2873.33

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

11.3. Year-round vegetables and fruit production in homestead at FSRD site: Nawvanger Char, Jamalpur (BINA)

Twenty-three types of vegetables were grown by utilizing 6 different niches of homestead area. Season wise vegetables productions at different niches of homestead were presented in the Table 11.3.1. It was observed that before intervention farmers used only two niches that is open space and roof in a small scale (Table 11.3.2). After invention farmers used 7 different niches by following modified Goyeshpur vegetables and fruit production model developed by BARI. Among 7 different niches 6 different niches were utilized for vegetables production and one niches fruit production properly. It was observed that, vegetables production per homestead was only 84 kg before intervention which were found 541.4 kg in the 1st year, 525.3 kg in 2nd year and 540.2 kg in 3rd year after intervention utilization of 6 niches in the homestead. In case of fruit before intervention fruit production was 220 kg per homestead and after intervention it became 347 kg in the 1st year, 470 kg in in 2nd year and 495 kg in in 3rd year utilization of one niche (house boundary) in the homestead.

Table 11.3.1. Year-round vegetables and fruits production from different niches at FSRD site during 2018 to 2021

Niche	Rabi			Kharif-1			Kharif-2			Total (kg)			
	October- March			April-June			July-September			Year I	Year II	Year III	
	Year I	Year II	Year III	Year I	Year II	Year III	Year I	Year II	Year III				
Open sunny space	Bed-1	60.0	75.0	78.0	8.0	13.0	11.0	12.0	15.0	16.0	80.0	103.0	105.0
	Bed-2	43.0	22.0	37.0	11.0	19.0	15.0	15.0	16.0	23.0	69.0	57.0	75.0
	Bed-3	52.0	51.0	45.0	9.0	10.0	9.0	12.0	10.0	15.0	73.0	71.0	69.0
	Bed-4	78.0	34.0	35.0	14.0	18.0	19.0	10.0	12.0	10.0	102.0	64.0	64.0
Roof top	20	22.0	24.0	20.0	22.0	21.0	6.0	5.0	5.0	46.0	49.0	50.0	
Trellis	60	55.0	61.0	35.0	37.0	49.0	18.0	20.0	19.0	113.0	112.0	99.0	
Shady Place	16.5	21.0	23.0	-	3.0	3.0	9.0	10.0	15.0	25.5	34.0	41.0	
Marshy Land	-	-	-	-	-	-	20.0	20.3	21.7	20.0	20.3	21.7	
Fence	4.4	5.0	5.5	4.0	5.0	6.0	4.5	5.0	4.0	12.9	15.0	15.5	
Total (vegetables)	333.9	283.0	308.5	101.0	127.0	133.0	106.5	113.3	128.7	541.4	525.3	540.2	
Total Fruits production (house boundary)	24	35.0	50.0	283.0	385.0	380.0	40.0	50.0	65.0	347	470.0	495.0	
Total (vegetables +fruit)	357.9	320.0	358.5	384.0	512.0	513.0	146.5	163.3	193.7	888.4	995.3	1035.2	

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

Utilizing 6 niches each farmer earned on an average Tk. 9178 by producing vegetables and Tk. 9312 by producing fruits (2018-2021) but before intervention it was only Tk. 2870 by producing vegetables and Tk. 4664 by producing fruits (Table 11.3.2). The highest amount of vegetables (311 kg) was produced at the open land followed by trellis (108 kg) and highest income (Avg. Tk. 5320) was earned from open sunny place followed by trellis (Avg. Tk. 1721). From the result it was observed that on an average 311, 48, 108, 34, 21 and 14 kg vegetables were produced at open land, roof, trellis, partial shady area, marshy land and fence, respectively. By utilizing the boundary area of the homestead, fruits production was found 437 kg (Table 11.3.2).

Table 11.3.2. Year round vegetables, fruits production and income from different niches of homestead at FSRD site during Feb. 2018 to Jan. 2021 (Comparative data)

Niches	Before intervention		After intervention									
			Year I		Year II		Year III		Average		Av. increment over before intervention	
	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (%)
Open sunny place	60.0	1950.0	324.0	4965.0	295.0	5335.0	313.0	5661.0	311	5320	418	173
Roof top	24.0	920.0	46.0	990.0	49.0	1067.0	50.0	1089.0	48	1049	100	14
Trellis	-	-	113.0	1885.0	112.0	1740.0	99.0	1538.0	108	1721	100	100
Shady place	-	-	25.5	295.0	34.0	545.0	41.0	657.0	34	499	100	100
Marshy place	-	-	20.0	325.0	20.3	333.0	21.7	356.0	21	338	100	100
Fence	-	-	12.9	262.0	15.0	242.0	15.5	250.0	14	251	100	100
Total Vegetables production and income	84	2870.0	541.4	8722	525.3	9262	540.2	9551	536	9178	538	220
House boundary (fruit)	220.0	4664.0	347.0	7638.0	470.0	9887.0	495.0	10412.0	437	9312	98.6	99.6
Total fruit production and income	220.0	4664.0	347.0	7638.0	470.0	9887.0	495.0	10412.0	437	9312	98.6	99.6
Total Vegetables + Fruit production	304.0	7534.0	888.4	16360	995.3	19149	1035.2	19963	973	18490	220.0	145

* Year I=Feb.2018-Jan.2019, Year II=Feb.2019-Jan.2020 & Year III=Feb.2020- Jan.2021



Picture 11.3.1. Vegetables production at FSRD site Nawvanger Char, Jamalpur

Utilization pattern of year round vegetables and fruits production at homestead

By utilizing 4 to 4.5 decimal land of the homestead, each farmer on an average produced 541.4 kg, 525.3 kg and 540.2 kg vegetables among which they consumed 83 kg, 101 kg and 104 kg; distributed 46 kg, 44 kg & 45.2 kg and sold 412.4 kg, 380.3 kg & 391 kg at 1st, 2nd and 3rd year, respectively which are very high than before intervention 38.5 kg, 11.5 kg & 34 kg respectively (Table 11.3.3).

For fruit production program, fruit saplings were distributed among the farmers to get fruits year round. All farmers have few fruit plants in their homestead area. But due to lack of proper management they could not obtained proper yield. Due to proper management of existing fruit trees in the homestead yield of fruit increased significantly. Motivational work and higher yield of fruit, the consumption of fruits by family members were increased than before intervention. In the first year (2018-19) farmers obtained average 347 kg fruits among which they consumed 162 kg, distributed 52 kg and sold 133 kg; at the second year (2019-20) farmers obtained average 470 kg fruits among which they consumed 232 kg, distributed 65 kg and sold 173 kg and at the third year (2020-21) farmers got average 495 kg fruits among which they consumed 240 kg, distributed 72 kg and sold 183 kg (Table 11.3.3).

Table 11.3.3. Year round vegetables and fruits production and utilization pattern before and after intervention at FSRD site during 2018 to 2021.

Description	Before intervention		After intervention					
	Vegetables (kg)	Fruit (kg)	Vegetables (kg)			Fruits (kg)		
			Year I	Year II	Year III	Year I	Year II	Year III
Consumption	38.5	90	83.0	101.0	104.0	162	232	240
Distribution	11.5	20	46.0	44.0	45.2	52	65	72
Selling	34.0	110	412.4	380.3	391.0	133	173	183
Total production	84	220	541.4	525.3	540.2	347	470	495
Gross return (Tk.)	4632	5502	10975	11389	11678	9958	11487	12012
Variable cost (Tk.)	1762	838	2253	2127	2127	2320	1600	1600
Gross margin (Tk.)	2870	4664	8722	9262	9551	7638	9887	10412

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

11.4. Year round vegetables production in the homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Yield performance of vegetables grown in different seasons in homestead area of the average of twelve farmers is presented in Table 11.4.1 and Table 11.4.2. The production of vegetables at homestead was satisfactory. For year round vegetables and fruit production at homestead has been followed modified “Gayeshpur” model developed by BARI. Due to use of improved production technology, vegetables production as well as per head intake of vegetables were increased to some extent per house hold. Vegetables produced at homestead from different niches were recorded regularly. The results, indicated that vegetables production varied with different seasons and higher vegetables production were in Rabi season 435 kg, 458 kg and 502 kg during 2018-19, 2019-20 and 2020-21 cropping season, respectively which were higher than the before intervention. Six niches were used to produce year round vegetables. Among the niches the highest vegetables production 379 kg, 331 kg and 405 kg were found from roof top during the 1st, 2nd and 3rd year, respectively and the lowest production were found from fence 26 kg, 32 kg and 21 kg during the 1st, 2nd and 3rd year, respectively.

Table 11.4.1. Year round vegetables production from different niches at FSRD site, Padmar Char, Ishurdi, Pabna during 2018 to 2021

Space	Rabi			Kharif-1			Kharif-2			Total (kg)			
	October-March			April-June			July-September			Year I	Year II	Year III	
	Year I	Year II	Year III	Year I	Year II	Year III	Year I	Year II	Year III				
Open sunny space	Bed-1	22	25	28	15	14	16	9	11	8	46	50	52
	Bed-2	29	33	39	25	27	26	8	10	13	62	70	78
	Bed-3	31	35	41	23	26	29	6	8	9	60	69	79
Total (Open sunny space)	82	93	108	63	67	71	23	29	30	168	189	209	
Roof top	115	117	137	131	110	135	133	104	133	379	331	405	
Trellis	118	123	132	123	116	122	127	93	98	368	332	352	
Shady Place	24	19	28	21	19	29	21	19	20	66	57	77	
Fence	9	15	8	8	6	7	9	11	6	26	32	21	
House Boundary	87	91	89	73	82	71	66	69	73	226	242	233	
Total (vegetables)	435	458	502	419	400	435	379	325	360	1233	1183	1297	
Average total production (kg)	465			418			355			1237.67			

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

Disposal pattern and cost return analysis of vegetables production at homestead

After intervention of new technology average total vegetables production was 1238 kg which was only 412 kg before intervention. Vegetables production was 200% over the before intervention. After intervention consumption, distribution and selling of vegetables were 348 kg, 181 kg and 709 kg, respectively. On the other hand, before intervention the consumption, distribution and selling of vegetables were 216 kg, 78 kg and 118 kg, respectively. Selling and consumption of vegetables were increased after intervention which were 709 kg and 348 kg, respectively. Both income and production were much higher in after intervention (Table 11.4.2). The Gross margin before intervention was Tk. 2619 but after intervention it was Tk. 3728 per homestead, which was 42% higher than the before intervention.

Table 11.4.2. Year round vegetables production and utilization pattern before and after intervention at FSRD Site, Padma Char, Ishurdi, Pabna during 2018 to 2021

Description	Before intervention	After intervention (Avg. of three years)
Consumption (Kg)	216	348
Distribution (Kg)	78	181
Selling (Kg)	118	709

Description	Before intervention	After intervention (Avg. of three years)
Total production (Kg)	412	1238
Gross return (Tk.)	8240	18565
Variable cost (Tk.)	5621	14837
Gross margin (Tk.)	2619	3728

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

11.5. Year round fruit production in homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Average yield of fruits in different seasons at homestead are presented in Table 11.5.1 & 11.5.2. The production of fruit was satisfactory due to following Gayeshpur model. House boundary used for production of fruits in the homestead. After intervention, the production of fruits was 23 kg, 245 kg and 262 kg during 1st, 2nd and 3rd year, respectively. After intervention the average production of fruit and income was 246.33 kg, and Tk. 4927 homestead⁻¹, respectively. The fruit production and income were 84.33% and 52.06% higher over before intervention.

Table 11.5.1. Year round fruits production from different niches at FSRD site, Padma Char, Ishurdi, Pabna during 2018 to 2021

Niches	Before intervention		After intervention									
			Year I		Year II		Year III		Average		Avg. increment over before intervention	
	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (%)
House boundary	162	3240	232	4640	245	4900	262	5240	246.33	4927	84.33	52.06
Total	162	3240	232	4640	245	4900	262	5240	246.33	4927	84.33	52.06

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

Disposal pattern and cost return analysis of fruit production at homestead

The intake of fruit was higher in after intervention (185 kg) than before intervention (98 kg) due to higher production of fruit. Fruit intake was increased per house hold 89% after intervention. After intervention distribution and selling of fruits per household were 29 kg and 33Kg, respectively. But before intervention distribution and selling of fruits household⁻¹ were 17 kg and 47 kg, respectively. Income was related to production where much higher in after intervention (Table 11.5.2.) Gross margin from fruit production at homestead⁻¹ before intervention was Tk. 1486 and after intervention it was Tk. 2351 as well as after intervention the gross margin increased by 58% than before intervention.

Table 11.5.2. Year round fruits production and utilization pattern before and after Intervention during 2018 to 2021

Description	Before intervention	After intervention (Avg. of 3 years)
Consumption (Kg.)	98	185
Distribution (Kg.)	17	29
Selling(Kg.)	47	33
Total production (Kg.)	162	246
Gross return (Tk.)	3240	4927
Variable cost (Tk.)	1754	2573
Gross margin (Tk.)	1486	2353

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021



Picture 11.5.1. Fruit production at FSRD site Ishurdi, Pabna

Farmer's reactions

1. Farmers are being familiar with the improved vegetables and fruit varieties.
2. Consumption of fresh vegetables and fruits by the family members has increased and changed the consumption habit towards vegetables and fruits.
3. Farmers dependency on local vegetables market has been decreased due to own homestead vegetables and fruits production.
4. Above all, the nutrition demands of the farm family members are hereby fulfilled to some extent as well as they earn some money by selling the products in the local market.



Ash gourd at roof top



Indian spinach at trellis



Kochu at marshy land



Fench



Partial shady place



Turmeric at partial shady place



Open sunny space



Trellis



Roof top

Picture 11.5.2. Homestead vegetables garden at FSRD Site Ishurdi, Pabna

11.6. Year round vegetables production in homestead at FSRD Site: Bagabari, Sirajganj

Homestead production system was implemented following the BARI developed vegetables production model Goyeshpur model (Table 11.6.1) with some modification for different niches. To increase farmer's income along with nutritional status of the family members, vegetables and fruits were produced round the year. To utilize homestead area efficiently different types of vegetables and fruits were grown using nine different production unit of a homestead (Table 11.6.1). High yielding varieties developed from NARS Institutes and locally available commercial hybrid varieties of different vegetables were selected for vegetables production at homestead. The area of each homestead was about 5 to 7 decimals. Thirty-one types of vegetables were grown by utilizing 9 different niches of homestead area. Season wise vegetables and fruit productions at different niches of homestead are presented in the Table 11.6.1.

It was found that before intervention farmers used seven niches in a small scale. But after intervention 9 different niches were utilized properly. It was observed that, vegetables production was only 244 kg before intervention which was found 756 kg in the 1st year, 916 kg in 2nd year and 898 kg in 3rd year after intervention with utilization of 9 niches in the homestead. In case of fruit, before the intervention fruit production was 352 kg and after intervention it were 525 kg in the 1st year, 665 kg in 2nd year and 610 kg in 3rd year utilization of one niche (other place) in the homestead.

Table 11.6.1. Season wise vegetables and fruit production from different niches at FSRD Site, Bagabari, Sirajganj during 2018 to 2021

Space		Rabi			Kharif-1			Kharif-2			Total (kg)		
		October- March			April-June			July-September			Year I	Year II	Year III
		Year I	Year II	Year III	Year I	Year II	Year III	Year I	Year II	Year III			
Open sunny space	Bed-1	58	60	56	53	59	55	39	51	49	150	170	160
	Bed-2	72	45	53	60	33	49	12	20	53	120	180	155
	Bed-3	85	55	70	72	42	60	73	26	65	220	225	195
Roof top		17	24	30	10	25	30	17	21	25	44	70	85
Trellis		15	22	28	18	14	20	12	24	22	45	60	70
Shady Place		12	16	18	10	11	12	8	13	15	30	40	45
Marshy Land		9	12	13	7	10	7	6	5	10	22	27	30
Unproductive Tree		18	19	18	14	13	14	8	8	16	40	42	48
Fence		6	8	7	5	5	6	4	7	7	15	20	20
Backyard		12	19	15	10	6	12	8	15	13	30	40	40
House Boundary		15	16	20	11	13	16	14	13	14	40	42	50
Total (vegetables production)		319	296	328	270	231	281	201	203	289	756	916	898
Total (Fruit production)		42	55	62	428	425	485	55	167	63	525	665	610
Total (vegetables +fruit)		361	55	390	698	656	765	256	370	352	1281	1581	1508

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

After invention utilizing nine niches each farmer earned on an average Tk. 16760 by producing vegetables and Tk. 11980 by producing fruits during three consecutive years. On the other hand, before intervention it was only Tk. 4880 by producing vegetables and Tk. 7040 by producing fruits. After the intervention, vegetables production and income increased in the homestead 652% and 243%, respectively. After the intervention, fruit production and income increased in the homestead 247% and 170%, respectively (Table 11.6.2).

Table 11.6.2. Round the year vegetables and fruits production from different niches in homestead at FSRD site during 2018 to 2021 (Comparative data)

Niches	Before intervention		After intervention									
			Year I		Year II		Year III		Average (three years)		Avg. increment over before intervention	
	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (%)
Open sunny place	45	900	301	6020	346	6920	380	7600	342	6840	297	660
Roof top	0	0	72	1440	80	1600	85	1700	79	1580	79	79

Niches	Before intervention		After intervention									
			Year I		Year II		Year III		Average (three years)		Avg. increment over before intervention	
	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (Tk.)	Production (Kg)	Income (%)
Trellis	0	0	68	1360	73	1460	60	1200	67	1340	67	67
Shady place	36	720	53	1060	70	1400	75	1500	66	1320	30	183
Marshy place	20	400	40	800	75	1500	47	940	54	1080	24	270
Unproductive tree	35	700	63	1260	68	1360	56	1120	62	1240	37	177
Fence	10	200	38	760	50	1000	50	1000	46	920	36	460
Backyard	18	360	48	600	76	1520	70	1400	47	940	47	261
House boundary	22	440	73	960	78	1560	75	1500	75	1500	53	341
Total (Veg.)	244	4880	756	15120	916	18320	898	17960	838	16760	652	243
Total (Fruit)	352	7040	525	10740	665	13540	610	11640	599	11980	247	170
Total	596	11920	1281	25860	1581	31860	1508	29600	1437	28740	899	413

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021

11.7. Utilization pattern of year round vegetables and fruit production in homestead at FSRD Site: Baghabari, Sirajganj

By utilizing 5 to 7 decimal land of the homestead, each farmer on an average produced 756 kg, 916 kg and 898 kg vegetables among which they consumed 322 kg, 390 kg & 415 kg; distributed 7 kg, 10 kg & 10kg and sold 427 kg, 516 kg and 473 kg in the 1st, 2nd and 3rd year, respectively which were higher than the before intervention 170 kg, 30 kg and 144 kg, respectively (Table (Table 11.7.1))

As a fruit production program, fruit saplings were distributed among the farmers to get fruits throughout the year. All farmers have few fruit plants in their homestead area. But due to lack of proper management they could not obtained proper yield. Due to proper management of old fruit plants yield of fruit production was increased significantly. Before intervention, 352 kg fruit was produced per homestead among which they consumed, distributed and sold 148 kg, 61 kg and 143 kg, respectively. After intervention amount of fruit consumption increased by family members than before intervention. During the first year farmers obtained average 525 kg fruits among which they consumed 245 kg, distributed 15 kg and sold 265 kg; second year farmers obtained average 665 kg fruits among which they consumed 265 kg, distributed 18 kg and sold 382 kg and in the third year farmers produced average 610 kg fruits among which they consumed 260 kg, distributed 20 kg and sold 330 kg (Table 11.7.1)

Table 11.7.1. Round the year vegetables and fruits production and utilization pattern before and after intervention at FSRD site during 2018 to 2021

Description	Before intervention		After intervention					
	Vegetables (kg)	Fruit (kg)	Vegetables (kg)			Fruits (kg)		
			Year I	Year II	Year III	Year I	Year II	Year III
Consumption	170	148	322	390	415	245	265	260
Distribution	30	61	7	10	10	15	18	20
Selling	44	143	427	516	538	265	382	330
Total production	244	352	756	916	963	525	665	610



Picture 11.7.1. Vegetables production at FSRD site Baghabari, Sirajganj

11.8. Vegetables production nearby the homestead at FSRD Site: Nawvanger Char, Jamalpur (BINA)

The area of each vegetables garden was about 35 to 36 decimals near the homestead. Maximum production was obtained (2382 kg) in Rabi season followed by kharif-I (802 kg) and kharif-II (324 kg). The highest gross margin (Tk. 37313) was obtained from Rabi season followed by kharif-I (Tk. 14140). Rabi crops cultivation is more profitable than crops grown in kharif-I and kharif-II season. Farmers get higher benefit through early production of vegetables. Before intervention farmers did not produced vegetables in this land. But after invention each farmers produced average 3508 kg vegetables and earned gross margin Tk. 55714 per year (Table 11.8.1).

Table 11.8.1. Yield and cost return analysis of vegetables production nearby the homestead before and after intervention at FSRD site Nawvanger Char, Jamalpur during 2018 - 2021

Vegetables	Before intervention (kg)			After intervention (kg) (Avg. three years)		
	Rabi	Kharif-1	Kharif-2	Rabi	Kharif-1	Kharif-2
Rabi crops (tomato, chilli, cauliflower, brinjal, country bean, bitter gourd, bottle gourd, red amaranth/ Jute leaves)	-	-	-	2382	-	-
Khari-I crops (Onion, lady's finger, carrot, indian spinach, cucumber, sponge gourd, snake gourd)	-	-	-	-	802	-
Kharif-II (Water spinach, indian spinach, stem amaranth, lady's finger, white gourd, bitter gourd, sponge gourd, moulovikachu, and panikachu)	-	-	-	-	-	324
Total production (Season wise)	-	-	-	2382	802	324
Avg. production (three years)				3508		
Gross return (Tk.)	-	-	-	43938	20040	5761
Variable cost (Tk.)	-	-	-	6625	5900	1500
Gross margin (Tk.)	-	-	-	37313	14140	4261
Total Gross margin (Tk.)				55714		

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021



Picture 11.8.1. Vegetables production at the land near to homestead at FSRD site Nawvanger Char, Jamalpur

11.9 Chewing type sugarcane production in house boundary at FSRD Site: Char Kharicha, Mymensingh (BARI)

Chewing type sugarcane productions in the house boundary or nearby homestead create an income generation and might be a good source of direct glucose. Among the selected farmers, two farmers cultivated the BSRI developed variety Rongbilash. After intervention of the sub-project activities, it was observed that a remarkable yield increased due to proper management. However, average 275 no. sugarcane homestead⁻¹ was obtained by each farmer of which they consumed 75 no., distributed 50 no., and rest one sold in market and an earned Tk. 3000 per homestead (Table 11.9.1).



Picture 11.9.1. Chewing type sugarcane production in house boundary at FSRD Site: Char Kharicha

Table 11.9.1. Yield and cost return analysis of chewing type sugarcane in house boundary of homestead at FSRD site, Char Kharicha, Mymensingh during 2019-2020

Name of farmers	Sapling supplied (no.)	Survival (no.)	Yield (no.)	Consumption (no.)	Distribution (no.)	Selling (no.)	Income (Tk.)
Md. Abdul Momin	20	18	200	50	50	100	2000
Md. Sekandar Ali	25	25	350	100	50	200	4000

Market price of sugarcane: 20 Tk. per piece

11.10. Performance of chewing type sugarcane cultivation in homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Chewing type sugarcane variety Rongbilash were planted at 12-selected farmer's homestead of FSRD site Ishurdi, Pabna during 2018-2021. The program was undertaken to observe the performance of chewing type sugarcane, increase nutrition status as well as income of farm family at homestead of Char land ecosystem. It was found that each farm family earned 3450, 5495 and Tk. 7180, respectively during 1st, 2nd and 3rd years (Table 11.10.1).

Table 11.10.1. Yield, cost and return analysis of chewing type sugar cane cultivation in homestead at FSRD Site: Padma Char, Ishurdi, Pabna during 2018-2021

Cropping season	1 st year	2 nd year	3 rd year
Farmers (no.)	12	12	12
Pits (no.)	10	15	20
Settling per pit (no.)	5	5	5
Canes produced per household (no)	200	316	414
Price per cane (Tk.)	20	20	20
Gross return (Tk.)	4000	6320	8280
Variable cost (Tk.)	550	825	1100
Gross margin (Tk.)	3450	5495	7180

* Year I=Feb. 2018-Jan. 2019, Year II=Feb. 2019-Jan. 2020 & Year III=Feb. 2020- Jan. 2021



BSRI Akh 41 (Amrita)



BSRI Akh 42 (Ranbgbilash)

Picture 11.10.1. Chewing cane cultivation in homestead at FSRD site Ishurdi, Pabna

11.11. Establishment of mini orchard in farmer's household at FSRD site: Char Kharicha, Mymensingh (BARI)

Establishment of orchard is a long run process which could be established nearby homestead of a farmer to fulfill the demand of nutrient source as well as alternate income generation. For this purpose, planting materials (i.e. Saplings) were supplied during February to December 2020 to three farmers having 16 decimal land size each for establishing a mini orchard in their respective homestead area in FSRD site, Mymensingh. According to the farmers choice two Lotkan (Burmese grape) and one Mango orchard were established nearby homestead. BARI Aam-3, and Burmese grape (local) were planted in the orchard. However, survival rate of fruit saplings was still 100%. As the plant will take 2-3 years to fruit bearing, different types of vegetables and spices such as chilli and red amaranth were grown in the interspace of mini orchard. By this time farmers earned Tk.1980 from interspace of mini orchard.

11.12. Establishment of mini orchard at FSRD Site: Charpara, Sonatola, Bogura (BARI)

A mini orchard for commercial purpose with mango, guava and lemon was established at FSRD site, Bogura on three decimals of land near the homestead of concern farm family during February to December 2020. As fruits are rich source of nutrition like vitamins, minerals, different amino acids; the orchard will provide not only family nutrition but meet handsome cash from selling of fruits to the farm family. Keeping this view in mind, a farmer was provided with 20 Mango, 4 Guava and 16 Lemon saplings on 20th August, 2020 and cost was involved Tk. 4000. The varieties for Mango were BARI Aam-3, BARI Aam-4, BARI Aam-11, for Guava was BARI Peyara-2 and seedless Lemon saplings were planted along the side of border. As the orchard will take 1-2 years to come to production, different vegetables (Tomato, Cauliflower, Cabbage, Indian spinach), spices (Onion) are being growing now in the inter plant spaces. By this time farmers earned Tk. 2010 from interspace of mini orchard. The garden yet not in fruiting stage and hopefully production will start after 2/3 years.

11.13 Establishment of mini orchard (Binalebu-1) at the backside of the homestead at FSRD Site: Nawvanger Char, Jamalpur (BINA)

Nearby homestead a mini lemon orchard with lemon variety (var. Binalebu-1) was developed during the year 2020-21. Fifteen lemon saplings of var. Binalebu-1 were distributed among each of the farmers. Lemon saplings are in growing stage. To ensure nutritional security of the member of the households ten cutting of chewing sugarcane (var. Amrita) were also distributed among each of 12 farmers. Some chewing type sugarcane were grown in the interspace of orchard. By this time, farmers earned Tk. 2025 from chewing type sugarcane.

11.14. Plantation and management of existing fruit trees at famers homestead at FSRD Site: Char Kharicha, Mymensingh (BARI)

A number of different fruits sapling were supplied to the cooperator farmers in view of increasing nutrient intake from fruits sector by the households of at FSRD Site, Mymensingh during the year of 2018-2021. Under these program different types of fruit saplings e.g. Mango, Litchi, Guava, Lemon, Coconut, Chewing type Sugarcane, Dragon fruit and Burmese grape were supplied among cooperator and their neighbor's farmers. Beside the new plantattion existing friut trees were brought under management like, irrigation, fertilization, pruning & spray against insect & diseases. The total number of supplied sapling and their survival rate of different sapling are shown in Table 11.14.1. A total of 355 different fruit saplings and 30 sugarcanes settling were distributed among the cooperator farmers in three consecutive years. Survival rate of different fruit saplings ranged from 66 -100 %. The saplings are now in growing stage. Sugar cane already have harvested two times. By this time, farmers earned Tk. 2520 homestead⁻¹ from chewing type sugarcane.

Table 11.14.1. Distribution of fruit saplings at FSRD site, Char Kharicha, Mymensingh during 2018-2021

Sl. No.	Types of fruit saplings	Variety	Number of fruits sapling				Survival rate (%)
			Year I	Year II	Year III	Total	
01	Mango	BARI Aam-3	60	30	40	130	79
02	Litchi	BARI Litchi-1	40	-	-	40	85
03	Lemon	BARI Lemon-2	30	30	-	60	80
04	Guava	BARI Peyara-2	30	-	-	30	75
05	Dragon fruit	BARI Dragon Fruit -1	25	-	-	25	100
06	Coconut	local	-	30	-	30	100
07	Sugarcane	BSRI Akh-42/local	-	30	-	30	66
08	Burmese grape	Local	-	-	40	40	100
Total			185	120	80	385	Range(66-100)

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020-Jan. 2021

11.15. Plantation and management of fruit trees at FSRD Site: Charpara, Sonatola Bogura (BARI)

Fruit trees are the essential elements of a homestead. Though there are some common fruit tree species (Mango, Jackfruit) usually exist around the homestead area but they are lack of fruit diversity. In order to extend the harvesting period of fruit or make the fruits available throughout year in the homesteads different fruit tree species need to be accommodated there along with the management of the existing plants. With the view of increasing fruits production as well as diversity OFRD, Bogura provided different fruit saplings with the financial support of the sub-project for plantation in the farmers homestead areas. Besides new plantation, existing fruit trees were brought under management like irrigation, fertilization, training and pruning,



Picture 11.15.1. Saplings distribution at FSRD Site: Charpara, Sonatola Bogura

spray against insects and diseases. A total of 473 different types of fruit saplings (Mango, Litchi, Dragon fruit, Dwarf Coconut and quick growing Guava, Papaya, Lemon) were distributed among the cooperator farmers for plantation in their homestead. Among the supplied saplings, 1% mango and 1% litchi became died due to transportation shock. Due to new plantation and best management of existing fruit trees, fruit production increased remarkably in the subsequent years. Details of fruits saplings distribution are presented in the Table 11.15.1.

Table 11.15.1. Distribution of fruit saplings at FSRD site, Bogura during 2019 to 2021

Sl. No.	Types of the fruit saplings	Variety	Sapling number		Total (No.)	Mortality (%)
			Year II	Year III		
1	Mango	BARI Aam-4	35	250	285	1
2	Litchi	BARI Litch-3	10	12	22	1
3	Dwarf Coconut	Vietnam	6	12	18	0
4	Guava	BARI Peyara-2	12	60	72	0
5	Lemon	Seed less	20	12	32	0
6	Dragon fruit	BARI Dragon Fruit-1	8	36	44	0
Total distributed sapling			91	382	473	

* Year II=Feb. 2019-Jan. 2020 & Year III=Feb.2020- Jan.2021

11.16. Plantation and management of existing fruit trees in homestead at FSRD Site: Nawvanger Char, Jamalpur (BINA)

Under fruit production program, a total of 536 saplings of different fruits were distributed among the cooperator farmers to get fruits throughout the year (Table 11.16.1). Survival rate of different planted fruit saplings were ranged from 80-100 %. The fruit saplings are now in growing stage.

Table 11.16.1. Sapling distribution of fruit trees at FSRD Site: Nawvanger Char, Jamalpur, during 2018-2021

SI No.	Name of the trees	No. of farmers	Total saplings	Survivability (%)
1.	Malta (BARI Malta-1)	20	20	100
2.	Mango (BARI Aam-3)	80	100	100
3.	Litchi (China 3)	100	130	100
4.	Coconut (Local)	12	24	95
5.	Guava (Thai Guava-7)	12	24	100
6.	Burmese grape (local)	12	12	100
7.	Golden apple (local)	40	52	90
8.	Lemon (Binalebu-1)	12	36	100
9.	Sapota (BARI Safeda -1)	12	12	90
10.	Pummelo (BARI Batabi lebu-2)	12	12	100
11.	Papaya (Red lady)	12	24	80
12.	Aonla (BARI Amaloki-1)	60	60	95
13.	Indian Bay leaf (local)	30	30	100
Total saplings distributed			536	Ranges 80-100



Before intervention



After intervention

Picture 11.16.1. Plantation of fruit trees at homestead (before and after intervention)

11.17. Plantation of fruit saplings and management of existing fruit tree at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Different types of fruit saplings such as mango, litchi, guava, lemon, custard apple, sharifa, pomegranate, coconut, wood apple etc. were distributed among the participatory farmers. A total of 1700 saplings of different fruits species were distributed among the 12 household (Table 11.17.1). Plants are growing well and the average survivability percentage of the saplings was 83.76.

Table 11.17.1. Performance of different fruit varieties at FSRD site, Padma-Char, Ishurdi, Pabna

Name of fruit sapling	Variety	Sapling (No.)	Planting month	Survivability (%)
Mango	BARI Aam-3	100	April 2018- March, 2020	80
Litchi	BARI Litchi-3	100		75
Guava	BARI Peyara-2	100		85
Lemon	BARI Lebu-1	200		85
Indian Olive	Local	100		75
Rose apple	Local	100		90
Golden apple	Hybrid	100		85
Coconut	Local	100		95
Custard apple	Local	100		88
Carambola	Hybrid	100		85

Name of fruit sapling	Variety	Sapling (No.)	Planting month	Survivability (%)
Wood apple	Hybrid	100		77
Bullock's heart (Ata)	Local	100		70
Papaya	Local	100		100
Indian dillenia (Chalta)	Local	100		92
Pummelo	BARI Batabilabu-3	100		87
Aonla	BARI Amloki-1	100		85
Total		1700		83.76



Picture 11.17.1. Saplings distribution at FSRD site, Padma-Char, Ishurdi, Pabna

11.18. Plantation of fruits and spice sapling and management of existing fruit trees in the homestead at FSRD Site: Baghabari, Sirajganj (BLRI)

Number of fruits and spices sapling, variety and survivability rate are presented in Table 11.18.1. A total of 699 fruits and spice saplings were distributed among the 12 farmers during February 2018-January 2021. Among them 256, 262 and 181 saplings were distributed during 1st, 2nd and 3rd year, respectively (Table 11.18.1). All farmers have few fruit plants in their homestead area. But due to lack of proper management those could not obtain proper yield. For this reason, a total of 60 old existing mango trees provided proper management (fertilizer, spraying insecticide and pesticide, irrigation etc.). Due to proper management of old fruit plants, yield of fruit was increased significantly. The overall survivability rate of different fruits and spices saplings ranged from 70-100%. Now the fruits and spices saplings are at growing stage.

Table 11.18.1. Distribution of fruit and spices saplings at FSRD site, Baghabari, Sirajganj during 2018- 2021

Sl. No	Number of saplings distributed						Survivability (%)
	Types of fruits sapling	Variety	Year I	Year II	Year III	Total	
01	Papaya	Read lady	80	120	60	260	85
02	Guava	BARI Peyara-2	2	2	2	6	100
03	Burmese grape	BARI Lotkan -1	24	24	12	48	100

Sl. No	Number of saplings distributed						Survivability (%)
	Types of fruits sapling	Variety	Year I	Year II	Year III	Total	
04	Bay leaf	BARI Tejpata -1	12	12	12	36	87
05	Betel nut	Local	45	24	24	93	100
06	Coconut	Vietnam	12	12	12	36	90
07	Bael	BARI Bael-1	06	06	12	24	83
08	Rose apple	BARI Jamrul -1	07	12	10	29	95
09	Wood apple	BARI Kodbael-1	07	05	05	17	95
10	Ber	Local	10	06	05	21	90
11	Sapota	BARI Safeda-1	07	05	05	17	85
12	Custard apple	Local	08	05	05	18	80
13	Koromcha	Local	12	05	05	22	95
14	Black pepper	BARI Golmorich-1	12	12	12	36	70
15	Lemon	BARI Lebu -1	12	12	12	36	90
Total			256	262	181	699	Range (70-100)



Picture 11.18.1. Fruits and spices plant at FSRD site Baghabari, Sirajganj

11.19. Production of Vermicompost at FSRD Site: Char Kharicha, Mymensingh (BARI)

Vermicompost is an organic fertilizer could be established nearby homestead of a farmer for organic source of fertilizer and safe food production. The vermicompost plant might have been an income generation plant as it is sold for organic fertilizer and as well as selling purpose of worm. For this instant, one farmer was supplied all the materials for establishing a vermicompost plant on 25th Nov, 2020 and establish cost was Tk. 3500. However, their production is still on the pipeline and hopefully output will come after 2/3 months later.

11.20. Fodder production nearby homestead at FSRD Site: Char Kharicha, Mymensingh (BARI)

One farmer has been cultivated Napier grass at the nearby homestead in 2 decimal lands. The farmer has harvested 250 kg grasses and sold it Tk. 2500 @ Tk.10 per kg and still it is in good condition for grass production.

11.21. Cultivation of Napier grass in homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

This research activates conducted during 2018-19, 2019-20 cropping season. Green fodder production in the homestead or nearby homestead area might be a promising technology for maintaining farmers own cattle as well as earning cash money. From these views, Napier grass production was started at farmer's field. Twelve farmers were selected for Napier grass cultivation at FSRD site. The land area of each farmer was 33 decimals. The performances of Napier grass production are presented in the Table 11.21.1. The average yield of green fodder was found 52 t ha⁻¹. It was also recorded that total variable cost, gross return and gross margin were 4,500, 15,000 and Tk. 10,500, respectively per 33 decimal of land.

Table 11.21.1. Performances of Napier grass at FSRD Site, Padma Char, Ishurdi, Pabna during 2018-2020

Year	Number of farmers	Yield Kg/33 decimal	Price per kg (Tk.)	Variable cost (Tk.)	Gross return (Tk.)	Gross margin (Tk.)
Feb 2018- dec 2020	12	10,000	1.5	4,500	15,000	10,500



Picture 11.21.1. Napier grass production at FSRD site Padma Char, Ishurdi, Pabna

11.22. Family labor utilization pattern

From the observation of five FSRD sites it was observed that homestead production systems create an opportunity for employment and empowerment for woman. Char land farmers have to face unemployment and under employment due to seasonal work and natural calamities. The diversified farming system provides regular employment to the farmers. One of those area homestead is a unique place where family members involve and share their labour with better understanding among the family members. They usually shared and paid their labour according to the suitability of their own time management to run their farm smoothly in order to improve their daily livelihood. It's a never-ending journey to reach the destination where they would like to find themselves as a whole. They utilize their family labour in different daily activities throughout the year. The details of family labour utilization presented in the Table 11.22.1. It was observed that men paid their labour mostly on hardworking activities like land preparation, sowing or planting of crops, different intercultural operations, harvesting as well as marketing of produced goods. On an average about 56.43% labour of a farm family came from male (Men) part. Though females were mostly involved in cooking, but they also met their shoulder with their male counterpart to work on different activities as stated above. Averagely, 43.57% female labour was involved to do the different jobs in their own farm. Particularly 100% women are employed in cooking. Children of the farm family were also involved as a helping hand to support the family in their leisure period. On an average, 9.43% labour came from children to help the family for land preparation to marketing as well as cooking. From the data after intervention of homestead it has been observed that family labour as women and children can utilize their labour properly and women are coming forward and participated in more income generation.

Table 11.22.1. Family labor utilization pattern for homestead activities at FSRD site (Average of five sites) during 2018-2021

Types of work	Men (%)				Women (%)				Children (%)			
	Year I	Year II	Year III	Avg.	Year I	Year II	Year III	Avg.	Year I	Year II	Year III	Avg.
Land preparation	70	65	60	65	30	35	40	35	6	8	10	8
Seed/seedling	60	50	55	55	40	50	45	45	5	10	15	10
Sowing/Planting	65	55	60	60	35	45	40	40	5	6	7	6
Intercultural operations	80	60	70	70	20	40	30	30	8	6	10	8
Harvesting	70	50	60	60	30	50	40	40	5	5	8	6
Marketing	90	80	85	85	10	20	15	15	8	10	12	10
Cooking	0	0	0	0	100	100	100	100	18	16	20	18
Average	62.14	51.43	55.71	56.43	37.86	48.57	44.29	43.57	7.86	8.71	11.71	9.43

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020-Jan. 2021

B. Improvement of Cropping System

I. Improvement of existing cropping pattern

The crops and cropping systems in char land were performed with a view to develop improved cropping pattern as well as to increase crop productivity by introducing new technology or variety. Following crops and cropping systems were practiced in the FSRD site, during 2018-2020 for the improvement of cropping pattern, two cropping patterns were developed each site in Char land ecosystem of component institute.

11.23. Improvement of existing cropping pattern at FSRD site: Char Kharicha, Mymensingh (BARI)

Cropping pattern 1:

The results of tested pattern against existing pattern are presented in Table 11.23.1. In the improved pattern BARI Sarisha-14 gave the higher seed yields (1640 and 1750 kg ha⁻¹) over the average national yield of Mustard (1079 kg ha⁻¹) at the FSRD site, Char Kharicha, Mymensingh during 2018-19 and 2019-20. Moreover, the crop duration of modern mustard variety BARI Sarisha-14 was expected and did not hamper on Boro rice cultivation (Khan *et al.*, 2013). In improved pattern Boro rice gave the highest yield (5.05 and 6.5 t ha⁻¹) over the existing pattern (4.5 and 5.8 t ha⁻¹) during the two consecutive years might be due to intercropping practices such as application of balanced fertilizer, appropriate seedling rate and age, better management practice and also due to inclusion of modern variety. Mustard yield increased 100% as it was cultivated in the fallow land and T. Aman rice yield slightly decreased in improved pattern might be due to varietal performance (Table 11.23.1). Considering average of two years results, it was observed that, REY in improved cropping pattern was 13.58 tha⁻¹ against 9.06 in existing pattern that contributed higher gross margin (Tk. 111691 ha⁻¹). The average MBCR of two years was 2.08.

Table 11.23.1. Yield and economic return of improved and existing cropping pattern at the FSRD site, Char Kharicha, Mymensingh during 2018-19 and 2019-20

Observation	Improved cropping pattern			Existing cropping pattern		
	T. Aman	Mustard	Boro	T. Aman	Fallow	Boro
Year-I: 2018-19						
Seed/grain yield (t ha ⁻¹)	4.12	1.64	5.05	4.32	-	4.5
Straw yield (t ha ⁻¹)	3.5	3.5	4.5	3.5	-	4.5
REY (t ha ⁻¹)	13.58			8.82		
Gross return (Tk. ha ⁻¹)	69420	74020	85300	72620	-	76500
Total variable cost (Tk. ha ⁻¹)	43858	35750	65000	41580	-	64550
Gross margin (Tk. ha ⁻¹)	25562	38270	20300	31040	-	11950
Whole pattern Gross margin (Tk. ha ⁻¹)	84132			42990		
MBCR	2.06			-		
Year-II: 2019-20						
Seed /grain yield (t ha ⁻¹)	3.5	1.75	6.5	3.5	-	5.8
Straw yield (t ha ⁻¹)	4.0	3.0	4.5	4.0	-	4.0
Whole pattern REY (t ha ⁻¹)	13.58			9.3		
Gross return (Tk. ha ⁻¹)	67000	81750	147000	67000	-	131600
Total variable cost (Tk. ha ⁻¹)	45000	46500	65000	45000	-	65000
Gross margin (Tk. ha ⁻¹)	22000	35250	82000	22000	-	66600
Whole pattern Gross margin (Tk. ha ⁻¹)	139250			88600		
MBCR	2.09			-		
Average						
REY	13.58			9.06		
Gross Margin (Whole pattern)	111691			86045		
MBCR	2.08			-		

REY: Rice equivalent yield, Unit price (Tk. kg⁻¹): Mustard=43 & 45, Mustard by-product=1, Boro rice=16 & 22, Rice straw=1, Aman rice=16 & 18, Rice straw=1 Tk.

Cropping pattern-2: The results of the tested pattern against existing pattern are presented in Table 11.23.2. In the improved pattern BARI Alu-25 gave the higher yield (26.90 and 20.00 t ha⁻¹) over the average national yield of potato (18.00 t ha⁻¹) at the FSRD site, CharKharicha, Mymensingh during the two consecutive years 2018-19 and 2019-2020. Moreover, the crop duration of modern potato variety BARI Alu-25 was expected and did not hamper on Boro rice cultivation (Khan, *et al.*, 2013). In improved pattern Boro rice gave the highest yield (5.20 and 6.0 t ha⁻¹) over the existing pattern (5.0 and 5.5 t ha⁻¹) during the two consecutive years might be due to intercultural practices such as application of balanced fertilizer, appropriate seedling rate and age, better management practice and also due to inclusion of modern variety. Potato yield increased 100% as it was cultivated in the fallow land and T.aman rice yield slightly decreased in improved pattern might be due to varietal performance. Considering average of two years result, it was observed that, REY in improved cropping pattern was 35.68 t ha⁻¹ against 9.20 in existing pattern that contributed higher gross margin (Tk. 414236 ha⁻¹). The average MBCR of two years was 3.47.

Table 11.23.2. Yield and economic return of improved and existing cropping pattern at the FSRD site, Char Kharicha, Mymensingh during 2018-2019

Observation	Improved cropping pattern			Existing cropping pattern		
	T. Aman	Potato	Boro	T. Aman	Fallow	Boro
Year-I: 2018-19						
Seed /grain yield (t ha ⁻¹)	4.15	26.90	5.20	4.30	-	5.0
Straw yield (t ha ⁻¹)	3.8	33.63	4.5	3.3	-	4.0
REY (t ha ⁻¹)	42.98			9.3		
Gross return (Tk. ha ⁻¹)	78500	538000	87700	80700	-	84000
Total variable cost (Tk. ha ⁻¹)	43898	142840	60750	41680	-	70000
Gross margin (Tk. ha ⁻¹)	34602	395160	26950	39020	-	14000
Whole pattern Gross margin (Tk. ha ⁻¹)	456712			53020		
MBCR	3.97			-		
Year-II: 2019-20						
Seed /grain Yield (t ha ⁻¹)	4.20	20.0	6.0	3.5	-	5.5
Straw yield (t ha ⁻¹)	3.4	-	5.2	4.0	-	5.0
REY (t ha ⁻¹)		18.18				
Whole pattern REY (t ha ⁻¹)	28.38			9		
Gross return (Tk. ha ⁻¹)	87400	400000	137200	74000	-	126000
Total variable cost (Tk. ha ⁻¹)	45000	142840	65000	45000	-	65000
Gross margin (Tk. ha ⁻¹)	42400	257160	72200	29000	-	61000
Whole pattern Gross margin (Tk. ha ⁻¹)	371760			90000		
MBCR	2.97			-		
Average						
REY	35.68			9.20		
Gross Margin (Whole pattern)	414236			71510		
MBCR	3.47			-		

REY: Rice equivalent yield, Unit price (Tk. kg⁻¹): Potato=20, Boro rice=16 & 22, Rice straw=1, Aman rice=18 & 20, Rice straw=1

11.24. Improvement of existing cropping pattern at FSRD Site: Charpara, Sonatola, Bogura (BARI)

According to the suitability of the land a four-crop based Mustard – Boro - T. aus -T. Aman and a three crop-based Wheat-Jute-T. Aman patterns were developed against Mustard – Boro - T. Aman rice and Boro-Fallow-T. Aman rice respectively. Transformation of three crop-based patterns to four crops and two crops based to three by changing suitable varieties of selected crops could contribute to higher system productivity as well as economic return.

Cropping pattern 1: Yield and economic performance of the tested pattern against existing pattern is presented in Table 11.24.1. In the improved pattern BARI Sarisha-14 gave higher seed yield (1.46 and 1.51tha⁻¹ in 20118-19 and 2019-20 respectively) over the local Tori-7 (0.95 and 0.96 tha⁻¹ in 20118-19 and 2019-20 respectively) at the FSRD site, Charpara, Bogura during 2018-19 and 2019-20. Moreover, the crop duration of modern mustard variety BARI Sarisha-14 was expected and did not hamper on Boro rice cultivation. In improved pattern. T. Aus rice planted in alternate pattern contributed to 3.52-3.96 tha⁻¹ grain in the respective years. Higher rice equivalent yield was recorded as 15.33 tha⁻¹ in 2018-19 and 16.93 tha⁻¹ in 2019-20 seasons from improved pattern and lower (10.71 and 11.44 tha⁻¹ in 2018-19 and 2019-20 respectively) from existing pattern. Higher rice equivalent yield contributed to the higher gross margin (Tk. 141660 ha⁻¹ in 2018-19 and Tk. 169630 ha⁻¹ in 2019-20) in improved pattern and lower (Tk. 92370 ha⁻¹ in 2018-19 and Tk. 111900 ha⁻¹ in 2019-20) in the existing pattern. MBCR was recorded as 2.04 and 2.10 for the respective years. Considering average of two years result it was observed that REY in improved cropping pattern was 16.23 tha⁻¹ against 11.08 in existing pattern that contributed higher gross margin (Tk. 155645 ha⁻¹). The result of the study is consistent with the findings of (Khan *et al.*, 2017).

Cropping pattern 2: Yield and economic performance of the tested pattern against existing pattern is presented in Table 11.24.2. In the improved pattern BARI Gom-30 gave satisfactory grain yield (3.76 tha⁻¹) and Jute contributed to the fibre yield of 2.43 tha⁻¹ at the FSRD site, Char Shyampur, Bogura during 2019-2020. Higher rice equivalent yield was recorded as 15.35 tha⁻¹ in improved pattern and lower (10.20 tha⁻¹) in the existing pattern. Higher rice equivalent yield (15.35 tha⁻¹) contributed to the higher gross margin (Tk.188680 ha⁻¹) in improved pattern and lower (Tk. 106630 ha⁻¹) in the existing pattern. MBCR was calculated as 4.92 from the improved pattern.

Table 11.24.1. Yield and economic return of four crop based cropping pattern against existing cropping pattern at the FSRD site, Charpara, Sonatola, Bogura during 2018-20.

Observation	Improved cropping pattern				Existing cropping pattern		
	Mustard	Boro	T. Aus	T. Aman	Mustard	Boro	T. Aman
Year-I: 2018-19							
Seed/grain yield (t ha ⁻¹)	1.46	4.18	3.58	3.52	0.95	3.98	3.9
Straw yield (t ha ⁻¹)	1.68	5.1	3.75	3.68	1.1	4.59	4.2
REY (t ha ⁻¹)	15.53				10.71		
Gross return (Tk ha ⁻¹)	60080	93800	79100	77760	39100	88780	86400
Total variable cost (Tk ha ⁻¹)	29390	52480	42560	44650	24380	50980	46550
Gross margin (Tk ha ⁻¹)	30690	41320	36540	33110	14720	37800	42850
Whole pattern Gross margin (Tk. ha ⁻¹)	141660				92370		
MBCR	2.04				-		
Year-II: 2019-20							
Seed /grain yield (t ha ⁻¹)	1.51	4.63	3.78	3.96	0.96	4.24	4.2
Straw yield (t ha ⁻¹)	1.85	5.25	4.56	4.72	1.23	4.96	5.23
Rice equivalent yield (t ha ⁻¹)	16.93				11.44		
Gross return (Tk ha ⁻¹)	62250	103100	84720	88640	39630	94720	94460
Total variable cost (Tk ha ⁻¹)	29390	52480	42560	44650	24380	50980	41550
Gross margin (Tk ha ⁻¹)	32860	50620	42160	43990	15250	43740	52910
Whole pattern Gross margin (Tk. ha ⁻¹)	169630				111900		
MBCR	2.10				-		
Average							
REY	16.23				11.08		
Gross Margin (Whole pattern)	155645				102135		
MBCR	2.07				-		

Price; Mustard: 40 Tk/kg, Mustard stover: 1.0 Tk/kg and Rice: 20 Tk/kg, Rice straw: 2.0 Tk/kg,

Table 11.24.2. Yield and economic return of three crop based cropping patterns against existing cropping pattern at FSRD site, Charpara, Sonatola, Bogura during 2018-20.

Observation	Alternate cropping pattern			Existing cropping pattern		
	Wheat	Jute	T.Aman	Boro	Fallow	T. Aman
Crop						
Seed /grain Yield (tha ⁻¹)	3.76	2.43	4.12	4.81	-	4.35
Straw/Stover yield (tha ⁻¹)	3.12	5.16	4.72	5.06	-	5.42
Rice equivalent yield (t ha ⁻¹)	15.35			10.20		
Gross return (Tk. ha ⁻¹)	78320	136980	91840	106320	0	97840
Total variable cost (Tk. ha ⁻¹)	34860	38950	44650	50980	0	46550
Gross margin (Tk. ha ⁻¹)	43460	98030	47190	55340	0	51290
Whole pattern Gross margin (Tk. ha ⁻¹)	188680			97530		
MBCR	4.92			-		

Price; Wheat: 20 Tk/kg, Jute fiber: 50 Tk/kg, Rice: 20 Tk/kg, Rice straw: 2.0 Tk/kg, Wheat stover: 1.0 Tk/kg, stick: 3 Tk./kg

11.25. Improvement of existing cropping pattern at FSRD Site: Nawvangar Char, Jamalpur (BINA)

Cropping pattern-1

Existing CP: Jute (var. JRO 524)-T. Aman (var. Sharwna/Hori)-Grasspea (var. BARI Khesari-1)

Improved CP: Jute (var. JRO 524)-T. Aman (var. Binadhan-11)-Maize (var. Hybrid 981)

The existing cropping pattern of Jute (var. JRO 524)-T. Aman (var. Sharwna/Hori)-Grasspea (var. BARI Khesari-1) was improved by inclusion of Jute (var. JRO 524)-T. Aman (var. Binadhan-11)-Maize (var. Hybrid 981) at the FSRD site, Nawvangar char, Jamalpur during the year of 2018-19 and 2019-2020 (Table 11.25.1 and Table 11.25.2). In Kharif-I, Jute was grown both in improved and existing cropping pattern. The fibre yield was found more in improved cropping pattern (3.00 t/ha in 2018-19 and 3.08 t/ha in 2019-20) than existing cropping pattern (2.5 t/ha both in two year) due to proper agronomic management (Islam et al., 2018). In Kharif-II season, aman rice grain yield was increased 27% might be due to application of balance fertilizer, appropriate seedling rate and age, better management practices and also inclusion of modern variety instead of local rice variety. In Rabi season grass pea (used as fodder) crop was replaced by growing hybrid maize in improved cropping pattern which increased yield. The rice equivalent yield was increased due to cultivation of hybrid maize, jute and improved T. Aman rice variety (Ali, et al., 2008 and Sarker, et al., 2020). However, during 2018-19 the gross margin Tk. 2,38,383 ha⁻¹ and during 2019-20 gross margin Tk. 2,50,668 ha⁻¹ was obtained from improve cropping pattern which was higher than existing cropping pattern (Tk. 78,550 and 81,350 in the year 2018-19 and 2019-20 respectively). Gross margin increased 203% and 208% in improved cropping pattern compared to existing cropping pattern during the year 2018-19 and 2019-20 respectively. Maize tremendously increased the system productivity and economic return of the three crops based cropping pattern.

Table 11.25.1 Yield and economic analysis of improved and existing cropping patterns at FSRD site Nawvangar char, Jamalpur during 2018-2019

Observation	Improved cropping pattern			Existing cropping pattern		
	Jute	T.Aman	Maize	Jute	T. Aman	Grasspea
Crop						
Seed /grain/fibre Yield (t ha ⁻¹)	3.0 (Fiber)	4.8	10.37	2.5 (Fiber)	3.8	Uses as fodder (0.64)
Straw/stick yield (t ha ⁻¹)	1.8 (Jute stick)	5.0	-	1.5 (Jute stick)	4.0	-
Rice equivalent yield (t ha ⁻¹)	8.19	5.34	11.49	6.83	4.23	1.73
Whole pattern rice equivalent yield (t ha ⁻¹)	25.02			12.79		
Gross return (Tk. ha ⁻¹)	1,51,500	98,800	2,12,585	1,26,250	78,300	32,000
Total variable cost (Tk. ha ⁻¹)	1,05,000	55,000	64,502	95,000	48,000	15,000
Gross margin (Tk. ha ⁻¹)	46,500	43,800	1,48,083	31,250	30,300	17,000
Whole pattern gross margin (Tk. ha ⁻¹)	2,38,383			78,550		
MBCR	3.40					

Price (Tk kg⁻¹): Jute-47.5, Jute stick-5, T.aman rice- 18.5, Straw-2, Maize-20.5, khesari-50

Table 11.25.2. Yield and economic analysis of improved and existing cropping patterns at FSRD site, Nawvangar Char, Jamalpur during 2019-2020

Observation	Improved cropping pattern			Existing cropping pattern		
	Jute	T. Aman	Maize	Jute	T. Aman	Grasspea
Crop						
Seed /grain Yield (t ha ⁻¹)	3.08 (Fiber)	5.0	10.96	2.5 (Fiber)	3.9	Used as fodder (0.64)
Straw yield (t ha ⁻¹)	1.19 (Jute stick)	5.2	-	1.45 (Jute stick)	4.6	-
Rice equivalent yield (t ha ⁻¹)	8.22	5.56	12.14	6.81	4.6	1.73
Whole pattern rice equivalent yield (t ha ⁻¹)	25.92			13.14		
Gross return (Tk. ha ⁻¹)	1,52,250	1,02,900	2,24,819	1,26,000	81,350	32,000
Total variable cost (Tk. ha ⁻¹)	1,05,000	55,000	69,301	95,000	48,000	15,000
Gross margin (Tk. ha ⁻¹)	47,250	47,900	1,55,518	31,000	33,350	17,000
Whole pattern gross margin (Tk ha ⁻¹)	2,50,668			81,350		
MBCR				3.37		

Price (Tk kg⁻¹): Jute-47.5, Jute stick-5, T. Aman rice- 18.5, Straw-2, Maize-20.5, Ksheshari-50

(b) Cropping pattern-2

Existing CP : Fallow-T. Aman (var. Sharwna)-Boro (var. BRRIdhan 28)

Improved CP : Aus (var. Binadhan-19)-T. Aman (var. Binadhan-7)-Mustard (var. Binasarisha-9)-Mungbean (var. Binamoog-8)

The existing cropping pattern Fallow -T. Aman (var. Sharwna) - Boro (var. BRRIdhan 28) was improved by inclusion of T. Aus (var. Binadhan-19)-T. Aman (var. Binadhan-7)-Mustard (var. Binasarisha-9)-Mungbean (var. Binamoog-8) at the FSRD site, Nawvangar Char, Jamalpur during the year of 2018-19 and 2019-2020 (Table 11.25.3 and 11.25.4). In Kharif-II, T. Aman was grown both in existing and improved cropping pattern. Yield was found more in improved cropping pattern (4.6 t/ha in 2018-19 and 4.5 t/ha in 2019-20) than existing cropping pattern (3.8 t/ha in 2018-19 and 3.9 t/ha 2019-20). In Kharif-II season, T. Aman rice yield was increased 21% and 15% in the year 2018-19 and 2019-20 respectively due to better management practices and also inclusion of modern variety instead of local rice variety. In Rabi season Boro rice was replaced by growing mustard and mungbean in improved cropping which increased yield. The rice equivalent yield was increased due to cultivation of 4 crops by replacing 2 crops in the cropping pattern and also growing improved T. aman rice variety at the Kharif-II season. Gross margin increased 49% and 64% in improved cropping pattern compared to existing cropping pattern during the year 2018-19 and 2019-20 respectively (Table 11.25.3 and Table 11.25.4).

Table 11.25.3. Yield and economic analysis of alternate and existing cropping patterns at FSRD Site, Nawvangar Char, Jamalpur during 2018-19

Observation	Improved cropping pattern				Existing cropping pattern		
	Aus	T. Aman	Mustard	Mungbean	Fallow	T. Aman	Boro
Crop							
Seed /grain Yield (t ha ⁻¹)	3.2	4.6	1.3	0.83	-	3.8	5.6
Straw/Stover yield (t ha ⁻¹)	3.4	4.7	1.4	2.00	-	4.5	5.4
Rice equivalent yield (t ha ⁻¹)	3.54	5.12	2.96	2.87	-	4.3	6.2
Whole pattern rice equivalent yield (t ha ⁻¹)	14.49				10.50		
Gross return (Tk. ha ⁻¹)	70,800	92,200	53,400	51,800	-	77,400	1,11,600
Total variable cost (Tk. ha ⁻¹)	48,046	47,000	27,448	24,887	-	50,000	58,100
Gross margin (Tk. ha ⁻¹)	22,754	45,200	25,952	26,913	-	27,400	53,500
Whole pattern gross margin (Tk. ha ⁻¹)	1,20,819				80,900		
MBCR					2.02		

Price (Tk kg⁻¹): Aus Rice- 20, Straw-2, T. Aman Rice-18, Straw-2, Boro Rice-18, Mustard-40, Stover-1, Mungbean-60, Stover-1

Table 11.25.4. Yield and economic analysis of improved and existing cropping patterns at FSRD Site, Nawvanger Char, Jamalpur during 2019-20

Observation	Improved cropping pattern				Existing cropping pattern		
	Aus	T.Aman	Mustard	Mungbean	Fallow	T. Aman	Boro
Crop							
Seed /grain Yield (t ha ⁻¹)	3.0	4.5	1.5	0.82	-	3.9	5.5
Straw/Stover yield (t ha ⁻¹)	3.6	4.9	1.7	2.01	-	4.6	5.1
Rice equivalent yield (t ha ⁻¹)	3.36	5.04	3.39	2.81		4.41	6.06
Whole pattern rice equivalent yield (t ha ⁻¹)	14.60				10.48		
Gross return (Tk. ha ⁻¹)	67,200	90,800	61,700	51,210	-	79,400	1,09,200
Total variable cost (Tk. ha ⁻¹)	48,046	47,000	27,448	24,887	-	50,000	58,100
Gross margin (Tk. ha ⁻¹)	19,154	43,800	34,252	26,323	-	24,400	51,100
Whole pattern gross margin (Tk ha ⁻¹)	1,23,529				75,500		
MBCR	2.10						

Price (Tk kg⁻¹): Aus Rice- 20, Straw-2, T. Aman Rice-18, Straw-2, Boro Rice-18, Mustard-40, Stover-1, Mungbean-60, Stover-1

11.26. Improvement of existing cropping pattern at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Cropping Pattern-I

Existing cropping pattern: Aus (BRRI dhan48) - Blackgram (BARI Mash-3) - Lentil (BARI Moshur-6)

Improved cropping pattern: Radish (Mollica) - Radish (Mollica) - Carrot (Orange king) - Wheat (BARI Gom - 31)

Yield and economic analysis of improved and existing cropping pattern are presented in Table 11.26.1. The improved cropping pattern Radish (Mollica) - Radish (Mollica) - Carrot (Orange king) - Wheat (BARI Gom - 31) gave higher rice equivalent yield over existing pattern Aus (BRRI dhan48) - Blackgram (BARI Mash-3) - Lentil (BARI Moshur-6) at the FSRD site, Padma-Char, Ishurdi, Pabna during 2019-2020. Improved cropping pattern gave 61.58 tha⁻¹ rice equivalent yields where as only 15.36 tha⁻¹ RYT was found from existing cropping pattern. The higher gross margin Tk. 7,83,400 ha⁻¹ and MBCR (2.44) were obtained from improved cropping pattern. On the other hand, gross margin was calculated from existing pattern only Tk. 2,38,418 ha⁻¹. Moreover, total crop duration of improved cropping pattern was 8 days earlier than existing pattern.



1. Radish



2. Radish



3. Carrot



4. Wheat

Picture 11.26.1. Improved cropping pattern at FSRD site Padma Char, Ishurdi, Pabna

Table 11.26.1. Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Padma Char, Ishurdi, Pabna, during 2018-2019

Observation	Improved cropping pattern				Existing cropping pattern		
	Radish	Radish	Carrot	Wheat	Aus	Blackgram	Lentil
Crop							
yield (tha ⁻¹)	36	41	25	4.23	3.72	1.12	1.38
Straw yield (tha ⁻¹)	0	0	0	2	6.57	1	1.49
rice equivalent yield (tha ⁻¹)	18.00	20.50	18.75	4.33	3.72	3.36	8.28
Whole pattern Rice equivalent yield (tha ⁻¹)	61.58				15.36		

Observation	Improved cropping pattern				Existing cropping pattern		
	Radish	Radish	Carrot	Wheat	Aus	Blackgram	Lentil
Crop							
Gross Return (Tk. ha ⁻¹)	360000	410000	375000	86600	74400	67200	165600
Total variable cost (Tk. ha ⁻¹)	112050	112050	149400	74700	53842	7470	7470
Gross Margin (Tk. ha ⁻¹)	247950	297950	225600	11900	20558	59730	158130
Whole pattern Gross margin (Tk. ha ⁻¹)	783400				238418		
MBCR					2.44		

Cropping pattern-2

Existing cropping pattern: Aus (BRRI dhan48)-Mustard - Fallow

Improve cropping pattern: Radish (Mollica)-Carrot (Orange king)- Groundnut (BARI Chinabadam - 8)

Yield and economic analysis of improved and existing cropping pattern are presented in Table 11.26.2. In the improved pattern Radish (Mollica)-Carrot (Orange king)- Ground nut (BARI Chinabadam - 8) gave higher rice equivalent yield over existing pattern Aus (BRRI dhan48)-Mustard - Fallow at the FSRD site, Padma Char, Ishurdi, Pabna during 2019-2020.

Improved cropping patter gave 42.55 tha⁻¹ rice equivalent yields where as only 13.98 tha⁻¹ RYT was found from existing cropping pattern. The higher total gross margin Tk. 8,83,250 ha⁻¹ and MBCR (3.61) were obtained from improved cropping pattern. On the other hand, gross margin was calculated from existing pattern only Tk. 2,18,288 ha⁻¹. Moreover, total crop duration of improved cropping pattern was 10 days earlier than existing pattern.

Table 11.26.2 Yield and economic analysis of improved and existing cropping patterns at the FSRD site, Padma Char, Ishurdi, Pabna, during 2018-2019

Observation	Improved cropping pattern			Existing cropping pattern		
	Radish	Carrot	Ground nut	Aus	Mustard	Fallow
Crop						
yield (tha ⁻¹)	36	25	1.45	3.72	3.42	-
Straw yield (tha ⁻¹)	0	0	2	6.57	1	-
rice equivalent yield (tha ⁻¹)	18.00	18.75	5.80	3.72	10.26	-
Whole pattern Rice equivalent yield (t ha ⁻¹)	42.55			13.98		
Gross Return (Tk. ha ⁻¹)	360000	375000	464000	74400	205200	-
Total variable cost (Tk. ha ⁻¹)	112050	149400	54300.00	53842	7470.00	-
Gross Margin (Tk. ha ⁻¹)	247950	225600	409700.00	20558	197730	-
Whole pattern Gross margin (Tk. ha ⁻¹)	883250			218288		
MBCR				3.61		



1. Radish



2. Carrot



3. Ground nut

Picture 11.26.2. Improved cropping pattern at FSRD site Padma Char, Ishurdi, Pabna

11.27. Replacement of existing Sugarcane varieties by newly developed BSRI varieties at FSRD Site, Padma Char, Ishurdi, Pabna (BSRI)

The experiment was undertaken for replace the existing traditional sugarcane varieties by high yielding varieties developed from BSRI. Seven varieties of sugarcane (Isd 34, Isd 39, Isd 40, BSRI Akh 43, BSRI Akh 44, BSRI Akh 45 & BSRI Akh 46) were tested at 12 farmer's field at FSRD site during 2018-2019, 2019-2020 and 2020-2021. The plot size was 33 decimal per farmer. It was observed from three years result, average highest yield (98.51tha^{-1}) was obtained from BSRI Akh 46 and lowest (77.84t ha^{-1}) was from Isd 34. Among the seven varieties the highest gross margin (Tk. 22555 ha^{-1}) was found from BSRI Akh 46 and lowest (Tk. 13455 ha^{-1}) was from Isd 34 (Table.11.27.1).



Picture 11.27.1. Newly developed BSRI varieties in FSRD char land ecosystem

Table 11.27.1 Performance of different varieties of sugarcane at FSRD Site Padma Char, Ishurdi, Pabna during 2018-2021 (Avg. of 3 years)

Treatments	No. of tillers ($\times 10^3 \text{ ha}^{-1}$)	No. of Millable cane ($\times 10^3 \text{ ha}^{-1}$)	Yield tha^{-1}	Yield (t/ 33 decimal)	Variable cost (Tk./33 decimal)	Gross return (Tk./ 33 decimal)	Gross margin (Tk./ 33 decimal)	Gross margin (Tk./ha)
V ₁ : Isd 34	136	105	77.84	1.49	2800	4601	1801	13455
V ₂ : Isd 39	136	110	85.86	1.64	2800	5074	2274	16994
V ₃ : Isd 40	140	113	85.67	1.64	2800	5063	2263	16906
V ₄ : BSRI Akh 43	148	120	94.25	1.81	2800	5571	2771	20701
V ₅ : BSRI Akh 44	149	125	92.67	1.77	2800	5475	2675	19985
V ₆ : BSRI Akh 45	154	113	96.05	1.84	2800	5674	2874	21471
V ₇ : BSRI Akh 46	166	132	98.51	1.89	2800	5819	3019	22555

11.28. Improvement of existing cropping pattern at FSRD site: Baghabari, Sirajganj (BLRI)

Cropping pattern-1:

Existing CP: Fallow – Boro- T-Aman

Alternate CP: Mustard (BARI Sarisha-14)-Boro (BRRI dhan74)-T. Aman (BRRI dhan51)

In 2018-19, average grain yield of crops in the alternate cropping pattern, Mustard (BARI Sarisha-14), Boro (BRRI dhan74) and T. Aman (BRRI dhan51) were recorded as 1.75, 5.05 and 3.07 t/ha, respectively where as in the existing cropping pattern 4.5 and 3.5 t ha^{-1} yield of Boro (BRRI dhan28) and T. Aman (local), respectively. The rice equivalent yield of alternate and existing cropping patterns was 11.56 t $\text{ha}^{-1}\text{year}^{-1}$ and 9.42 t $\text{ha}^{-1}\text{year}^{-1}$, respectively (Table 11.28.1). In 2019-2020, the average grain yields in alternate cropping pattern were recorded as 1.80, 5.05 and 3.70 t/ha of Mustard, Boro and T. Aman, respectively whereas 4.33 and 4.6 t/ha yield of Boro and T. Aman were recorded in the existing cropping pattern. The rice equivalent yield of alternate and existing cropping patterns were 12.37 t $\text{ha}^{-1}\text{year}^{-1}$ and 9.42 t $\text{ha}^{-1}\text{year}^{-1}$, respectively (Table 11.28.2). From cost and return analysis, in both the years alternate cropping pattern performed better than the existing cropping pattern. In 2018-19 the gross margin was higher in alternate cropping pattern (Tk.

58420 ha⁻¹) compared to the existing cropping pattern (Tk. 21000 ha⁻¹). In 2019-20 alternate cropping pattern gave the higher gross margin (Tk. 62320 ha⁻¹) over the existing cropping pattern. The marginal benefit cost ratio (MBCR) was found 2.06 and 1.96, respectively in 2018-19 and 2019-20 which indicated the superiority of the three crops pattern over farmers' pattern.

Table 11.28.1. Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Baghabari, Sirajganj during 2018-2019

Observation	Improved cropping pattern			Existing cropping pattern		
	Mustard	Boro	T. aman	Fallow	Boro	T. aman
Crop						
Seed /grain Yield (t ha ⁻¹)	1.75	5.05	3.7	-	4.5	3.5
Straw yield (t ha ⁻¹)	3.0	4.5	4.0	-	4.5	4.0
Rice equivalent yield(t ha ⁻¹ year ⁻¹)	11.56				9.42	
gross return (Tk. ha ⁻¹)	238670			166000		
Total variable cost (Tk. ha ⁻¹)	180250			145000		
Gross margin (Tk. ha ⁻¹)	58420			21000		
MBCR				2.06		

Rice: 20 Tk./Kg and Mustered 40 Tk./kg

Table 11.28.2. Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Baghabari, Sirajganj during 2019- 2020

Observation	Improved cropping pattern			Existing cropping pattern		
	Mustard	Boro	T. Aman	Fallow	Boro	T.aman
Crop						
Seed /grain Yield (t ha ⁻¹)	1.80	5.15	3.80	-	4.3	3.6
Straw yield (t ha ⁻¹)	3.0	4.5	4.0	-	4.5	4.0
Rice equivalent yield(t/ha/Year)	12.37				9.42	
Gross return (Tk. ha ⁻¹)	247570			171000		
Total variable cost (Tk. ha ⁻¹)	185250			146000		
Gross margin (Tk. ha ⁻¹)	62320			25000		
MBCR				1.96		



Picture 11.28.1 Cropping pattern at FSRD site, Baghabari, Sirajganj

Cropping pattern-2

Improved CP: Onion (BARI Piaj-4)-Sesame (BARI Til -4) -T. Aman (BRRi dhan51)

Existing CP: Onion (local) -Jute (local)-Fallow

In 2018-19, the average yield of crops in improved cropping pattern, onion (BARI Piaj-4), Sesame (BARI Till - 4), and T. Aman (BRRi dhan51) were recorded as 7.5, 1.5 and 4.5 t ha⁻¹, respectively whereas in the existing cropping pattern produced 7.5 and 2.8 t ha⁻¹ yield of onion (local) and jute (local), respectively. The rice equivalent yield of improved and existing cropping patterns were 14.35 t ha⁻¹/year and 10.44 t ha⁻¹/year, respectively (Table 11.28.3). During 2019-2020, average yield of crops in improved cropping pattern were recorded as 8.0, 1.5 and 4.5 t/ha of onion (BARI Piaj-4), Sesame (BARI Til- 4) and T. Aman (BRRi dhan51), respectively where as 7.8 and 5.3 t ha⁻¹ yield of onion and jute were recorded in the existing cropping pattern (Table 11.28.4). The rice equivalent yields of improved and existing cropping patterns were 14.75 t ha⁻¹/year and 10.80 t ha⁻¹/ year, respectively (Table 11.28.4). From the cost return analysis, in

both the years improved cropping pattern performed better than the existing cropping pattern. In 2018-19 the gross margin was higher in improved cropping pattern (Tk. 179200 ha⁻¹) compared to the existing cropping pattern (Tk. 156750 ha⁻¹). It was mainly influenced by the additional Til and T. Aman new variety in the pattern. In 2019-20 improved cropping pattern gave the higher gross margin (Tk. 182200 ha⁻¹) over the existing cropping pattern. The marginal benefit cost ratio (MBCR) was found 1.29 and 1.31, respectively in 2018-19 and 2019-20 which indicated the superiority of the three crops pattern over farmers' pattern.

Table 11.28.3. Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Baghabari, Sirajganj during 2018-2019

Observation	Improved cropping pattern			Existing cropping pattern		
	Onion	Til	T. aman	Onion	Jute	Fallow
Crop						
Seed /Grain yield (t ha ⁻¹)	7.5	1.45	4.5	7.5	2.8	
Yield(t ha ⁻¹)	16.46	1.56	4.56	15.9	2.42	
Straw yield (t ha ⁻¹)		1.68	4.7		3.63	
Rice equivalent yield(t/ha/ Year)	14.35			10.44		
Gross return (Tk. ha ⁻¹)	235800	72650	50210	185580	75400	
Total variable cost (Tk. ha ⁻¹)	86500	60750	32210	58500	45700	
Gross margin (Tk. ha ⁻¹)	149300	11900	18000	127080	29670	
Gross return (Tk. ha ⁻¹)	358660			260980		
Total variable cost (Tk. ha ⁻¹)	179460			104200		
Gross margin (Tk. ha ⁻¹)	179200			156750		
MBCR	1.29					

Table 11.28.4. Yield and economic analysis of alternate and existing cropping patterns at the FSRD site, Baghabari, Sirajganj during 2019- 2021

Observation	Improved cropping pattern			Existing cropping pattern		
	Onion	Til	T. aman	Onion	Jute	Fallow
Crop						
Seed /grain yield (t ha ⁻¹)	8.0	1.5	4.5	7.8	5.3	-
Yield(t ha ⁻¹)	18.46	1.60	4.60	16.0	2.45	-
Rice equivalent yield (t ha ⁻¹ year ¹)	14.75			10.80		
Gross return (Tk. ha ⁻¹)	368660			269980		
Total variable cost (Tk. ha ⁻¹)	184460			109200		
Gross margin (Tk. ha ⁻¹)	182200			160780		
MBCR	1.31					



Picture 11.28.3. Onion (BARI Piaj-1)- Sesame (BARI Til- 4)-T-Aman (BRRi dhan 51)

11.29. Production program on HYV of different crops at FSRD Site: Char Kharicha, Mymensingh (BARI)

Results: After intervention of the program the variety and production technologies of BARI were disseminated in the concern farmer's field and it was observed that the yield and income were generated enormously. However, the yield, cost and return of different crops have been shown in Table 11.29.1.

Okra: The BARI released variety BARI Dherosh-2 was cultivated in the farmers field with recommended dose of inputs supplied and observations were done routinely. The data were collected after every harvest and converted the yield with market price and performance was observed. The average fruit yield of okra

was 19.58 t ha⁻¹ during the three consecutive years. The gross return was calculated and it was obtained Tk. 264900 ha⁻¹, total variable cost and gross margin were Tk. 57145 and Tk. 207755 ha⁻¹, respectively. The benefit cost ratio was (BCR) 4.74 which indicated that this technology is economically profitable.

Bottle gourd: The BARI Lau-3 was cultivated in the farmers' field and the average fruit yield of bottle gourd during the three years of cultivation was 28.90 t ha⁻¹. The gross return, total variable cost and gross margin were Tk. 324850, Tk. 115000 and Tk. 209850 ha⁻¹, respectively. The benefit cost ratio was 2.72 which marked a profitable technology as well as variety cultivated in the farmers' field.

Snake gourd: During the first two consecutive years the snake gourd was cultivated according to the technology and variety in the concern farmers' field. The inputs from the OFRD, BARI, Mymensingh were supplied to the field and collected data showed that the average fruit yield of snake gourd was 20.35 t ha⁻¹. The gross return, total variable cost and gross margin were converted as per the market price of the products and observed that the gross return was one an average Tk. 271725, the TVC was Tk. 91725 and the gross margin was Tk. 180000 ha⁻¹, respectively. The BCR 2.96 showed cultivating of snake gourd in farmer's field was profitable.

Stem amaranth: The BARI released variety BARI Danta-1 was cultivated in the farmers' field to show the performance of the variety. It is quick growing vegetables and the average yield of two consecutive years was 33.75 t ha⁻¹. The gross return was so high Tk. 287500 ha⁻¹, the total variable cost was lower than that of any other crops and it was Tk. 52790 ha⁻¹ and gross margin were Tk. 267500, Tk. 52790 and Tk. 234710 ha⁻¹, respectively. So far, the BCR was 5.44 which indicated that this technology is economically advantageous.

Bitter gourd: The BARI Korola-2 was supplied to the concern farmers field to show the performance of the variety among the farmers and the average yield of bitter gourd was obtained 19.96 t ha⁻¹ which indicated a promising variety in that locality. The calculated gross return, the total variable cost and the gross margin were calculated and it was observed that the GR was Tk. 291900, the TVC was Tk. 137500 and the GM was Tk. 213050 ha⁻¹, respectively. The obtained BCR 2.54 showed BARI korola-2 is a promising variety that could be disseminated among the farmers in the farming system research site.

Potato: BARI released potato variety has taken over the place to replace the local cultivar which was usually cultivated in the location. All inputs were supplied from the sub-project. The average tuber yield of potato was found 26.97 t ha⁻¹. The gross return, the total variable cost were Tk. 303400, Tk. 119434 and Tk. 183966 ha⁻¹, respectively. The BCR was 2.54 which further indicated that the high yielding BARI released variety of potato cultivation is economically profitable in the farmers' field. The BARI Alu-25 made a good awareness among the farmer in the farming system research and development site.

Mustard: The BARI Sarisha-14 is a promising variety of mustard all over the country is cultivating. However, in the concern sub-project site the variety gave a good performance and it was 1.66 t ha⁻¹ which is better seed yield than that of national average (1.079 t ha⁻¹). After calculating the gross return, it was obtained Tk. 72825 ha⁻¹, total variable cost was Tk. 32913 ha⁻¹ and the calculated gross margin was Tk. 40278 ha⁻¹, respectively. The benefit cost ratio was 2.28 indicated a better technology in the farmer's field.

Papaya: A production technology was followed in the sub-project area of FSRD site, Mymensingh where hybrid variety was used. Other than variety all other technical supports were provided and a promising good result were observed in the year 2020. However, the yield was obtained 35.00 t ha⁻¹ and the calculated gross return was Tk. 525000 ha⁻¹, the total variable cost was Tk. 192750 ha⁻¹ and gross margin was Tk. 332250 ha⁻¹, respectively. The benefit cost ratio 2.72 indicated an accepted cultivation technology in the farmers' field.

Brinjal: A locally collected brinjal variety was used in the farmers' field and the production technique was disseminated over there in. All the inputs were supplied from OFRD, BARI, Mymensingh and the obtained yield was 28.00 t ha⁻¹ in the year, 2020. The calculated gross return was Tk. 560000 ha⁻¹, the total variable cost was Tk. 120000 ha⁻¹ and gross margin was Tk. 440000 ha⁻¹, respectively. The benefit cost

ratio was 3.66 indicated an accepted cultivation technology in the farmers' field.

Farmers' opinion: Farmers are very much impressed having the higher yield of BARI Sarisha-14 and was happy to be easily fitted to Mustard-Boro-T. Aman cropping pattern without hampering the Boro cultivation. Farmers reacted over the variety very positively and satisfaction with for its high yield. A good number of seed has been stored by the farmers for growing in the next year. High yielding potato variety (BARI developed variety) create an awareness among the farmers for higher yield and high market price in early marketing but lack of storage facility and fluctuation of market price of tuber as of the main constraints for extension of the technology. Under production program highest yield (35 tha⁻¹) was found from papaya but highest BCR (5.44) was found from BARI Danta-1. All the BARI released varieties and technologies make a good impact to the farmers as of the crops provided higher yield and economic return, quality and sometimes attractive shape and color. They would follow the technology and grow the crops variety in the coming year and some of them stored a large amount of seeds for the next year cultivation.

Table 11.29.1 Performance of different crops under production program at FSRD site, Char Kharicha, Mymensingh during 2018-21

Crop	Variety	Yield (t ha ⁻¹)				GR (Tk. ha ⁻¹)	TVC (Tk. ha ⁻¹)	GM (Tk. ha ⁻¹)	BCR
		Year-I	Year-II	Year-III	Avg.				
Okra	BARI Dherosh-2	19.15	-	20.00	19.58	264900	57145	207755	4.74
Bottle gourd leaf	BARI Lau-3	35.85	25.85	25.00	28.90	324850	115000	209850	2.72
Snake gourd	BARI Chichinga-1	22.35	18.35	-	20.35	271725	91725	180000	2.96
Data	BARI Danta-1	36.75	30.75	-	33.75	287500	52790	234710	5.44
Bitter gourd	BARI Korola-2	19.46	20.46	-	19.96	291900	137500	213050	2.54
Potato	BARI Alu-25	28.30	26.30	26.30	26.97	303400	119434	183966	2.54
Mustard	BARI Sarisha-14	1.58	1.75	1.64	1.66	72825	32913	40278	2.28
Papaya	Red lady	-	-	35.00	35.00	525000	192750	332250	2.72
Brinjal	Local	-	-	28.00	28.00	560000	120000	440000	3.66

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020-Jan. 2021

11.30. Production program HYV of different crops at FSRD Site: Charpara, Sonatola, Bogura (BARI)

Yield, cost and return of different crops under production program are presented in Table 11.30.1. Production program with HYV of potato (BARI Alu-25 and BARI Alu-36), mustard (BARI Sarisha-14), sweet potato (BARI Misti Alu-8), wheat (BARI Gom-28, BARI Gom-30 and BARI Gom-33) and maize (BARI Hybrid Maize-9) were conducted at FSRD Site, Charpara, Sonatola, Bogura during 2019-20. The average yield of potato, mustard, sweet potato, wheat and maize were 26.65, 1.47, 24.52, 3.62, and 7.50 and gross margin were 150000, 44740, 143480, 33510 and Tk. 56760 ha⁻¹, respectively during 2019-21 (Table 11.30.1).

Farmer's opinion: Both potato and mustard varieties were higher yielder than the local cultivar and thus farmers were very happy to cultivate those crop varieties in between two rice crops. The variety of sweet potato (BARI Misti Alu-8) was higher yielder than local cultivar and orange fleshed with better taste. The wheat varieties were higher yielder as well as rust, blast resistant and heat tolerant. Yield of maize varieties was not up to the mark; moreover they had lodging tendency to storm. Fall army worm is a new threat for maize cultivation.

Table 11.30.1. Crop yield and economic return of different crops under production programs at FSRD site, Charpara, Sonatola, Bogura during 2019-21

Crops	Crop yield (tha ⁻¹)			Gross return (Tk.ha ⁻¹)	Cultivation cost (Tk.ha ⁻¹)	Gross margin (Tk.ha ⁻¹)
	Year-II	Year-III	Avg. yield			
Potato	25.85	27.45	26.65	266500	116500	150000
Mustard	1.4	1.54	1.47	73500	28760	44740
Sweet potato	25.44	23.6	24.52	196160	52680	143480
Wheat	3.74	3.5	3.62	72400	38890	33510
Maize	7.53	7.4	7.5	112500	55740	56760

* Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Dec.2021

11.31. Production program on HYV of different crops at FSRD Site: Nawvanger Char, Jamalpur (BINA)

Jute:

The average yield of Jute was 3.0 t ha⁻¹ with gross return, variable cost and gross margin were 147500 ha⁻¹, 105000 ha⁻¹ and Tk. 42000 ha⁻¹, respectively. The benefit cost ratio was 1.4 (Table 11.31.1).

Farmers' opinion: Farmers are very much impressed having the higher yield of jute.

Table 11.31.1. Performance of jute variety under production program at FSRD site, Nawvanger Char, Jamalpur during April to July 2020

Variety	Fiber yield (t ha ⁻¹)	Jute stick yield (t ha ⁻¹)	Gross return (Tk. ha ⁻¹)			Cost of production (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	BCR
			Jute fiber	Jute stick	Total			
JRO-524	3.0	1.0	142500	5000	147500	105000	42000	1.4

Price (Tk kg⁻¹): Jute-47.5, Jute stick-5

Rice:

The average yield of Binadhan-11 was 4.8 t ha⁻¹ with gross margin in Tk.86400 ha⁻¹.The gross return, total cost and gross margin were 96400 ha⁻¹, 55000 ha⁻¹ and Tk.41400 ha⁻¹ respectively. The benefit cost ratio was 1.75 (Table 11.31.2).

Farmers' opinion: Farmers are very much impressed having the higher yield of Binadhan-11 and a good amount of seed was stored by the farmers for growing in the next year.

Table 11.31.2. Performance of rice variety under production program at FSRD site, Nawvanger Char, Jamalpur during July- October 2020

Variety	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Gross return (Tk. ha ⁻¹)			Cost of production (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	BCR
			Grain	Straw	Total			
Binadhan-11	4.8	5.0	86400	10000	96400	55000	41400	1.75

Market price (Tk kg⁻¹): Amanrice-18, straw-2

Mustard:

The production program was conducted in the farmer's field of the FSRD site, Nawvanger char, Sadar, Jamalpur during rabi season of 2020-21 for increasing area and production of mustard. The variety viz. Binasharisha-4 and Binasharisha-9 were used in this production program. The number of cooperator farmers was eight. The unit plot size was 3 bigha with disperse farmers. The average yield of Binasharisha-4 and Binasharisha-9 was observed 1.42 and 1.46 t ha⁻¹ respectively along with gross margin in 30952 and Tk. 32572 ha⁻¹. The benefit cost ratio was found 2.12 and 2.18 for Binasharisha-4 and Binasharisha-9 (Table 11.31.3).

Farmers' opinion: Farmers are very much impressed having short duration and the higher yield of Binasarisha-9 and a good amount of seed has been stored by the farmers for growing in the next year.

Table 11.31.3. Performance of mustard variety under production program at FSRD site, Nawvanger Char, Sadar, Jamalpur during 2020-21

Variety	Seed yield (t ha ⁻¹)	Stover yield (t ha ⁻¹)	Gross return (Tk. ha ⁻¹)			Cost of production (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	BCR
			Seed	Stover	Total			
Binasarisha-4	1.42	1.60	56800	1600	58400	27448	30952	2.12
Binasarisha-9	1.46	1.62	58400	1620	60020	27448	32572	2.18

Market price (Tk kg⁻¹): Mustard-40, stover-1

Groundnut:

The production program was conducted in the farmer's field of the FSRD site, Nawvanger char, sadar, Jamalpur during Kharif-II season of 2020-21 for increasing area and production of groundnut. The variety viz. Binachinabadam-4 was used in this production program. The number of cooperators farmers were eight. The unit plot size was 1bigha with disperse farmers. The seeds were sown on 15 August 2020 maintaining line sowing. The yield, gross return, gross margin and BCR was observed 2.4 t ha⁻¹, 120000 ha⁻¹, Tk. 54000 ha⁻¹ and 1.81, respectively (Table 11.31.4).

Farmers' opinion: Farmers are very happy having the higher yield of groundnut.

Table 11.31.4. Performance of groundnut variety under production program at FSRD site, Nawvanger char, Sadar, Jamalpur during 2020-21

Variety	Seed yield (t ha ⁻¹)	Gross return (Tk. ha ⁻¹)	Cost of production (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	BCR
Binachinabadam-4	2.4	120000	66000	54000	1.81

Market price (Tk kg⁻¹): Groundnut-50

Banana:

The average yield of banana was 53 bunch per 5 decimal area with gross margin in Tk. 15900 in 2018-19 and 54 bunch per 5 decimal area with gross margin in Tk. 16200 in 2019-2020. The gross return, total cost and gross margin were found Tk. 15900, Tk. 4750 and Tk. 11150 per 5 decimal, respectively in the year 2018-19 and Tk. 16200, Tk. 3300 and Tk. 12900, respectively in the year 2019-20 (Table 11.31.5).

Farmers' opinion: Farmers are very much impressed having the higher yield of Sabri banana.

Table 11.31.5. Performance of banana under production program at FSRD site, Nawvanger Char, Jamalpur

Year	Variety	Fruit yield (bunch/5 dec.)	Gross return (Tk./5 dec.)	Cost of prod. (Tk./ 5 dec.)	Gross margin (Tk./ 5 dec.)	BCR
1 st year (2018-19)	Sabri	53	15900	4750	11150	3.3
2 nd year (2019-20)	Sabri	54	16200	3300	12900	4.9

Market price (Tk. bunch⁻¹): Banana-300



Picture 11.31.4: Under production program different crops (Jute, rice, mustard, groundnut, banana) at FSRD site, Nawvanger Char, Jamalpur

C. Livestock Component

For improvement of cattle health and to control diseases and keeping mortality rate in minimal, proper vaccination is a key program. Farmers would be economically benefitted through deworming of cattle because of its health improvement. Proper vaccination against four major diseases reduces the mortality rate of cattle. In the vaccinated group Anthrax Vaccine, FMD vaccine, BQ vaccine and HS vaccines were injected as per recommended schedule. Disease is the main problem faced by the farmers for poultry rearing. Only proper vaccination can reduce the mortality rate of poultry. To reduce mortality rate and investigating effectiveness of poultry vaccine at farmers level this program was conducted at the farmers households. In the vaccinated group BCRDV, RDV, Fowl pox and Fowl cholera, Duck plague vaccine were used as per recommended schedule. All the FSRD sites under Char land eco-system of the sub-project were undertaken different types of activities for improvement and increased income of concern farm family and the results of those activities are given below as site wise.

11.32. Improvement of cattle health through deworming at FSRD site: Char Kharicha, Mymensingh (BARI)

Average body weight gain, milk production and lactation period after deworming are presented in Table 11.32.1. It was observed that deworming is an easy process to adopt with minimum cost. Eight cattle (milch cows) were dewormed and eight were kept controlled (non dewormed) during the program in FSRD site. While the number of dewormed livestock was as 110.

After deworming, the milking rate per day and body weight of cattle gaining observed promisingly. It was found that, before deworming the frequency of disease incidence was higher whereas after dewormed the average body weight, disease incidence, lactation yield and the lactation period increased over the controlled cows. The gaining body weight of dewormed milch cow was observed as 40 g/day/cow and average lactation yield was increased up to 0.4 L/day over the controlled.

Table 11.32.1. Average body weight gain, milk production and lactation period after deworming at FSRD site, Mymensingh during 2018-2020

Treatment	Animal (no)		Avg. Body wt. gain/day/animal (g)		Avg. Lactation yield (liter/day)		Avg. Lactation period (day)	
	Year-I	Year-II	Year-I	Year-II	Year-I	Year-II	Year-I	Year-II
Controlled Cattle	05	08	90	90	1.65	1.6	215	215
Dewormed Cattle	05	08	135	130	2.05	2.0	222	222

* Year-I: 2018-19, Year-II: 2019-2020

11.33. Improvement of cattle health by deworming at FSRD Site: Baghabari, Sirajganj (BLRI)

A total of 1420 cattle were dewormed in the sub-project area during February 2018 - January 2021. Data were collected to compare dewormed cattle with controlled cattle. It was observed that body weight gained (127 and 125g), milk production (2.65 and 2.5 L/day) and lactation period (228 and 225 day) was increased by Dewormed + Vitamin ADE injection and only Dewormed cattle respectively, where as non-treated cattle showed lower performance (Table-11.33.1).

Table 11.33.1. Average body weight gain, milk production and lactation period after different treatment at FSRD site Baghabari, Sirajganj during 2018- 2021

Treatment	No. of animal	Avg. Body wt. gain/day/animal (g)	Avg. Lactation yield (L/day)	Avg. Lactation period (day)
Controlled Cattle	60	85	1.7	210
Dewormed Cattle	1160	125	2.5	225
Dewormed+ Vitamin ADE injection treated Cattle	200	127	2.65	228

11.34. Improvement of cattle health through deworming and dewormed + vitamin ADE injection at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

The program was conducted at the FSRD site, Padma-Char, Ishurdi, Pabna during 2018-20. The result showed that body weight was gained (442 g/day) and milk production (2.96 liter/day) increased by dewormed and vitamin ADE injected cattle. After 90 days body weight was gained (124 kg) which was 27.04% higher over initial weight due to dewormed + vitamin AED injection. Only dewormed and non-treated cattle showed lower performance (Table 11.34.1).

Table 11.34.1. Body weight gained and milk production after different treatment provided on cattle at FSRD Site Padma Char, Ishurdi, Pabna during 2018-2020.

Parameter	No. of farmers	Animal (no.)	Avg. initial body weight (kg)	Body weight after 90 days (kg)	Avg. body weight gained (g/day)	Milk yield/day (liter)	Body wt. increase over initial wt. (%)	Milk yield increase over non treated Cattle (%)
Non treated	6	23	109	113	82	1.19	4.50	
Treated (dewormed cattle)	48	98	103	121	313	2.83	18.25	137.82
Treated (Dewormed + Vitamin ADE Injected Cattle)	6	12	98	124	442	2.96	27.04	148.72

10.35. Cattle fattening through UMS and UMS + Vitamin ADE injection at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Body weight and market value increment by feeding UMS and UMS + Vitamin ADE injection are presented in Table 11.35.1. After deworming 12 cattle were selected for fattening program. Among the selected cattle, six were provided UMS and remaining six were provided UMS + Vitamin ADE injection. Average initial body weight of the selected cattle was 136 kg and 124 kg for the treatment UMS and UMS + vitamin ADE injection, respectively. After 90 days of UMS feeding average body weight was 187 kg which was 38% higher over initial body weight. Average initial value was Tk. 32,356 / cattle, which was increased to Tk. 54,100/cattle. After 90 days of UMS feeding the value increment per cattle was 67.20% higher over initial value. On the other hand, for the treatment of UMS + Vitamin ADE injection average body weight increase after 90 days was 184.29 kg, which was 49.18 % higher over initial body weight. Average initial value was Tk. 39,416, which was increase to Tk. 71,083. After 90 days of UMS + Vitamin ADE injection the value increment per cattle was 81.39% higher over initial value.

Table 11.35.1. Body weight and market value increment by feeding UMS and UMS + Vitamin ADE injection at FSRD Site, Padma Char, Ishurdi, Pabna during 2018-2020

Type of intervention	No. of cattle	Initial body wt. (kg)	Body wt. after 90 days (kg)	Body wt. increase over initial wt. (%)	Initial value (Tk.)	Present value (Tk.)	Value increment (%)
UMS	6	136	187	38	32,356	54,100	67.20
UMS and Vitamin ADE injection	6	124	184	49.18	39,416	71,083	81.39



Picture 11.35.1: Vitamin ADE injection at FSRD Site, Padma Char, Ishurdi, Pabna

Farmer's reaction:

1. The cooperator farmers were interested in adopting of this technology
2. Some of the marginal farmers opined that it required large initial investment
3. UMS supplementation of urea molasses straw showed better performance in respect of milk production and body weight over the control.

11.36. Vaccination of cattle at FSRD site: Char Kharicha, Mymensingh (BARI)

A total of 220 cattle were vaccinated at FSRD site, Mymensingh under this program and vaccinations were done against anthrax and FMD diseases of cattle. Frequency of disease incidence of livestock was listed out from the cooperative farmers. It was observed that, after vaccination the mortality rate by foot and mouth disease (FMD) was drastically reduced and it was 0% but before intervention of the program it was found 10-15% of mortality (Table 11.36.1). The cooperator farmers could easily be adopted the technology of vaccination as it is minimum cost. The farmers continued the vaccination program as per schedule. The cooperator farmers were very much interested about the vaccination program and admitted that it was a good way to reduce mortality rate. Vaccination of cattle, make improvement of health of livestock and handsome cash return to the target farmers. That's why the cooperator farmers were interested and adopted this technology as per routine wise after finishing the experimental period.

Table 11.36.1. Mortality rate (%) of cattle before vaccination and after vaccination against major diseases at FSRD Site, Char Kharicha, Mymensingh during 2018- 2020

Year of vaccination	Name of the vaccine	No. of cattle Vaccinated	Mortality (%)	
			Before vaccination	After vaccination
Feb 2018- Jan. 2019	Anthrax & FMD	110	10	0
Feb 2019- Jan.2020	Anthrax & FMD	110	15	0
Total		220	Range 10-15	0

11.37. Vaccination of livestock at FSRD site: Charpara, Sonatola, Bogura (BARI)

A total of 670 cattle were vaccinated against Anthrax and FMD, 200 goat and 120 sheep were vaccinated against PPR at the FSRD site, Bogura. Frequency and incidence of diseases of livestock was listed out from the cooperative farmers. It was observed that, after vaccination the mortality rate by foot and mouth disease (FMD) was drastically reduced and it was shown nil (0%) whereas before vaccination it ranged from 2-15% (Table 11.37.1). The cooperator farmers were very much interested about the vaccination program and

admitted that it was a good way to reduce mortality rate. Vaccinations of cattle make improvement of health of livestock and handsome cash return to the target farmers. That's why the cooperators farmers were interested and adopted this technology as per routine wise after finishing the experimental period.

Table 11.37.1. Mortality rate (%) of livestock before vaccination and after vaccination against major diseases at FSRD Site, Sonatola, Bogura during 2018 - 2021

Year of vaccination	Name of the vaccine	No. of livestock vaccinated			Mortality (%)	
		Cattle	Goat	Sheep	Before vaccination	After vaccination
Year I	Anthrax & FMD	400	-	-	15	0
Year II	Anthrax & FMD, PPR	50	50	40	3	0
Year III	Anthrax & FMD, PPR	220	150	80	2	0
Total		670	200	120	Ave.6.66	nil

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021

11.38. Deworming and vaccination programme on livestock at FSRD Site: Nawvanger Char, Jamalpur (BINA)

Deworming of Cattle: One hundred fifty cattle of cooperators farmers' were vaccinated. Data were collected to compare dewormed cattle with controlled cattle (Table 11.38.1). It was observed that dewormed cattle produce more milk (1.6 L/day) than controlled cattle (1.0 L/day). Average body weight 34% was increased in dewormed cattle than controlled.

Table 11.38.1. Average body weight gain, milk production and lactation period after deworming at FSRD site, Nawvanger Char, Jamalpur 2018-20

Treatment	No. of animal	Avg. Body wt. gain/day/animal (g)	Avg. Lactation yield (L/day)	Avg. Lactation period (day)
Controlled Cattle	1	245	1	210
Dewormed Cattle	150	328	1.6	280

A total of 150, 100 and 200 cattle were vaccinated in the sub-project area during the year 2018-19, 2019-20 and 2020-21, respectively. The cattle were vaccinated with Nitronex Vermic Catofus against FMD. Before vaccination mortality rate of cattle due to FMD was around 4.66 % but after vaccination it is around nil (Table 11.38.2).

Table 11.38.2. Mortality (%) of livestock before and after vaccination against major diseases at FSRD site Nawvanger Char, Jamalpur during 2018- 2021

Year of vaccination	Name of the Vaccine	Number of cattle Vaccinated	Mortality (%)	
			Before vaccination	After vaccination
2018-19	Nitronex Vermic Catofus	150	5	0
2019-20	Nitronex Vermic Catofus	100	4	0
2020-21	Nitronex Vermic Catofus	200	5	0
Total		400	Avg. 4.66	Nil

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021

11.39. Vaccination on cattle to reduce mortality rate at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Number of cattle, name of the vaccines and mortality percentage are presented in Table 11.39.1. Vaccination program of cattle was conducted at FSRD site, Padma Char Ishurdi, Pabna during February 2018 to January 2021. The numbers of different types of vaccinated cattle were 207, 265, 138 and 143 against major disease like Anthrax, Foot and Mouth Disease, HS and Black Quarter, respectively during 2018-2021. Mortality percentages of cattle against different diseases were recorded among the cooperative farmers. It was found that before vaccination mortality (%) of cattle due to different diseases was higher (7-18%). After vaccination of cattle, all of the diseases reduced drastically and mortality rate was recorded about 0-3% (Table 11.39.1).

Table 11.39.1. Mortality (%) of cattle before and after vaccination against different major diseases at FSRD Site, Padma Char, Ishurdi, Pabna, during 2018-2021

Date of vaccination	Name of the vaccine	Number of cattle vaccinated	Mortality (%)	
			Before vaccination	After vaccination
2018- 2021	Anthrax	207	7	0
	FMD	265	15	3
	HS	138	18	1
	BQ	143	9	0
	Total	753	Range 7-18	Range 0-3

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021



Picture 11.39.1. Vaccination programme of cattle at FSRD site Padma Char, Ishurdi, Pabna

11.40: Vaccination programme on livestock to reduce mortality at FSRD Site: Baghabari, Sirajganj (BLRI)

A total of 235, 418 and 490 livestock were vaccinated in the sub-project area during the year 2018-19, 2019-20 and 2020-21, respectively. The livestock were also vaccinated against major disease like Anthrax, FMD and PPR to control diseases. Significantly reduced mortality was observed in the sites due to routine and mass vaccination of cattle, goat and sheep (Table 11.40.1). It was found that before vaccination mortality (%) of livestock due to different diseases was higher (10-15%). After vaccination of livestock, all of the diseases reduced drastically and mortality rate was recorded about 1-2%.

Table 11.40.1. Mortality (%) of livestock before and after vaccination against major diseases at FSRD site Baghabari, Sirajganj during 2018- 2021

Year of vaccination	Name of the vaccine	No. of livestock vaccinated				Mortality (%)	
		Cattle	Goat	Sheep	Total	Before vaccination	After vaccination
Year I	Anthrax, FMD, PPR	145	60	30	235	12	2
Year II	Anthrax, FMD, PPR	280	78	60	418	15	1
Year III	Anthrax, FMD, PPR	300	100	90	490	10	1
	Total	725	238	180	1143	Range 10-15	Range 1-2

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021



Picture 11.40.1. Vaccination programme of cattle at FSRD site. Baghabari, Sirajganj

11.41. Artificial insemination on cattle at FSRD Site: Char Kharicha, Mymensingh

One farmer was suggested to artificial insemination and supplied brahmi AI to two of the cow and it was waiting for calf birth. The cattle were inseminated on June 20th, 2020 and the feed for caring the cattle were also supplied by the supervision of FSRD Site team. During the last six months the body weight increased as 60 kg (Table 11.41.1).

Table 11.41.1. Performance of artificial insemination after attaining 6 months of growing at FSRD site, Char kharicha, Mymensingh during February – December, 2020

Farmers number	Cattle (No.)	Initial body wt. (kg)	Body wt. after 6 months (kg)	Body wt. increased (kg)
1	2	115	175	60

11.42 Beef fattening at FSRD Site: Charpara, Sonatola, Bogura (BARI)

Beef fattening program was carried out at FSRD Site, Sonatola, Bogura during February 2020 to January. 2021. Details about beef fattening are presented in Table 11.42.1. A total of 8 cattle from six farmers household were selected for fattening. The initial body weight of the selected animal was ranged from 38 kg to 92 kg with an average weight of 56.67 kg. The cattle were provided with supplied feed as prescribed by Department of Livestock Services (DLS) Office, Bogura. Besides this, farmers also feed their cattle with their farm produced crop stubble, grass. After 160 days of rearing, cattle weight increased remarkably ranged from 55 kg to 140 kg with an average increased body weight 85.67 kg. The average increment of body weight was 50.17%. Initially the mean value of each cattle was Tk. 51833 which was increased to Tk. 67166 with an average increased value of 29.58%.

Table 11.42.1. Performance of beef fattening at household level at FSRD site, Charpara, Sonatola, Bogura during 2018 –2021

Farmer	No. of cattle	Initial body wt. (kg)	Body wt. after 160 days (kg)	Wt. increased over Initial (%)	Initial value (Tk)	Present value (Tk)	Increment (%)
Farmers 1	2	92	135	47	78000	103000	32
Farmers 2	1	45	60	33	40000	49000	23
Farmers 3	2	85	140	65	75000	102000	36
Farmers 4	1	40	55	38	37000	48000	30
Farmers 5	1	38	60	58	41000	50000	22
Farmers 6	1	40	64	60	40000	51000	23
Average		56.67	85.67	50.17	51833	67166	29.58

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021

11.43. Beef fattening progmmme as a source of income generation at FSRD Site: Nawvanger Char, Jamalpur (BINA)

To increase the income of the farmers, 12 cattle from 12 farmers were selected for beef fattening program. Performance of Beef fattening program presented in the Table 11.43.1. After completing beef fattening program it was observed that on an average body weight of the cattle was increased 27% at the first round and 51% at the second round in the year 2018-19 and 52% at the first round and 56% at the second round in the year 2019-20 and 57% at the first round and 46% at the second round in the year 2020-21. Initially the farmers bought cattle by at the first round and 56% at the second round in the year in the year 2018-19 and Tk. 33000 & 40000 in the year 2019-20 and Tk. 42000 & 32000 in the year 2020-21. After 3 months rearing of the cattle due to increase body weight each farmer on an average sold it by Tk. 68,000 & 97,000 at first and second round respectively in 2018-19 and Tk. 65,000 & 70,000 at first and second round respectively in 2019-20 and 78000 & 62,000 in 2020-21. Average profit per farmer was calculated Tk. 71800 at the first year, 42800 at the second year and 46800 at the third year after deducting all cost including feed and medicine. Farmers are very happy due to getting higher profit from beef fattening.

Table 11.43.1. Body weight and market value of cattle under beef fattening program at FSRD Site, Nawvanger Char, Jamalpur during 2018-2021

Year	Farmer	No of cattle Farmer ⁻¹	Initial Body wt. (kg animal ⁻¹)	Body wt. after 90 days (kg animal ⁻¹)	Body wt. increase over initial (%)	Initial value (Tk. animal ⁻¹)	Present value (Tk. animal ⁻¹)	Market value increment (%)
2018-19	12	1	110	140	27	30,000	68,000	127
	12	1	113	171	51	44,000	97,000	121
2019-20	12	1	98	149	52	33,000	65,000	97
	12	1	114	178	56	40,000	70,000	75
2020-21	12	1	118	185	57	42,000	78000	86
	12	1	96	140	46	32000	62000	94

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021

11.44. Goat rearing in the farmers' household for increase income of farmers at FSRD site: Char Kharicha, Mymensingh (BARI)

One of the important sub sectors of livestock component is goat rearing in household to generation of income. For this purpose, four female goats were distributed among the four farmers (each farmer got one goat) on 30 November 2020. Performance of goat rearing at household level is presented in Table 11.44.1. The survival rate of distributed goat was 100%. After one month of rearing body weight gained/goat about 0.7 - 0.9 kg.

Table 11.44.1. Performance of goat rearing at household level at FSRD site, Char Kharicha, Mymensingh during Nov. 2020 – Jan. 2021

Description of Item	Observation
Number of farmers	4
No of goat supplied per farmers	1
Date of supplied	30 th Nov, 2020
Age of goat during distribution (month)	11-12
Initial body wt./goat (kg)	10
Procurement price/goat (Tk.)	3000
No of goat survive (%)	100
Weight gained/goat (kg) after one month	0.7 – 0.9

11.45. Goat rearing in the farmers' household for increase income of farmers at FSRD Site: Baghabari, Sirajganj (BLRI)

Performances of distributed goat in farmers' household are presented in Table 11.45.1. Four to six months aged goat were distributed among the 12 farmers during 2018-2019. Average initial body weight of distributed goats was 5.0- 6.0 kg. After six month of rearing average body weight gained during 1st, 2nd and 3rd year 10 kg, 14 kg and 15 kg, respectively. From 12 house hold a total of 239 kids were borne from 2018 - 2021. Average Gross margin Tk. 11667, Tk. 27700 and Tk. 24666 farm⁻¹ were found in the 1st, 2nd and 3rd year, respectively. Some goat has third progeny and some have second. Farmers were very enthusiastic in adopting this program and also like to continue this program

Table 11.45.1. Performances of distributed goat in farmers' household at FSRD Site Baghabari, Sirajganj during 2018- 2021

Description of Item	Year I	Year II	Year III
Number of farmers	12	-	-
No. of goat distributed per farmers	02	-	-
Total No. of goat distributed	24	-	-
Date of distribution	02 Dec. 2018	-	-
Age of goat during distribution (month)	6	-	-
Initial body wt. / goat (kg)	5.0-6.0	-	-
Procurement price/ goat (Tk.)	5000-6000	-	-

Description of Item	Year I	Year II	Year III
No. of goat + Kid	51	112	148
No. of goat +Kid per farmer	4	9	12
Weight gained/ goat (Kg.) after 6 months	10	14	15
Total number of kids born (Feb.2018-Jan. 2021)	27	88	124
Gross return (Tk.) per farmer	21250	46666	61666
Total variable cost (Tk.) per farmer	9583	20416	37000
Gross margin (Tk.) per farmer	11667	26250	24666

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021



Picture 11.45.1. Goat rearing at farmers household at FSRD Site Baghabari, Sirajganj

11.46. Sheep rearing at farmer's household at FSRD site: Charpara, Sonatola, Bogura (BARI)

Initially eight farmers were provided with sheep till June 2020. Two sheep became dead due to feeding on insecticide sprayed fodder. After the month of June 2020, again six sheep were distributed among the rest six farmers including two who had lost their sheep. The animals were vaccinated and provided with feed. Previously given four adult ewes have given birth to new offspring. One sheep gave 3 kids and the other three gave 6 (each gave 2) offspring. Average Gross return, rearing cost and gross margin of individual farmer was Tk. 6333, 2000 and 4333 per year, respectively (Table 11.46.1). Some sheep's had third progeny and some had second. Farmers were very happy in adopting this program and also like to continue this program.

Table 11.46.1. Performance of sheep rearing in household level at FSRD Site, Charpara, Sonatola, Bogura during 2018 –2021

Description of Item	Year I	Year II	Year III
Number of farmers	1	7	6
No of sheep supplied per farmers	1	1	1
Date of supplied	25 July 2018	25 Sep 2019	16 July, 2020
Age of Sheep during distribution (month)	6-7	8-9	7-8
Initial body wt./Sheep (kg)	5-7	4.5-6	5-7
Procurement price/Sheep (Tk.)	3000-3500	3500-4000	3800-4200
No of goat survival (%)	100	80	100
Weight gained/Sheep (kg) after 6 months	9.6	8-11	7-8
Total number of lambs born (Feb.2018-Jan. 2021) per farmer	-	4	5 (2 dead)
Gross value (Tk.)/ farmer		6333	
Rearing cost (Tk.)/farmer		2000	
Gross margin (Tk.)/farmer		4333	

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020- Jan. 2021

11.47. Sheep rearing in the farmers' household for increase income of farmers at FSRD Site: Baghabari, Sirajganj (BLRI)

Performances of distributed sheep in farmers' household are presented in the Table 11.47.1. Six months aged sheep were distributed among the 12 farmers during 2018-2019. Average initial body weights of distributed sheep were 5.0- 6.0 kg. After six month of rearing average body weight gained during 1st, 2nd

and 3rd year were 8 kg, 15 kg and 15 kg, respectively. From 12 household a total of 248 lambs were found from February 2018 - January 2021. Average Gross margin were found Tk. 16667, Tk. 27250 and Tk. 32917 farm family⁻¹ in the 1st, 2nd and 3rd year, respectively. Some sheep had third progeny and some had second. Farmers were very enthusiastic in adopting this program and also like to continue this program.

Table 11.47.1. Performances of distributed sheep in farmers' household at FSRD Site Baghabari, Sirajganj during 2018- 2021

Description of Item	Year I	Year II	Year III
Number of farmers	12	-	-
No of sheep supplied per farmers	2F, 1M	-	-
Total No. of sheep distributed	36	-	-
Date of supplied	08 June, 2019	-	-
Age of sheep during distribution (month)	6	-	-
Initial body wt./ sheep (kg.)	5.0-6.0	-	-
Procurement price/ sheep (Tk.)	4000-5000		
No of sheep + lamb	78	118	160
Total number of lamb born (Feb.2018-Jan.2021)	42	82	124
Weight gained/ sheep (Kg) after 6 months	8.0	15.0	15.0
No. of sheep + lamb per farmer	6	9	13
Gross return (Tk.) per farmer	26000	39333	53333
Total variable cost (Tk.) per farmer	9333	12083	20416
Gross margin (Tk.) per farmer	16667	27250	32917

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Jan.2021



Picture 11.47.1. Sheep rearing at FSRD Site Baghabari, Sirajganj

11.48. Vaccination of poultry birds at FSRD site: Char Kharicha, Mymensingh (BARI)

A total of 1320 poultry birds were vaccinated against major diseases during 2018-2021. Four types of vaccines as BCRDV, RDV, Fowl Pox, and Fowl Cholera were used on poultry birds. (Table 11.48.1). It revealed that, mortality rate can be minimized significantly through vaccination and it came down below 5% most of the cases. By the application of RDV and Fowl Cholera vaccine reduced the mortality rate 86%. Moreover, BCRDV and Fowl pox vaccine could reduce the mortality rate at about 88%. After vaccination of poultry, all of the diseases frequency reduced drastically and mortality rate ranged from 2-5% (Table 11.48.1) and this type of program was mostly impacted on concern farmers and so far they would follow to vaccinate the poultry in routinely.

Table 11.48.1. Mortality rate (%) of chicken before vaccination and after vaccination against major diseases at FSRD Site, Char Kharicha, Mymensingh during 2018- 2021

Year of vaccination	Name of the vaccine	No. of chicken Vaccinated	Mortality (%)	
			Before vaccination	After vaccination
Year I	BCRDV	200	21	3
	RDV	190	25	4
	Fowl Pox	180	25	5
	Fowl Cholera	170	22	3

Year of vaccination	Name of the vaccine	No. of chicken Vaccinated	Mortality (%)	
			Before intervention	After intervention
Year II	BCRDV	150	18	2
	RDV	140	20	3
	Fowl Pox	130	25	4
	Fowl Cholera	160	21	3
Year III	Not done due to COVID-19	-	-	-
Total		1320	Range 18-25	Range 2-4

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020-Jan. 2021

11.49. Vaccination of poultry birds at FSRD site: Charpara, Sonatola, Bogura (BARI)

Five types of vaccines as BCRDV, RDV, Fowl Pox, Fowl Cholera & Duck plague were vaccinated in the program (Table 11.49.1). It revealed that, mortality rate can be minimized significantly through vaccination and it went down below 6% most of the cases which can be considered as negligible comparing to the condition before the vaccination program. By the application of vaccine, average mortality went down from 22.40% at pre intervention to 5.47% at post intervention condition. After vaccination of poultry birds, all of the diseases frequency reduced drastically, and mortality rate is about 5.47 % (Table 11.49.1). This type of program was mostly impacted on concern farmers and so far, they would follow to vaccinate the poultry in routinely.

Table 11.49.1. Mortality rate (%) of poultry birds before vaccination and after vaccination against major diseases at FSRD site, Bogura during 2018 – 2021

Year of vaccination	Name of the vaccine	No. of poultry birds Vaccinated		Percentage of mortality (%)	
		Chicken	Duck	Before vaccination	After vaccination
Year I	BCRDV	460	-	28	4
	RDV	329	-	21	6
	Fowl Pox	270	-	19	5
	Fowl Cholera	180	-	17	6
	Duck plague	-	200	30	5
Year III	BCRDV	150	-	28	3
	RDV	120	-	21	5
	Fowl Pox	120	-	19	6
	Fowl Cholera	130	-	17	4
	Duck plague	-	105	30	5
Year III	BCRDV	140	-	17	7
	RDV	250	-	16	4
	Fowl Pox	130	-	25	6
	Fowl Cholera	150	-	13	6
	Duck plague	-	200	35	10
Total		2429	505	Avg. 22.40	Avg. 5.47

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020-Jan. 2021

11.50. Vaccination programme on poultry birds at FSRD Site: Nawvanger Char, Jamalpur (BINA)

A total of 900 chicken and 384 pigeon were vaccinated with BCRDV, RDV, Fowl Pox, Fowl Cholera during Feb. 2018- January. 2021. It was found that before vaccination, frequency of different disease were higher. After vaccination of chicken and pigeon frequency and mortality rate reduced significantly. By the application of vaccine, average mortality went down from 32% at pre intervention to 9.69 % at post intervention condition (Table 11.50.1). After vaccination of chicken and pigeon, all of the frequency of disease occurrence reduced drastically. Farmers were interested to continue vaccination of chicken and pigeon due to reduction of mortality.

Table 11.50.1. Mortality (%) of poultry birds before and after vaccination against major diseases at FSRD Site, Nownanger Char, Jamalpur during 2018 - 2021.

Year of vaccination	Name of the Vaccine	No. of poultry birds Vaccinated		Percentage of Mortality (%)	
		Chicken	Pigeon	Before vaccination	After vaccination
Year I	BCRDV, RDV Fowl Pox, and Fowl Cholera	300	72	32	12
Year II	BCRDV, RDV Fowl Pox, and Fowl Cholera	250	144	32	10
Year III	BCRDV, RDV Fowl Pox, and Fowl Cholera	350	168	32	07
Total		900	384	Ave. 32	Ave. 9.69

* Year I= Feb. 2018-Jan. 2019, Year II= Feb. 2019-Jan. 2020 & Year III= Feb. 2020-Jan. 2021

11.51. Vaccination on poultry birds at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Vaccination program on poultry birds was conducted at FSRD site, Padma Char Ishurdi, Pabna during February 2018 to January 2021. Number of poultry birds vaccinated, name of the vaccines applied poultry birds and mortality percentage are presented in the Table 11.51.1. The poultry birds were vaccinated with BCRDV, RDV, Fowl Pox and Fowl Cholera at regular interval during 2018 - 2021. A total number of 1410 poultry birds were vaccinated (Table 11.51.1). Mortality percentage of poultry birds against different diseases were recorded among the cooperative farmers. It was found that before vaccination mortality rate of poultry birds due to different diseases ranged 17-39% and average 27.7%. After vaccination, all of the diseases reduced drastically and mortality rate was recorded about 01-11% and average (5.5%).

Table 11.51.1 Mortality (%) of poultry birds before and after vaccination against major diseases at FSRD Site, Padma-Char, Ishurdi, Pabna during 2018-2021

Duration	Name of vaccine	No. of birds	Mortality rate (%)	
			Before vaccination	After vaccination
2018-2021	BCRDV, RDV, Fowl pox and Fowl cholera	213	39	4
	BCRDV, RDV, Fowl pox and Fowl cholera	392	18	11
	BCRDV, RDV, Fowl pox and Fowl cholera	386	17	1
	BCRDV, RDV, Fowl pox and Fowl cholera	419	37	6
Total		1410	Range 17-39 (Avg. 27.7)	Range 1-11 (Avg. 5.5)

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Jan.2021



Picture 11.51.1. Vaccination programme on poultry birds at FSRD site: Padma Char, Ishurdi, Pabna

11.52. Vaccination programme on poultry birds at FSRD Site: Baghabari, Sirajganj

A total number of 1809 poultry birds were vaccinated in the sub-project area during 2018-2021 of which 980, 259, 240 and 330 were chicken, duck, pigeon and turkey, respectively. The birds were vaccinated against major diseases like Ranikhet and Duck plague. It was observed that average mortality rate was

highly reduced by 2.33% by using vaccination against major diseases in sub-project area (Table 11.52.1). It was found that before vaccination mortality (%) of poultry birds due to different diseases was higher (8-25%). After vaccination of poultry birds, occurrence of all of the diseases reduced drastically and mortality rate was recorded about 1-4% (Table 11.52.1).

Table 11.52.1. Mortality (%) of poultry birds before and after vaccination against major diseases at FSRD Site Baghabari, Sirajganj during 2018- 2021

Year	Name of the vaccine	No. of poultry birds Vaccinated					Mortality rate (%)	
		Chicken	Duck	Pigeon	Turkey	Total	Before vaccination	After vaccination
Year I	BCRDV,RDV and Duck plague	250	56	30	72	408	25	4
Year II	BCRDV,RDV and Duck plague	300	118	130	143	691	15	2
Year III	BCRDV,RDV and Duck plague	430	85	80	115	710	8	1
Total		980	259	240	330	1809	Range 8-25	Range 1-4

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Jan.2021



Picture 11.52.1. Vaccination on Poultry birds at FSRD Site, Baghabari, Sirajganj

11.53. Turkey rearing in the farmers' household at FSRD site: Char Kharicha, Mymensingh (BARI)

Average performances of turkey bird at farmers' level up to 5 months of rearing have been shown in Table 11.53.1. Twenty days old total 25 turkey birds were distributed among the four farmers of FSRD Site, Char Kharicha, Mymensingh during October 2018. Among the distributed birds, 52% were died due to lack of selection of chicks, health care, brooding, feeding, housing etc. and inadequate technical information and support. But the performance of alive birds was very good. Initial body weight chick⁻¹ of turkey during distribution was 250-300 g. The body weight gained (4.0-5.0 kg bird⁻¹) and average (4.50 kg bird⁻¹) after five months of rearing following semi scavenging system. Farmers were interested in rearing turkey as it collected 50% feed staff from green vegetables and field grasses that reduced total cost of production and made it profitable business.

Table 11.53.1. Performance of Turkey rearing after 5 months of distribution at FSRD Site, Char Kharicha, Mymensingh during 2018-2019

Name of Farmer	Bird supplied (no)	Chick survives (no)	Initial body wt. (g/bird)	Body wt. after 5 months (kg/bird)
1. Md. Reju Miah	9	5	250-300	4.50
2. Md. Sayan Uddin	7	3	250-300	4.00
3. Md. Mirash Uddin	5	3	250-300	4.50
4. Md. Abadul Miah	4	1	250-300	5.00
Total	25	12	-	4.50

11.54. Performance of Turkey in farmer's level for egg and meat purpose at FSRD Site: Baghabari, Sirajganj (BLRI)

Number of farmers, number of chicks, initial body weight, body weight gained after 16 weeks, total egg production, consumption, distribution, sale and cost return analysis are presented in Table 11.54.1. Among the twelve cooperator farmers 216 chicks were distributed and 164 chicks were survived. The average initial body weight of a chick was 56 g. After 16 weeks of rearing average body weight was gained 3.0 kg bird⁻¹. Average number of egg production was 605 per farm⁻¹ year⁻¹. Due to higher production of egg consumption rate was increased among the family members. Farmers sold and hatched egg on an average 40% and 44%, respectively. About 15% eggs were damaged during hatching. By hatching eggs baby chicks were sold in the market. Farmers earned money from selling of eggs, chicks and adult birds. Maximum income was obtained from selling adult birds followed by turkey chicks and eggs. Gross margin from turkey rearing were obtained Tk. 28200, Tk. 57020 and Tk.3150 farm⁻¹ during 1st, 2nd and 3rd, year, respectively. Farmers were highly interested to include this new intervention in their existing farming system because turkey rearing under semi scavenging system was very easy and profitable.

Table 11.54.1 Performances of Turkey in farmers household at FSRD Site Baghabari, Sirajganj during 2018- 2021

Description of Item	Year-I	Year-II	Year-III	Total	Average
Number of farmers	12	12	12	36	12
No of birds supplied	72	72	72	216	72
Initial body wt./bird (kg)	55	56	56	167	56
Procurement price/bird (Tk.)	80	80	80	240	80
No of chick survive	52	66	46	164	55
Egg Production (Number)					
Consumption	120	116	210	446	149
Sale	170	721	300	1191	397
Distribution	10	34	15	59	20
Total number of Egg	300	989	525	1814	605
Performance of Bird					
Weight gained/bird (Kg)	3.2	3.2	3.01	9.41	3
Consumption	10	20	19	49	16
Sale	40	42	26	108	36
Distribution	2	2	0	4	1
Total number	52	66	46	164	55
Total income from bird (Tk.)	31200	39600	27600	98400	32800
Total variable cost (Tk.)	15500	18500	17500	51500	17167
Total return/farmer in Tk. (Market value of Egg + Meat)	43200	75520	48600	167320	55773
Gross margin (Tk)	28200	57020	31500	116720	38907

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Jan.2021

11.55. Duck rearing in the farmer's household at FSRD Site: Char Kharicha, Mymensingh (BARI)

During February 2019 - January 2020, four Khaki Campbell ducks were supplied to each of three farmers and the survival rate was promising and it was observed that around 79%. Some ducks were died might be due to duck plague. After 6 months of rearing the average body weight of each duck was achieved around 1.6 kg. The ducks were able to lay eggs after attaining at the age of 6 months and it continued whole the year. After intervention of improved feeding, technological support and vaccination the laid eggs per duck was increased and it was on an average 112 eggs and income Tk. 1220/ month/farm (Table 11.55.1). Again, during February 2020 – January 2021, four Khaki Campbell ducks were supplied to each of 10 farmers and their survival rate was promising and it was almost 100%. After 6 months of rearing, it was observed that average body weight gained around 1.57 kg and some of the ducks were being laid to eggs and the average egg laid per month/farm was observed as 47. After intervention of the program the awareness of consumption of egg in farm family was increased and, on an average, it was observed 49% which ensure

the nutritional balance that means the improvement of livelihood. During the last two months on an average per month Tk. 474 to be earned by a family that they expense for their improvement of livelihood. On the other hand, some farm family expressed their satisfaction on fulfillment the aesthetic need and as well as bear the expenditure of their child education.

Table 11.55.1. Performance of Duck rearing after 6 months of distribution at FSRD Site, Char Kharicha, Mymensingh during 2019-2021

Name of farmers	Ducks supplied (no)	Duck survived (no.)	Body wt. after 6 months (kg)	Egg laid month ⁻¹ (no.)	Egg consumption month ⁻¹ (no.)		Monthly income (Tk.)
					Before	After	
Year-I: February 2019 - January 2020							
Md. Abdul Momin	8	7	1.7	120	20	30	1200
Md. Abdul Kadir	8	6	1.6	110	15	28	1100
Md. AbulHashem	8	6	1.5	106	13	25	1060
Average	8	6.3	1.6	112	16	28	1220
Year-II: February 2020 – January 2021							
Md. Abdul Momin	4	4	1.8	50	20	40	500
Md. Abdul Kadir	4	4	1.6	45	30	45	450
Md. Azizul islam	4	4	1.5	65	40	60	650
Md. Sekandar Ali	4	4	1.6	50	20	30	500
Md. Emdadul Haque	4	4	1.7	60	20	30	600
Md. Fazlur Rahman	4	4	1.6	70	20	25	700
Md. Mostafa Mia	5	4	1.5	29	40	60	290
Md. Kamrul Islam	4	4	1.4	35	25	35	350
Md. Sain Uddin	4	4	1.6	30	15	20	300
Md. Mirash Uddin	4	4	1.4	40	15	20	400
Average	4	4	1.57	47	24	36	474

Market price of egg: 40 Tk per 4 pieces

11.56. Duck rearing in farmers household at FSRD site: Charpara, Sonatola Bogura (BARI)

Eleven farmers were provided Khaki Campbell which was collected from local duck farm. Averagely 3 ducks were died in each family might be due to duck plague a unique disease for duck. After 5 months of rearing the average body weight of each duck was achieved around 1.12 kg in 120 days and 2.2 kg in 180 days (Table 11.56.2). The survival rate was 80%. It was observed that around 88% ducks were able to lay eggs after attaining at the age of 6 months and it continued whole the year. After intervention of improved feeding, technological support and vaccination the laid eggs per duck was increased and it was on an average 150 eggs per month (Table 11.56.1). It was observed that after rearing of ducks the consumption rate of eggs per farm family has been increased from 27 to 98 with an average increment of 262.93%, which ensure the nutritional balance of the concerned farmers. The monthly income obtained from egg per household was calculated as Tk. 480 (Table 11.56.3). Initially 250g weighed ducklings were supplied to the farmers that gained 2.2 kg weight each after six months rearing with 780% increased body weight along with 337.5% higher market value (Table 11.56.3). About 62% eggs produced in the farm family was consumed by themselves. 6% eggs were distributed to the relatives and finally 32% was sold in the market to get cash income for meeting other household needs. They obtaining extra cash income from the duck rearing possesses the livelihood improvement of the cooperator farm family.

Table 11.56.1. Performance of Khaki Campbell rearing at FSRD Site, Sonatola, Bogura during 2019-2020

Name of farmers	Ducks supplied (no)	Duck survived (no)	Egg laid month ⁻¹ (no)	Egg consumption month ⁻¹ (no)	
				Before	After
1. Md. Miju	15	12	159	25	92
2. Md. Abdul Kalam	15	13	156	23	98
3. Md. Anarul Islam	15	14	210	30	103
4. Md. Saidur Rahman	15	12	173	27	95
5. Md. Sukur Ali	15	10	113	23	96

Name of farmers	Ducks supplied (no)	Duck survived (no)	Egg laid month ⁻¹ (no)	Egg consumption month ⁻¹ (no)	
				Before	After
6. Md. Helal	15	13	156	29	104
7. Helal Mia	15	12	126	27	96
8. Md. Alaul	15	11	144	26	95
9. Md. Ainul Islam	15	10	98	31	102
10. Md. Jenarul Islam	15	14	148	23	90
11. Md. Bitul Sarkar	15	13	168	33	107
Average	15	12 (Avg. 80%)	150	27	98

Table 11.56.2. Individual body weight gain by Khaki Campbell rearing at FSRD Site, Bogura during 2019- 2020

Breed	Initial body wt. at 60 days old (g)	120 days old (kg)	180 days old (kg)	Body wt. increase over Initial (%)	Market value Increment (%)
Khaki Campbell	250	1.12	2.2	780	337.5

Initial price: 80 Tk./duckling, Present value: 350 Tk./duck,

Table 11.56.3. Utilization pattern of eggs hatched by Khaki Campbell at FSRD site Bogura during 2019-2020

No of egg produced	Consumption (%)	Distribution (%)	Sale (%)	Income from sale (Tk.)
150	62%	6%	32%	480

Market price of egg: 40 Tk. per 4 pieces

11.57. Duck rearing in the farmer's household at FSRD Site: Baghabari, Sirajganj (BLRI)

The result of Beijing breed rearing are presented in Table 11.57.1. Fifty days old duckling were distributed among the two farmers (each farmer 25 no.). Average initial body weight of duckling during distribution was 55-60 g. Body weight gained after six month of rearing 2.0 - 2.1 kg. It was found that the average monthly number of eggs laid was 127 per farm. After rearing of duck average egg consumption reached 32 where as it was 14 numbers before intervention per month /farm family. Egg consumption increased 128% compared to before intervention with improved breed. The average monthly income from eggs was Tk. 1200/ farm family.

Table 11.57.1 Performance of improved breed of duck (Beijing) after 6 months of rearing at FSRD Site Baghabari, Sirajganj during 2018- 2021

Name of Farmer	No. of ducks survived at present	Initial body weight (g)	Body wt. after 6 months (kg)	Egg production/ monthly/farm	Egg Consumption/ month/farm		Monthly income (Tk.)/farm
					Before rearing	After rearing	
Mst Julia khatun	22	55	2.0	126	16	36	1250
MstArifakhatun	24	60	2.1	128	12	28	1180
Average	23	57.5	2.05	127	14	32	1200



Picture 11.57.1. Duck Rearing at FSRD Site Baghabari, Sirajganj

11.58. Sonali chicken rearing at farmer's level for egg and meat purpose at FSRD Site: Char Kharicha, Mymensingh (BARI)

Sonali breed has much productive and adaptive capacity in village conditions. Keeping these views, the study was undertaken during the November 2020 (Table 11.58.1). The survivable rate of supplied birds was 100%. Average initial weight was 0.75 kg bird⁻¹ during distribution among the cooperator farmers. Production of eggs and meat is still in pipeline but body weight gained 1.20 kg bird⁻¹ after three month of rearing (Table 11.58.1).

Table 11.58.1 Performance of Sonali chicken at farmer's household level up to 3 months of rearing at FSRD Site, Char Kharicha, Mymensingh during Nov. 2020 – Jan. 2021

Description of Item	Observation
Number of farmers	11
No of birds supplied (per farmer)	6
Date of supplied period	10 th Nov. 2020
Initial body wt./bird (kg)	0.75
Procurement price/bird (Tk.)	127
No of chicken survive (%)	100
Date of delivery egg	not yet
Egg Production (Number)	-
Consumption	-
Sale	-
Distribution	-
Total number of Egg	-
Performance of Bird	
Weight gained/bird (Kg) after 3 months	1.2
Consumption	-
Sale	-
Distribution	-
Total number	-
Total income from bird (Tk.)	-
Total variable cost (Tk.)	-
Total return/farmer in Tk. (Market value of Egg + Meat)	-
Gross margin (Tk.)	-

11.59. Rearing of Sonali chicken for meat purpose and income generation at FSRD Site: Nawvanger Char, Jamalpur (BINA)

For improved chicken rearing as per plan 15 chickens at 1st & 2nd batch and 20 chickens at 3rd batch were given to each farmer. After 75 days rearing, it was observed that body weight of the chicken was increased in the range from 1280 to 1430 gm chicken⁻¹ whereas initial body weight was in the range of 200-250 gm chicken⁻¹ (Table 11.59.1). Farmers started sonali chicken rearing from February 2019. They reared the chicken up to 75 days. It was observed that at the year February 2019- January 2020 and February 2020–January 2021 each farmer had invested Tk. 4,760 and Tk. 5340, respectively for feed supplement cost along with one month old birds buy, medicine and vaccination etc. By selling the chickens reared 3 times during the year farmers earned Tk. 6,727 and Tk. 7,407 during February 2019- January 2020 and February 2020 – January 2021, respectively.

Table 11.59.1. Performances of Sonali breed at farmers' level in 75 days of rearing at FSRD Site, Nawvanger Char, Jamalpur during 2019-2021

Description of Item	February 2019 to January 2020			February 2020 to January 2021		
	I	II	III	I	II	III
Number of Batch Year ⁻¹	I	II	III	I	II	III
No of birds supplied per farmers (no.)	15	15	20	20	20	20
Date of supply	9/1/19	1/5/19	20/11/19	10/1/20	15/5/20	25/11/20

Description of Item	February 2019 to January 2020			February 2020 to January 2021		
	Initial body wt. bird ⁻¹ (kg)	0.2	0.2	0.2	0.25	0.25
Procurement price bird ⁻¹ (Tk.)	56	60	60	70	70	70
No of chicken survive	15	15	20	20	20	20
Weight gained bird ⁻¹ (gm) after 75 days	1332	1280	1310	1425	1350	1430
Total number of chicken	15	20	20	20	20	20
Total income from bird Tk. (Market value of Meat)	4127	3220	4140	4215	4310	4222
Total variable cost (Tk.)	1580	1440	1740	1780	1780	1780
Gross margin (Tk.)	2547	1780	2400	2435	2530	2442
Total return/farmer in Tk. (Market value of Meat)	11487			12747		
Total variable cost (Tk.)	4760			5340		
Gross margin (Tk.)	6727			7407		



Picture 11.59.1. Sonali chicken rearing at FSRD Site Nawvanger Char Jamalpur

11.60. Chicken (Sonali) rearing in farmer's household for income generation at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Data related to performance of Sonali chicken at farmers' level are presented in Table 11.60.1 It was observed that the initial average body weight of pullets was recorded as 500, 600 and 600 g at first year, second year and third year, respectively. After six months of rearing with improved management body weight were increased 1.06, 1.20 and 1.19 kg during 1st, 2nd and 3rd year, respectively. The hen started laying eggs after 15-20 weeks of rearing. It was observed from three years results that by rearing of 12 pullets within a period of six months, a farmer could earn average gross margin Tk. 6349.

Table 11.60.1 Performances of Sonali Chicken at FSRD Site, Padma-Char, Ishurdi, Pabna during 2018- 2021

Description of Item	Year I	Year II	Year III
Number of farmers	12	12	12
No of birds supplied per farmer	15	15	15
Date of supply	17/02/2018	13/02/2019	19/02/2020
Initial body wt./bird (kg)	0.5	0.6	0.6
Procurement price/bird (Tk.)	89	92	90
No of chicken survive	128	119	131
Date of delivery egg (date)	23/06/2018	30/05/2019	27/06/2020
Egg Production (no.)	4560	3950	4675
Consumption (no.)	569	860	671
Sale (no.)	3741	2854	3840
Distribution (no.)	250	236	164
Total number of Egg	4560	3950	4675
Performance of Bird			
Weight gained/bird (Kg)	1.06	1.2	1.19

Description of Item	Year I	Year II	Year III
Consumption	13	15	16
Sale	115	104	115
Distribution	0	0	0
Total number	128	119	131
Total income from bird (Tk.)	41375	37641	42812.5
Total variable cost (Tk.)	34020	34560	34200
Total return/farmer in Tk. (Market value of Egg + Meat)	612.92	256.75	717.71
Gross margin (Tk.) per farmer	7355	3081	8612
Gross margin avg. of three years (Tk.) per farmer	6349		

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Jan.2021



Picture 11.60.1. Rearing of Sonali chicken at FSRD Site Padma Char, Ishurdi, Pabna

11.61. Hilly chicken rearing in the farmers' household for meat purpose at FSRD Site: Baghabari, Sirajganj (BLRI)

Average performances of Hilly chicken at farmers' level after 6 months of rearing presented in Table 11.61.1. Day old chicks were distributed among the 12 farmers in each three consecutive years. Average initial body weight of chicks was 45g. Body weight gained each year up to six months of rearing 1.10 kg, 1.12 kg and 1.6 kg, respectively. The average consumption, distribution and sale of the birds were 30, 2, and 184, respectively in the first year. In the second year it was 45, 4 and 215, respectively and in the third year it was 75, 7 and 375, respectively. It was observed that, during 1st, 2nd and 3rd year each farmer were invested 14020, 18900 and Tk. 35700, respectively for feed supplement cost along with one day old chick price, medicine and vaccination. Gross margin were found Tk. 55620, Tk. 41740 and Tk. 84860 per farm, respectively in the 1st, 2nd and 3rd year. The increase of gross margin mainly due to improved breed, adequate feed supplement and proper management. Farmers showed their interest in rearing hilly chicken for their faster growth and soft meat.

Table 11.61.1. Average performances of Hilly chicken for meat purpose after rearing of 6 months at FSRD site Baghabari, Sirajganj during 2018- 2021

Description of Item	Year I	Year II	Year III
Number of farmers	12	12	12
No of birds supplied per farmer	25	25	40
Date of supply	2/7/18	12/2/19	15/06/20
Initial body wt./bird (g)	45	45	45
Procurement price/bird (Tk.)	35	35	35
No of Chicken survive	216	264	456
After six-month weight gained/bird (Kg)	1.10	1.12	1.16
Consumption	30	45	75
Sale	184	215	375
Distribution	02	4	7
Total number of adult bird	216	264	456
Total income from bird (Tk.)	68640	58640	118560

Description of Item	Year I	Year II	Year III
Total variable cost (Tk.)	14020	18900	35700
Total return/farmer in Tk. (Market value of Egg + Meat)	69640	60640	120560
Gross margin (Tk.)	55620	41740	84860

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Jan.2021



Picture 11.61.1. Hilly Chicken Rearing at FSRD Site: Baghabari, Sirajganj

11.62. Rearing of pigeon for income generation at farmer's household at FSRD Site: Nawvanger Char (BINA)

Under pigeon rearing program a total of 38 pigeons were distributed among the 12 cooperator farmers during 2018-2021. The number of squabs born was 76, of which farm family consumed 22 numbers of pigeons and sold 54. Income in the 1st, 2nd and 3rd year were 1120, 3080 and Tk. 3280, respectively from each household (Table 11.62.1).

Table 11.62.1. Performance of pigeon rearing in farmer's household at FSRD Site: Nawvanger Char, Jamalpur during 2018-2021

Year	No. of pigeon supplied (Pair)	Average weight pigeon ⁻¹ (kg)	No. of Squab born farmer ⁻¹	No. Squab intake farmer ⁻¹	Sell	Total no. of pigeon at present farmer ⁻¹	Income (Tk.farm ⁻¹)
Year I	8	0.17	18	8	10	10	1120
Year II	14	0.19	28	6	22	14	3080
Year III	16	0.20	30	8	22	16	3280
Total	38	Avg.0.19	76	22	54	40	7480

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Jan.2021



Picture 11.62.1. Pigeon rearing at FSRD Site: Nawvanger Char

11.63. Pigeon rearing in the farmer's household at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Under pigeon, rearing program twelve selected farmers were given twenty-four pairs of pigeons for increasing income and nutrition of the farm family. Two pairs of pigeons were given to each farmer. The pigeon gave squab after two months of rearing. The number of pigeons was increased rapidly. Every month the pigeon produced squab. After eight month of rearing average number of pigeon farm⁻¹ was found forty. It was also observed that average four pigeons consumed by each farm family (Table 11.63.1).

Table 11.63.1. Performance of pigeon rearing in farmer's household at FSRD Site Padma Char, Ishurdi, Pabna during 2018-2021

Sl. No.	No. of Farmer	Pigeon supplied (Pair) farmer ⁻¹	No of Survive Pigeon	Selling/consume (No. farmer ⁻¹)	Present number of pigeons farmer ⁻¹
1	12	2	40	4	36



Picture 11.63.1. Pigeon rearing in the farmer's household at FSRD Site Padma Char, Ishurdi, Pabna

11.64. Rearing of pigeon at farmers household at FSRD Site: Baghabari, Sirajganj (BLRI)

The results of pigeon rearing data of selected farmers are presented in Table 11.64.1. Under pigeon rearing program total 3 pairs of pigeons were distributed each of 6 farmers. Average body weight gained per pigeon was 788 gm. Average squab production was 17 farmer⁻¹ year⁻¹. Most of the farmers sold the squab in local market. They sold 10, consumed 7 squabs which increased their income and nutritional uptake. From pigeon rearing, farmer earned of Tk. 1067 farmer⁻¹ year⁻¹ by squab production.

Table 11.64.1. Performance of supplied pigeons to different farmers household at FSRD Site Baghabari, Sirajganj during 2018-2020

Farmer No.	Pigeon no. family ⁻¹	Average wt. (g) pigeon ⁻¹	No. of Squab born farmer ⁻¹	Squab consumed farmer ⁻¹	Squab sold farmer ⁻¹	Income (Tk.) farmer ⁻¹
6	6	788	17	7	10	1067



Picture 11.64.1. Pigeon rearing at FSRD Site, Baghabari, Sirajganj

11.65. Fodder crop cultivation nearby homestead at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Performances of Pakchong grass cultivation nearby homestead are presented in Table 11.65.1. Four farmers were provided Pakchong grass for cultivation in his nearby homestead. It was observed that average 200 kg grass harvested from per house hold (10 decimal lands) and sold it Tk. 2000 @ Tk. 10 per kg. On the other hand, farmers were able to feed their cattle as their demand with saving money to buy cattle feed. Farmers were very much interested to cultivate new fodder crops like Pakchong grass for development of animal health, increased milk production and as well as additional income from fodder crop.

Table 11.65.1. Yield, cost and return analysis of Pakchong grass production nearby homestead at FSRD Site Padma Char, Ishurdi, Pabna (Avg. of three years)

Number of farmers	Name of fodder crop	Yield homestead ⁻¹ (kg)	Price kg ⁻¹	Gross return (Tk. 10 dec. ⁻¹)
4	Pakchong grass	200	10	2000



Picture 11.65.1 Growing fodder crop (Pakchong grass) at FSRD Site Padma Char, Ishurdi, Pabna

11.66. Fodder crop cultivation nearby homestead at FSRD Site: Baghabari, Sirajganj (BLRI)

Performance of Napier grass cultivation nearby homestead are presented in Table 11.66.1. Six farmers were provided Napier grass for production in their nearby homestead. It was observed that average 800 kg grass harvested from per house hold (10 decimal lands) and sold it Tk. 8000 @ Tk. 10 kg⁻¹. On the other hand, farmers were able to feed their cattle as their demand with saving money to buy cattle feed. Farmers were very much interested to produce fodder crop like Napier grass for development of animal health, increased milk production and as well as additional income from fodder crop.

Table 11.66.1. Yield and economics of Napier grass production nearby homestead at FSRD Site Baghabari, Sirajganj (Avg. of three years)

Number of farmer	Name of fodder crop	Yield homestead ¹ (kg)	Price kg ⁻¹	Gross return (Tk.10 dec.)
6	Napier grass	800	10	8000

D. Fisheries Component

11.67. Maximization of farmers' income through carp polyculture at low cost management at FSRD site: Char Kharicha, Mymensingh (BARI)

Survival rate: There were four seasonal ponds selected for poly culture of carp fishes in FSRD site, Mymensingh during 2018-2019. In carp polyculture silver carp, Rui, Catla, Mrigal and grass carp fingerlings were released in the pond. Number of ponds, average pond area (dec.) and depth (m), total amount (no.) and weight of fingerlings, total amount (kg) and number of fishes and survival rate etc. has been presented in Table 11.67.1. The average survival rate of various fishes was 75.20% .

Total production and economic return: Production and economic analysis of fish culture before and after intervention have been presented in Table 11.67.2. It was observed that, before intervention 3507 kg per ha fish was found with the gross margin Tk. 187563 ha⁻¹ whereas after intervention 6020 kg ha⁻¹ fish was found with the gross margin Tk. 360767 ha⁻¹. The BCR was 3.02 in before intervention and it was 3.98 after intervention. The result of the study consistent with the findings of Ahmed and Alam (1989).



Picture 11.67.1 Carp polyculture at FSRD site: Char Kharicha, Mymensingh

Utilization pattern: Among the total production farmers consumed, distributed to relatives and sold their products in local market. It was observed that, farmers sold most of the portion (433 kg), consumed about (40 kg) and distributed (15 kg) to their neighbors, relatives and well-wishers of the produced fishes (Table 11.67.3). The farmers were benefitted by carp polyculture system and they showed further interest for farming of carp polyculture.

Table 11.67.1. Performance of fish under carp polyculture in seasonal pond at FSRD Site, Char Kharicha, Mymensingh during 2018-2019

No of pond	Area & depth of pond (dec. & m)	Amount and number of fingerlings	Total amount & number of fish	Survival rate (%)
04	20 dec. 1.45 m	9.25 kg and 1375	488 kg and 1020	75.20

Table 11.67.2. Production and economic return at pre and post intervention of carp Polyculture technique at FSRD Site, Char Kharicha, Mymensingh during 2018-2019

Before intervention				BCR	After intervention				BCR
Production (kg ha ⁻¹)	Total income (Tk.)	TVC (Tk.)	Benefit (Tk. ha ⁻¹)		Production (kg ha ⁻¹)	Total income (Tk.)	TVC (Tk.)	Benefit (Tk. ha ⁻¹)	
3507	280560	92997	187563	3.02	6020	481600	120833	360767	3.98

Table 11.67.3. Utilization pattern of harvested fish under carp polyculture at FSRD Site, Char Kharicha, Mymensingh during 2018-2019

Total production (kg Pond ⁻¹)	Consumption (kg)	Distribution (kg)	Sale (kg)
488	40	15	433

11.68. Maximization of farmers' income through carp polyculture technique at low cost management at FSRD site: Charpara, Sonatola, Bogura (BARI)

Twelve seasonal ponds were selected for carp polyculture. The ponds were averagely 12 decimals sized with avg. 3.6 m depth and the survival rate of carp fishes were 75-85% (Table 11.68.1). Production, cost and return analysis are shown in Table 11.68.2. Around 250% production was increased after the intervention of improved technology in carp polyculture as compared to the previous condition. The results are in agreement with findings of Miah, *et al.*, (1993) and Ahmed and Alam (1989). The average production of fish after the intervention was obtained 52 kg in 2018 to 102 kg in 2019 per pond with the average gross margin Tk. 7180 per pond and the benefit increased to 257% from each pond. At pre intervention stage, farmers paid a little or no interest on modern pond management technique. Even, they did not have knowledge about standard carp polyculture management practices.

Table 11.68.1. Performance of carp polyculture in seasonal ponds at FSRD Site, Sonatola, Bogura during 2018-2021

Fish Breed	Initial size (cm)	Initial wt. (g)	Size after 90 days (cm)	Weight after 90 days (g)	Size after 180 days (cm)	Weight after 180 days (g)	Survival rate (%)
Silver carp	5	15	16	150	32	500	80
Catla	4	12	13	120	25	450	70
Ruhi	4	12	13	120	25	450	75
Grass carp	6	15	15	170	35	550	75
Rajputi	3	8	9	100	15	300	85

NB: New fingerlings (Now in growing stage) released after flood in October 2020

Table 11.68.2. Production, cost and return of carp polyculture in seasonal ponds at FSRD Site, Sonatola, Bogura during 2018-2021

Fish component	Before intervention	After intervention				Increased (%)
		Year I	Year II	Year III	*Average	
Production (kg/pond)	22	52	102	Not harvested	77	250
Total income (Tk./pond)	2640	6240	12240		9240	250
Cost (Tk./pond)	630	1060	3060		2060	227
Gross margin (Tk./pond)	2010	5130	9180		7180	257

* Average of three years. Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020- Jan.2021

Utilization pattern: Among the total production farmers consumed, distributed to relatives and sold their products in local market. It was observed that, farmers consumed most of the portion (50 kg), sold (19.31kg) and distributed (9.30 kg) through their neighbors, relatives and well-wishers of the produced fish (Table 11.68.3). The farmers were benefitted by carp polyculture system and they showed further interest for farming of carp polyculture.

Table 11.68.3. Utilization pattern of harvested fish under carp polyculture in seasonal ponds at FSRD Site, Sonatola, Bogura during 2018-2021

Fish component	Before intervention	After intervention				Increased (%)
		Year I	Year II	Year III	*Average	
Production (kg/pond)	22	52	102	Not harvested due to flood	77	250
Consumption (Kg)	16.80	32.48	67.20		49.84	196.67
Distribution (Kg)	5.20	6.40	9.30		7.85	50.96
Sale (Kg)	0	13.12	25.50		19.31	100

* Average of three years. Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020-Dec.2020

11.69. Maximization of farmers' income through carp polyculture at low cost management at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Number of ponds, pond area, pond depth, fish species and survivability of carp fishes in pond for carp polyculture are presented in Table 11.69.1. Three perennial ponds were selected which comprised of average 41 decimal area and average 1.33 m depth. The average survivability rate of various carp fishes was 64.53%.

Table 11.69.1. Fish production program at FSRD site Padma-Char, Ishurdi, Pabna, during 2018-2019

Pond No.	Pond area (Avg. of 3 ponds dec.)	Pond depth (Avg. of 3 ponds m)	Fish species	Survival rate of carp fishes (Avg. of 3 ponds %)
3	41	1.33	Silver carp, Rajputi, Rui, Katla, Mrigal, Mirrorcarp and grass carp	64.53

Fish production & cost-return analysis are presented in Table 11.69.2. The average production of fishes was obtained 452, 470 and 459 kg in the 1st, 2nd and 3rd year per pond, respectively. With the average gross margin Tk. 68,520 pond⁻¹ and the benefit cost ratio were 2.91. At pre intervention stage, farmers paid a little or no interest on modern pond management techniques. Even, they did not have knowledge about standard carp polyculture management.

Table 11.69.2. Production and economics of carp polyculture at FSRD Site, Padma Char, Ishurdi, Pabna during 2018-2021

Year	Pond size (dec.)	Total production (kg/pond)	Total cost (Tk./pond)	Gross return (Tk.)	Gross margin (Tk.)	BCR
Year I	40	452	22,462	90,416	67,954	3.03
Year II	45	470	23,792	94,091	70,299	2.95
Year III	38	459	24,530	91,838	67,308	2.74
Average	41	460	23594	92,115	68,520	2.91

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020- Jan.2021

Price of fish: Tk. 200/kg

Utilization pattern: Among the total production, it was observed that farmers sold most of the portion (Avg. 416 kg), consumed (Avg. 27.67 kg) and distributed (Avg. 17.33 kg) (Table 11.69.3). They distributed fishes among their neighbors, relatives and well-wishers and sold in local market. The farmers were

benefitted by carp polyculture system and they showed further interest for farming of carp polyculture.

Table 11.69.3. Utilization pattern of harvested fishes at FSRD site, Padma Char, Ishurdi, Pabna during 2018-2021

Year	Total production (kg/pond)	Consumed (kg)	Distributed (kg)	Sold (kg)
Year I	452	24	19	409
Year II	470	29	15	426
Year III	459	27	18	414
Average	460	27.67	17.33	416

* Year I= Feb.2018-Jan.2019, Year II= Feb.2019-Jan.2020 & Year III= Feb.2020- Jan.2021



Picture 11.69.1. Harvesting of fishes at FSRD Site, Padma Char, Ishurdi, Pabna

11.70. Maximization of farmers' income through carp polyculture technique at low cost management at FSRD Site: Baghabari, Sirajganj (BLRI)

One seasonal pond was selected for polyculture in FSRD site, Baghabari, Sirajganj during 2018-2021. In carp polyculture, fingerlings of carp fishes (Rui, Catla, Mrigal and Sorputi) were released in the pond. Number of ponds, average pond area (dec.) and depth (m), total amount (kg) and weight of fingerling, total amount and number of fishes and survival rate etc. are presented in Table 11.70.1. The results revealed that, in polyculture of carp fishes the average survival rate of various fishes were ranges from 67-88%. Production, cost and return analyses of fish culture before and after intervention are presented in Table 11.70.2. It was observed that, before intervention fish production was found 160 kg with the gross margin of Tk. 11100 per 11 dec. whereas after intervention production was 284 kg with the gross margin Tk. 35020 per 11 dec pond area. The BCR was 1.95 in before intervention and it was 3.5 after intervention.

Utilization pattern: Among the total production, farmers consumed, distributed to relatives and sold their products in local market. It was observed that, farmers sold most of the portion (Avg. 200 kg), consumed (Avg. 67 kg) and distributed (Avg. 17 kg) to their neighbors, relatives and well-wishers of the produced fishes (Table 11.70.2). The farmers were benefitted by carp polyculture system and they showed further interest for farming of carp polyculture.

Table 11.70.1. Performance of carp polyculture at FSRD site Baghabari, Sirajganj during 2018-2021 (Avg. of three years)

Area (dec.) & pond depth (m)	Name of fish species	Total number of fingerling	Average weight of fingerling(g)	Total number of fish's	Final Average weight/species (Kg)	Total production (Kg.)	Survival rate (%)
Area:11 decimal & Depth: 1.3m	Catla	60	8	40	1.00	40	67
	Rui	350	10	250	0.8	200	71
	Mrigal	50	8	40	0.75	30	80
	Sorputi	40	8	35	0.4	14	88
Total		500	Avg. 8.5	365	1.41	284	Ranges 67-88

Table 11.70.2. Total fish production, utilization pattern and income before and after intervention at FSRD site Baghabari, Sirajganj during 2018- 2021

Description	Before intervention (kg/11dec.)	After intervention (kg/11 dec.)
Total production (Kg)	160	284
Consumption (kg)	17	67
Distribution (kg)	13	17
Selling (Kg)	120	200
Gross return (Tk.)	21600	49020
Total cost (Tk.)	10500	14000
Gros margin (Tk.)	11100	35020
BCR	1.95	3.50

Selling price Tk./kg • Katla : 250, Rui: 250, Mrigal:200, Sorputi: 200

11.71. Maximization of farmers' income through the culture of monosex tilapia at low cost management at FSRD site: Char Kharicha, Mymensingh (BARI)

Three seasonal ponds were selected for monosex tilapia culture in FSRD Site, Char Kharicha, Mymensingh during 2019-2020. The ponds were average 20 decimal sized with a 1.45 m depth. Information on ponds area, fingerlings amount and weight, final total amount and number of fish, survival rate have been presented in Table 11.71.1. The results revealed that, 85% fingerlings were survived and gave achievable weight at harvest. The production and gross margin of fish varied from pond to pond due to its size (Table 11.71.2). It was observed that, before intervention 2507 kg ha⁻¹ fishes was found with the gross margin 150750 Tk.ha⁻¹ whereas after intervention 3268 kg ha⁻¹ fishes was found with the gross margin 206900 Tk.ha⁻¹. The



Picture 11.71.1 Tilapia fish culture at Char Kharicha, Mymensingh

BCR was 3.02 in before intervention and it was 3.73 after intervention. This results of the study consistent with the findings of Kohinoor, *et al.*, (2001). Among the total production farmers usually, sold most of the portion (79%), consumed about 16% and distributed about 3% among their neighbors, relatives and well-wishers (Table 11.71.3). The farmers showed their interest in cultivating monosex tilapia for its quick growing and more benefit.

Table 11.71.1. Performance of monosex tilapia in seasonal pond at FSRD Site, Char Kharicha, Mymensingh during 2019-2020

No of pond	Area and depth of pond (dec. & m)	Amount and number of fingerlings	Avg. weight of fingerlings (g)	Final average weight of fish (g)	Total amount & no. of fish	Survival rate (%)
3	26 dec & 1.56 m	23 kg & 473	50	278	118 kg & 417	85

Table 11.71.2. Production and economic return of monosex tilapia at FSRD Site, Char Kharicha, Mymensingh during 2019-2020

Before intervention				BCR	After intervention				BCR
Production (kg ha ⁻¹)	Gross return (Tk. ha ⁻¹)	TVC (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)		Production (kg ha ⁻¹)	Gross return (Tk. ha ⁻¹)	TVC (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	
2507	200560	49800	150750	3.02	3268	262400	55500	206900	3.73

Table 11.71.3. Utilization pattern of harvested tilapia fish at FSRD Site, Char Kharicha, Mymensingh during 2019-2020

Avg. production (kg pond ⁻¹)	Consumption (kg)	Distribution (kg)	Selling (kg)
118	20	4	94

11.72. Fish culture in backyard pond at FSRD Site: Nawvanger Char, Jamalpur (BINA)

The char land of sub-project area floods every year. It was observed that the flood water filled the backyard pond and the water stay 4 to 5 months. Some natural fishes trapped in the backyard pond with flood water. After recession of flood water modern management (liming, mentor feed etc.) was provided in the pond for fish culture. The pond number, pond area, fish production and gross margin are presented in Table 11.72.1. After 5 months culture of fish in the backyard pond average production of fishes was found 80 kg 12 dec⁻¹. and earned gross margin Tk. 12,000 by selling of them.

Table 11.72.1. Pond number, pond area, fish production and gross margin at the FSRD Site, Nawvanger Char, Jamalpur during 2020-21

Number of ponds	Average area of pond (dec.)	Production of fishes (Kg)	Gross margin (Tk.12 dec. ⁻¹)
2	12	80	12,000

11.73. Net pen fish culture in open water sources at FSRD Site: Nawvanger Char, Jamalpur (BINA)

After recession of flood water farmers cultured fish at the open water resource at the FSRD site from October 2020 to February 2021. For culture of fishes in the open water resources 4 farmers made their pen using nylon net at two side of the canal. They stocked larger size fishes. After 5 months culture of fish, a total of about 568 numbers of different type of fishes were harvested with survival rate 80-86%. Total amount of fishes was found 163.80 kg farmer⁻¹ among which they consumed 16.38 kg, distributed 4.91 kg and sold 142.51 kg fishes. The average gross margin and BCR were recorded Tk. 21161 and 3.91 farmer⁻¹, respectively (Table 11.73.2).

Table 11.73.1. Performance of mixed culture of carp fishes with monosex tilapia using net pen fish culture in open water resources during October 2020 to February 2021

Sl. No.	Area and depth of net pen	Name of fish species	Initial weight and number of fish (kg. and no.)	Average weight of fishes (g)	Final average weight (g)	Total number of fish	Survival rate (%)
1	1 acre and 20-30 cm	Rui	35 kg (no. 70)	500	1500	62	80
2		Catla	50 kg (no. 100)		1600	85	82
3		Mrigal	50 kg (no. 100)		1200	88	86
4		Silver carp	50 kg (no. 100)		1300	84	84
5		Tilapia	100 kg (no. 300)	333	850	249	83

Table 11.73.2. Total fish production, utilization pattern and income of harvested fishes at FSRD site during October 2020 to February 2021

Total fish production (kg)	Consumption (kg)	Distribution (kg)	Selling (kg)	Gross return (Tk.)	Total cost (Tk.)	Gross margin (Tk.)	BCR
163.80	16.38	4.91	142.51	28411	7250	21161	3.91

E. Off-farm activities

Other than agricultural activities, which called off-farm activities is also a good opportunity for increasing total farm income. Besides agricultural production, some farm families especially the women were engaged with sewing cloths with machine, making different handicrafts during their leisure periods. Introduced some off-farm activities at household' it would be helpful to increase total farm income.

11.74. Off-farm activities at FSRD site: Char Kharicha, Mymensingh (BARI)

Economic return and types of off-farm activities are presented in Table 11.74.1. It was found that after intervention the gross margin increased (Tk. 4200/year) which were 44.76% higher over before intervention. One household started handicrafts making for commercial practice, and finally, most of the households showed their interest in practicing handicrafts besides other off-farm activities. So, if all

households could introduce some off-farm activities, initially it would be helpful to increase total farm income.

Table 11.74.1. Economic return of off-farm activities at FSRD Site, Char Kharicha, Mymensingh during 2018- 20 21

Type of activities	Before intervention (Tk.)			After intervention (Tk.)			Gross margin (GM) increased (%)
	GR	TVC	GM	GR	TVC	GM	
Sewing machine	3000	1500	1500	8500	3200	2500	66.66
Irrigation provider	6000	2500	3500	9000	3500	5500	57.14
Electric shop	7000	3000	4000	8000	3000	5000	25.00
Tea stall	6000	4000	2000	8000	4000	3000	50.00
Selling labor	4000	-	4000	5000	-	5000	25.00
Average	5200	2750	3000	7700	3425	4200	44.76

11.75. Off-farm activities at FSRD site: Charpara, Sonatola, Bogura (BARI)

Economic return and types of off-farm activities are presented in Table 11.75.1 From the results for February 2018–January 2021, it was found that after intervention the gross margin increased (Tk. 21900/year) which was 62.0 % higher over before intervention.

Table 11.75.1. Economic return of off-farm activities at FSRD Site, Charpara, Sonatola, Bogura during 2018-2021

Type of activities	Before intervention (Tk.)			After intervention (Tk.)			Gross Margin (GM) increased (%)
	Gross return	Required cost	Gross margin	Gross return	Required cost	Gross margin	
Sewing machine	3750	1125	2625	8000	2600	5400	106
Irrigation provider	5250	2625	2625	7250	2850	4400	68
Fishing	11250	3000	8250	16500	4400	12100	47
Total	20250	6750	13500	31750	9850	21900	Ave.62

11.76. Off-farm activities at FSRD Site: Nawvanger Char, Jamalpur (BINA)

Economic return and types of off-farm activities are presented in Table 11.76.1. Two off farm activities like, compost preparation and sewing katha were implemented by four female cooperator farmers in the sub-project area. Every 50-60 days each farmer was producing 100-110 kg vermicompost and two Katha per year. The average gross income from off farm activities was Tk. 4704/farmer/year. They were using their own made vermicompost to their vegetables field and also earn money by selling it.

Table 11.76.1. Economic return of off-farm activities at FSRD Site, Nawvanger Char, Jamalpur during 2018 - 2021 (Avg. of four farmers)

Type of activities	Gross return (Tk.)	Required cost (Tk.)	Gross margin (Tk.)
Compost preparation	3688	1584	2104
Sewing katha	6466	3866	2600
Total	10154	5450	4704

Price of compost: Tk. 8-10/ kg and Price of katha: Tk.1300/katha



Picture 11.76.1 Vermicompost production at FSRD Site: Nowvanger Char, Jamalpur



Picture 11.76.2 Sewing katha by women members at FSRD Site: Nowvanger Char, Jamalpur

11.77. Off-farm activities at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Economic return and types of off-farm activities are presented in Table 11.77.1. It was observed that woman farmer earns Tk. 8000/ from weaving Nokshi Katha per year. If all households could introduce some off-farm activities, it would be helpful to increase total farm income of their own.

Table 11.77.1. Economic return of off-farm activities at FSRD Site, Padma Char, Ishurdi, Pabna during 2018 - 2021

Type of activities	Gross return (Tk.)	Required cost (Tk.)	Gross margin (Tk.)
Sewing katha	12000	4000	8000



Picture 11.77.1. Off farm activities at FSRD Site: Padma Char, Ishurdi, Pabna

11.78. Off-farm activities at FSRD site: Baghabari, Sirajganj (BLRI)

Economic return and types of off-farm activities are presented in Table 11.78.1. Other than agricultural activities, the households showed interest for sewing nakshi katha. For sawing Nakshi katha clothes, thread and other related material were provided each of 12 farmers. It was observed that farmers were earned avg. gross margin Tk. 6701 per year by selling Nakshi katha. This was 92.56% higher than before intervention.

Table 11.78.1. Economic return of off-farm activities at FSRD Site, Baghabari, Sirajganj 2018- 2021

Description item	Before intervention	After intervention	GM increased after intervention (%)
Gross return (Tk.)	5700	10210	79.00
Production cost (Tk.)	2220	3508	58.00
Gross margin (Tk.)	3480	6701	92.56

F. Cost and return from different component of an integrated farming

11.79. Cost and return from different component at FSRD Site: Char Kharicha, Mymensingh and Charpara, Sanatola, Bogura (BARI)

Cost and return related comparative data of an integrated farm are presented in Table 11.79.1 and Table 11.79.2 for FSRD site, Mymensingh and Bogura, respectively. Holistic approach in a farm under integrated way may bring higher income than the previous condition. Selection of suitable cultivars, following modern cultivation techniques, rearing of farm animal, feeding them in a proper way, timely vaccination of farm animals and birds, practicing carp polyculture techniques may enhance farm productivity as well as income in an integrated manner which ultimately contributed to livelihood development of the target beneficiary. The total income of a farm family at FSRD site, Mymensingh was increased from Tk. 64182 to Tk. 114498 after intervention. Gross margin was increased by 80.44%. On the contrary, at FSRD site Bogura, the gross return of a farm family was increased from Tk. 60995 to Tk. 109127 after intervention. Average gross margin was increased by 82.68% over before intervention.

Table 11.79.1. Economic return from different sub-systems for integration of farming system at FSRD Site: Char Kharicha, Mymensingh during 2018 - 2021

Components	Before intervention (Tk.)			After intervention (Tk.)			GM increased over (BI) (%)
	Gross return	Variable cost	Gross margin	Gross return	Variable cost	Gross margin	
Homestead vegetables	945	500	445	7960	2266	5693	1179.32
Homestead fruits	3000	500	2500	6050	1566	4483	79.32
Field crop	50017	17056	32961	65498	22770	42728	29.63
Livestock	2380	700	1680	15050	4470	10580	529.76
Fisheries	2640	630	2010	12240	3060	9180	356.72
Off-farm	5200	2750	3000	7700	3425	4200	44.67
Total	64182	22136	42596	114498	37557	76864	80.44

Table 11.79.2. Economic return from different sub-systems for integration of farming system at FSRD Site: Charpara, Sonatola, Bogura during 2018 - 2021

Components	Before intervention (Tk.)			After intervention (Tk.)			GM increased over (BI) (%)
	Gross return	Variable cost	Gross margin	Gross return	Variable cost	Gross margin	
Homestead vegetables	1174	650	524	8326	2830	5496	948.85
Homestead fruits	930	250	680	4680	1250	3430	404.41
Field crop	49071	18056	31015	61498	22770	38727	24.86
Livestock	2680	600	2080	13050	4570	8480	307.69
Fisheries	2640	630	2010	12240	3060	9180	356.72
Off-farm	4500	1500	3000	9333	2833	6500	116.66
Total	60995	21686	39309	109127	37313	71813	82.68

11.80. Cost and return from different component at FSRD Site: Nawvanger Char, Jamalpur (BINA)

Cost and return related comparative data of an integrated farm have been given in Table 11.80.1. Holistic approach in a farm under integrated way may bring higher income than the previous condition. Selection of suitable cultivars, following modern cultivation techniques, rearing of farm animal, feeding them in a proper way, timely vaccination of farm animals and bird, practicing carp polyculture techniques may enhance farm productivity as well as income in an integrated manner which ultimately contributed to livelihood development of the target beneficiary. It was revealed that, the Gross margin of a farm family at FSRD site, was increased from Tk. 1,13,084 to Tk. 4,07,962 after intervention. Total gross margin was increased 261% over before intervention.

Table 11.80.1. Economic return from different sub-systems for integration of farming system at FSRD Site: Nawvanger Char, Jamalpur during 2018 –2021

Components	Before intervention (Tk.)			Afterintervention (Tk.)			GM increased over (BI) (%)
	Gross return	Variable cost	Gross margin	Gross return	Variable cost	Gross margin	
Crop sector	237950	158000	79950	471428	226902	244526	206
Homestead	7534	2600	4934	22499	4009	18490	275
Area adjacent to homestead	-	-	-	69739	14025	55714	100
Livestock	30000	4000	26000	85874	22580	63294	143
Fisheries	2500	300	2200	24000	2500	21500	877
Off-farm activities	-	-	-	9888	5450	4438	100
Total	277984	164900	113084	683428	275466	407962	261

11.81. Cost and return from different component at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Cost and return related comparative data of an integrated farm are presented in Table 11.81.1. Holistic approach in a farm under integrated way may bring higher income than the previous condition. Selection of suitable cultivars following modern cultivation techniques, rearing of farm animal, feeding them in a proper way, timely vaccination of farm animals and bird, practicing carp polyculture technique may enhance farm productivity as well as income in an integrated manner, which ultimately contributed to livelihood development of target beneficiary. It was revealed that, the gross margin of a farm family at FSRD site, Padma Char, Ishurdi, Pabna was increased from Tk. 300757 to Tk. 960096 after intervention. Gross margin was increased by 219.23% over before intervention.

Table 11.81.1. Technologies used and return from different sub-systems of integrated farming systems at FSRD Site: Padma Char, Ishurdi, Pabna during 2018–2021

Components	Before intervention (Tk.)			After intervention (Tk.)			GM increased over (BI) (%)
	Gross return	Variable cost	Gross margin	Gross return	Variable cost	Gross margin	
Crop sector	293400	65047	228353	1216174.98	440979.33	775195.65	239.47
Homestead	11480	7375	4105	23491.67	17410.00	6081.67	48.15
Livestock	102781	69541	33240	290976.33	180677.67	110298.67	231.83
Fisheries	66524	31465	35059	92115.16	23594.67	68520.50	95.44
Off farm	0	0	0	20000	8000	12000	100
Total	474185	173428	300757	1622758	662662	960096	219.23

11.82. Cost and return from different component at FSRD Site: Baghabari, Sirajganj (BLRI)

Cost and return related comparative data of an integrated farm have been given in Table 11.82.1. Holistic approach in a farm under integrated way may bring higher income than the previous condition. Selection of suitable cultivars, following modern cultivation techniques, rearing of farm animal, feeding them in a proper way, timely vaccination of farm animals and bird, practicing carp polyculture techniques may enhance farm productivity as well as income in an integrated manner which ultimately contributed to livelihood development of the target beneficiary. It was observed that, the gross margin of a farm family at FSRD site was increased from Tk. 1062160 to Tk. 2205967 after intervention. Gross margin was increased 208% over before intervention. (Table 11.82.1)

Table 11.82.1. Technologies used and return from different sub-systems of integrated farming systems at FSRD Site: Baghabari, Sirajganj during 2018- 2021

Component	Before intervention (Tk.)			After intervention (Tk.)			GM increased over (BI) (%)
	Gross return	Variable cost	Gross margin	Gross return	Variable cost	Gross margin	
Homestead	11920	1250	10670	77950	19232	41311	387
Crop sector	867960	504400	363530	1213560	729420	482140	133
Livestock	110320	46400	639200	1797520	450750	1417043	220
Fisheries	86760	38000	48760	415473	150000	265473	544
Total	1076960	590050	1062160	3504503	1349420	2205967	208

G. Integration of farm component

11.83. Integration of farm component (BINA)

Integrated farming system is a waste or byproduct utilization system in which the wastes of one subsystem become an input to a second subsystem. Crop + Livestock + Poultry + Fisheries + Vermicomposting + Household integration studies were conducted during 2018-20 taking the char land marginal, small and medium farmers' situations. The primary inter-relationships at the farming system level are illustrated in Figure 11.83.1. It was observed that, results obtained from integrated farming are profitable.

Net income earned by the farmer was Tk. 4,07,962 whereas before intervention it was Tk. 1,13,084. Integrated farming system increased the net income and create employment from the small farm holding and providing balance diet for the resource poor farmers.

From the three years observation, it was found that two types of major farming systems exist in the Farming System Research and Development (FSRD) site. Among the two farming systems, the highest number of farmers practiced Crop + Livestock + poultry production system followed by Crop + Poultry production system.

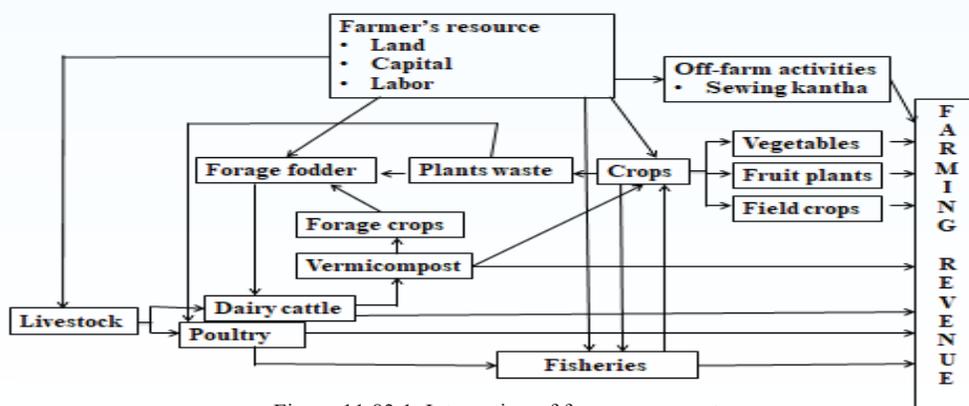


Figure 11.83.1. Integration of farm component

Through the sub-project activities, integrated farming system Crop + Livestock + Poultry + Fisheries + Vermicomposting + Household was developed. Here byproduct of one enterprise was effectively utilized for other enterprise (Figure 11.83.1), thus ensuring higher and efficient resource use efficiency. The integration of livestock, fish and crops is a sustainable system. Environmentally sound integration is ensured where livestock droppings and feed waste are used to make compost. Maize was cultivated in the cropping pattern. Maize is a suitable crop for char lands. The leaf of maize contains large amount of nutrients as which is very useful for cattle health. Integrated production systems is a means of establishing sustainable farming systems and are highly efficient, potentially crop residues are used as livestock feed.

11.84. Integration of farm component (BSRI)

Two types of major farming systems exist in the Farming System Research and Development (FSRD) site. Among the two farming systems, the highest number of farmers practiced by Crop + Livestock + poultry production system followed by Crop + Poultry production system. Through the sub-project activities, integrated farming system Crop + Livestock + Poultry + Fisheries + Vermicomposting + Household was developed. Here byproduct of one enterprise was effectively utilized for other enterprises, thus ensuring higher and efficient resource use efficiency. The integration of livestock, fisheries and crops is a sustainable system. Environmentally sound integration was ensured where livestock droppings and feed waste were used to make compost. Sugarcane was cultivated in the farmer's field for evaluation of new varieties. Sugarcane is a suitable crop for char lands. The leaf of sugarcane contains large amount of nutrients, which is very useful for cattle health and can be used as feed and fuel. Sugarcane press mud is very rich in organic matter, which is used as organic manure for field crop production. Integrated production systems was a means of establishing sustainable farming systems and are highly efficient, potential crop residues were used as livestock feed.

12. Research highlights

FSRD Site: Char Kharicha Mymensingh and Charpara Sonatola Bogura (BARI)

A. Homestead production System:

12.1. Title: Year Round Vegetables and Fruits Production at Homestead Area

Background: The fallow and un-utilized homestead areas were brought into vegetables and fruits production considering time and space to increase farm productivity as well as to improve livelihood.

Objectives: To increase vegetables, fruit production, consumption, family nutrition and utilize family labor

Methodology: The program was carried out at FSRD site, Mymensingh and Bogura by following the Narekeli model and Goyeshpur model, respectively during the year of 2018 - 21. Different niches viz. open sunny space, trellis, shady place, marshy land, tree support, fence, backyard, house boundary etc. were used scientifically for vegetables cultivation. Beside space utilization, some activities like chewing type sugarcane production, management of existing fruit trees, fodder production, vermicomposting etc. also done in homestead or near homestead. In most cases BARI developed crop varieties were used and recommended production package were imposed in both the model in both sites.

Key findings:

- At FSRD Mymensingh, vegetables production in homestead was 259.50, 996.50 and 336 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 and Feb. 2020 - Jan. 2021. However, average production was 530.7 kg homestead⁻¹ year⁻¹ that was 742% higher compare to 63 kg homestead⁻¹ year⁻¹ (as per base line) and the remarkable increment (742.3 kg homestead⁻¹ year⁻¹) was observed in vegetables production. After intervention, the average vegetables intake farm family⁻¹ was 106.67 kg homestead⁻¹ year⁻¹. Distribution and selling of vegetables were recorded as 14.0 and 410.0 kg homestead⁻¹ year⁻¹, respectively and by selling the vegetables in local market, gross margin was recorded as Tk. 5693 homestead⁻¹ year⁻¹.
- At FSRD Mymensingh, the fruit production trend was 135, 585 and 490 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 and Feb. 2020 - Jan. 2021. The average production was 403.30 kg homestead⁻¹ year⁻¹ that was 102% higher compare to 200 kg homestead⁻¹ year⁻¹ (as per base line). The fruits intake per farm family per year was 140 kg after the program intervention, whereas it was only 100 kg before intervention and the distribution and selling of fruits were 26.67 kg and 236.67 kg, respectively and gross return was Tk. 4484 homestead⁻¹ year⁻¹.
- At FSRD Bogura, by using all niches total vegetables production was 388.23, 483.40 and 55.04 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 & Feb. 2020 - Jan. 2021 and thus average production was 475.56 kg homestead⁻¹ year⁻¹ which was much higher than that of 117.39 kg homestead⁻¹ year⁻¹ at before intervention of model. Remarkable average increment of vegetables production (305.11%) was observed in vegetables cultivation at homestead. The average vegetables intake farm family⁻¹ was 277.32 kg after the program intervention during the three consecutive year. The distribution and selling were recorded as 67.87 kg and 130.36 kg and by selling in the local market; the gross margin was obtained as Tk. 3893 homestead⁻¹ year⁻¹.
- At FSRD Bogura, after intervention of proven technology related to fruit tree management, fruit production was 43, 90 and 156 kg homestead⁻¹ year⁻¹ during Feb. 2018 - Jan. 2019, Feb. 2019 - Jan. 2020 & Feb. 2020 - Jan. 2021. The average production was 96 kg homestead⁻¹ year⁻¹ which was much higher than that of 31 kg homestead⁻¹ year⁻¹ at before intervention of model and the remarkable average increment of fruit production (209.68%) was observed in this site. After intervention, fruits intake per farm family per year was 63.93 kg, whereas it was only 15.5 kg before intervention. The distribution and selling pattern were 11.63 kg and 20.43 kg homestead⁻¹ year⁻¹, respectively and income was Tk. 2873 homestead⁻¹ year⁻¹.

Key words: Homestead, Narekeli model and Goyeshpur model

12.2 Title: Efficient Use of Other Farm Resources Nearby Homestead Area

Background: One of the key objectives of this sub-project is to maximize the farm productivity with efficient utilization of farm resources and thus different type of activities were taken considering the farmer's needs and choice as well as on the basis of their existing resources.

Objective: To increase total farm productivity for livelihood improvement of household.

Methodology: Different activities other than vegetables and fruits production nearby homestead viz. chewing type sugarcane production in house boundary, vermicompost production, establishment of mini orchard, plantation and management of fruit trees and fodder production nearby homestead etc. were conducted at FSRD site, Mymensingh during the year of 2018-2021. A total of 2, 1, 3, 12 and 2 farm families were involved with chewing type sugarcane production in house boundary, vermicompost production, establishment of mini orchard, plantation and management of fruit trees and fodder production nearby homestead, respectively. On the other hand, establishment of mini orchard, saplings plantation and management of fruit trees were accomplished at FSRD site, Bogura during the year of 2018-2021. Only one family was involved to establish a mini orchard, while 12 families were involved with saplings plantation and management of fruit trees at FSRD site, Bogura.

Key findings:

FSRD site, Mymensingh: On average 275 sugarcane was obtained by each farmer of which they consumed 75, distributed 50, and rest one sold in market and a remarkable income (Tk. 3000) was generated. Vermicompost establish cost was Tk. 3500 and production is still in the pipeline and hopefully output will come after 2/3 month later. Survival rate of fruit saplings was 100%. The garden yet not in fruiting stage and hopefully production will start after 2/3 years. As the plant will take 1-2 years to fruit bearing different types of vegetables such as chilli and red amaranth is now being cultivated as intercrop in the orchard. One farmer produced Napier grass in 2 decimal areas and harvested 250 kg grasses and sold it Tk. 2500 @ Tk.10 kg⁻¹ and still it is in good condition for grass production.

FSRD site, Bogura: As the orchard will take 1-2 years to come to production, different vegetables (Tomato, Cauliflower, Cabbage, Indian spinach), spices (Onion) is now being growing the inter plant spaces. The garden yet not in fruiting stage and hopefully production will start after 2/3 years. A total of 473 saplings of different quality fruits varieties were supplied to homestead e. g. Mango, Litchi, Dragon fruit, Dwarf Coconut and quick growing fruit species like Guava, Papaya, Lemon were distributed among the farmers. Among the supplied saplings, 1% mango and 1% litchi became died due to transportation shock. As a result of new plantation coupled with management of fruit plants, the production increased remarkably in the subsequent years.

Key words: Chewing type sugarcane, Vermicompost, Mini orchard

FSRD Site: Nawvanger Char (BINA)

12.3 Title: Year Round Vegetables and Fruit Production at Homestead

Background: In the Nawvanger Char, there was found fallow and un-utilized homestead areas. Farmers had very few fruits trees and vegetables at their homestead. To bring this unused land in to exploited scientifically in considering time and space. Bangladesh Agricultural Research Institute (BARI) developed vegetables production model “Goyespur” model was followed in vegetables production systems by 12 farmers with some modifications according the choice of the farmer and suitability of the char land area.

Objective: To improve farmers’ economy and nutrition from vegetables production by efficient utilization of homestead.

Methodology:

The area of each vegetables garden was about 4 to 4.5 decimal at homestead. For implementing “Goyespur” model, in sunny places, seven beds were prepared by each farmer among which 4 beds for open land and 3 beds for trellis cultivation. The crops were selected for different production unit on the basis of the model with some modifications according the choice of the farmer and suitability of the char land area. Fertilizers for N, P and K were applied in each crop at recommended rates. Irrigation was applied as and when necessary.

Table 12.3.1. Proposed cropping patterns of year round profitable vegetables and fruits production in different niches at FSRD site Nawvanger Char, Jamalpur

Sl No.	Space		Rabi	Kharif-I	Kharif-II
			October – March	April – June	July – September
1.	Open land	Bed-1	Tomato (Hybrid)	Onion (BARI Pijaj-2)	Water spinach (Hybrid)
		Bed-2	Chilli (Hybrid)	Lady’s finger (Hybrid)	Indian spinach (Hybrid)
		Bed-3	Cauliflower (Hybrid)	Carrot (Hybrid)	Stem amaranth (Hybrid)
		Bed-4	Brinjal (Islampuri) +Red amaranth (Hybrid)	Indian spinach (Hybrid)	Lady’s finger (Hybrid)

SI No.	Space		Rabi	Kharif-I	Kharif-II
			October – March	April – June	July – September
2.	Roof		White gourd (Hybrid)	White gourd (Hybrid)	White gourd (Hybrid)
3.	Trellis:	Trellis-1	Country bean (BARI Sheem-1)	Cucumber (Hybrid)	White gourd (Hybrid)
		Trellis-2	Bitter gourd (Hybrid) + Spinach (Hybrid)	Sponge gourd (Hybrid)	Bitter gourd (Hybrid)
		Trellis-3	Bottle gourd (Hybrid)	Snake gourd (Hybrid)	Sponge gourd (Hybrid)
4.	Tree support		-	-	-
5	Partial shady area		Spinach (Hybrid)/ Red amaranth (Hybrid)/ Jute leaves (Binapatshak-1)	Turmeric (BARI Halud-1) Leaf aroid (Moulavi kachu)	
6	Marshy land:		Latiraj (BARI Panikachu-1)		
7.	Fence		Bitter gourd (Hybrid)	Bitter gourd (Hybrid)	
8.	Homestead boundary		a. Papaya (Red lady) b. Guava (Thai Guava-7) c. Lemon (Binalebu-1)		
9.	Back yard/waste land		1. Drumstick 2. Chewing type sugarcane (Amrita)		

Key findings:

By utilizing 4 to 4.5 decimal land of the homestead, each farmer produced Avg. 536 kg vegetables among which they consumed 96 kg, distributed 45 kg and sold 395 kg vegetables. Whereas, before intervention production, consumption, distribution and selling were 84 kg, 38.5 kg, 11.5 kg and 34 kg, respectively. From house boundary by growing fruits farmer produced Avg. 437 kg fruits among which they consumed 211 kg, distributed 63 kg and sold 163 kg whereas before intervention production, consumption, distribution and selling were 220 kg, 90 kg, 20 kg and 110 kg, respectively. By growing vegetables and fruits utilizing nine different production units of homestead farmers earned Tk. 18490 which was 145% higher than before intervention.

Key words: Homestead, Char land, Goyespur model, Vegetables, Fruits

12.4 Title: Vegetables Production Nearby Homestead

Background: In the Nawvanger char, there was found fallow and un-utilized land near the farmer's household. Farmers were not aware to the benefit of vegetables production round the year. By growing vegetables at the homestead, farmers showed interest to produce vegetables at the land near their house. The area of each vegetables garden was about 35.5 to 36 decimal. To bring this unused land in to exploit scientifically different types of vegetables were grown at the land adjacent to homestead.

Objective: To improve farmers' economy and nutrition from vegetables production by efficient utilization of unused land adjacent to homestead.

Methodology:

The area of each vegetables garden was about 35.5 to 36 decimals near the homestead. The area adjacent to homestead, vegetables were produced in beds and on trellis. The selected crops were as same as production unit of open land, trellis, partial shady area and marshy land crops of the vegetables production model "Goyespur" model used in homestead. Fertilizers for N, P and K were applied in each crop at recommended rates. Irrigation was applied as and when necessary.

Table 12.4.1. Yield and economics of vegetables production near by the homestead before and after intervention at FSRD site Nawvanger Char, Jamalpur during 2018 - 2021

Vegetables	Before Intervention (kg)			After Intervention (kg) Avg. Feb. 2018 to Jan. 2021		
	Rabi	Kharif-1	Kharif-2	Rabi	Kharif-1	Kharif-2
Rabi crops: Tomato, chilli, cauliflower, brinjal, country bean, bitter gourd, bottle gourd, red amaranth and Jute leaves.	-	-	-	2382		
Khari-I crops: Onion, lady's finger, carrot, Indian spinach, cucumber, sponge gourd and snake gourd	-	-	-		802	
Kharif-II: Water spinach, Indian spinach, stem amaranth, lady's finger, white gourd, bitter gourd, sponge gourd, taro (moulovikachu) and taro (panikachu).	-	-	-			324
Total production (Kg)	3508					
Total production	-	-	-	2382	802	324
Gross return (Tk.)	-	-	-	43938	20040	5761
Total variable cost (Tk.)	-	-	-	6625	5900	1500
Gross margin (Tk.)	-	-	-	37313	14140	4261
Total gross margin (Tk.)	55714					

Key findings:

The area of each vegetables garden was about 35.5 to 36 decimals near the homestead. Maximum yield was obtained (2382 kg) in Rabi season followed by Kharif-I (802 kg) and Kharif-II (324 kg). The highest gross margin (Tk. 37313) was obtained from Rabi season followed by Kharif-I (Tk. 14140). Rabi crops cultivation is more profitable than crops grown in Kharif-I and Kharif-II season. Farmers got higher benefit through early production of vegetables. Before intervention farmers did not produced vegetables in this land. But after invention each farmers produced average 3508 kg vegetables and earned gross margin Tk. 55714 year⁻¹.

12.5 Title: Plantation and Management of Existing Fruit Trees

Background: Farmers have very few fruits at the boundary of their house. They were not aware to intake sufficient fruits for nutrition. They did not buy enough fruits and consumed small amount of fruits which are not sufficient for nutrition. Sapling of fruit trees were distributed among the farmers to increase homestead fruit production and meet up malnutrition of their family member.

Objective: To improve farmers' economy and nutrition from fruits production by utilizing boundary and backyard unused land.

Methodology: Five hundred thirty six saplings were distributed among the farmers to get fruits for year round. Survival rate of different fruit saplings ranged from 80-100 percent in FSRD sites. A mini lemon orchard with Binalebu-1 was also developed at the backside of homestead. 12 saplings of Binalebu-1 were distributed each of 12 farmers. Again, to ensure nutritional security of the member of the households cutting of chewing sugarcane were also distributed to the farmers.

Table 12.5.1. Sapling distribution of fruit trees at FSRD site Nawvanger Char, Jamalpur

Sl No	Name of the trees	No. of sapling per farmer	No. of farmers	Total saplings	Survivability (%)
1.	Malta (BARI Malta-1)	1	20	20	100
2.	Mango (BARI Aam-3)	½	80	100	100
3.	Litchi (BARI Litchi -3)	½	100	130	100
4.	Coconut (Local)	2	12	24	95
5.	Guava (Peyara -2)	2	12	24	100

SI No	Name of the trees	No. of sapling per farmer	No. of farmers	Total saplings	Survivability (%)
6.	Burmese grape (BARI Lotkan-1)	1	12	12	100
7.	Golden Apple (local)	½	40	52	90
8.	Lemon (Binalebu-1)	3	12	36	100
9.	Sapota (BARI Safeda-1)	1	12	12	90
10.	Pummelo (BARI Batabi Lebu-2)	1	12	12	100
11.	Papaya (Red lady)	2	12	24	80
12.	Aonla (BARI Amloki-1)	1	60	60	95
13.	Indian Bay leaf (Local)	1	30	30	100
Total saplings distributed				536	

Key findings: Farmers all have few fruit plants in their homestead area. But lack of proper management they could not get proper yield. For doing proper management of old fruit plants and motivational work to eat nutritious food, the consumption of fruits by family members were increased than before intervention. Saplings of fruit trees were distributed among the farmers of the sub-project to increase homestead fruit production and meet up malnutrition of their family member. Survivability of different kind of fruit saplings were ranges from 80-100%.

Key words: Fruit, management, Nutrition, Plantation and Survivability

12.6 Title: Raised Mini Nursery of Vegetables Seedling Using Vermicompost in Seed Starting Cell Tray

Background:

Flood is a regular phenomenon for char land people. Every year flood come between the times from June to August. During flood farmers could not produce seedling for their homestead garden. After recession of flood water, farmers have to buy seedling by higher price. On the other hand more or less every farmer at the char land has cattles. Cowdung is available at their house. So a mini nursery utilizing cowdung through vermicomposting is a sustainable way to get healthy seedlings just after receding flood water and utilize cowdung.

Objective: To grow healthy seedling and reduce cost of production in sustainable way.

Methodology:

Vermicomposting technology was disseminated among the woman farmers of the households. To utilize cowdung the compost was prepared by vermicomposting. Vegetables seedlings were grown using seed starter tray in raised bed of 40-45 cm high, 1.5 m wide and 3 m long with bamboo shade. The bamboo shade was covered with net and also with white polythene. The cell of the seed starter tray was filled with growing media according to the following treatment.

T1: Sand : Soil = 1:1

T2: Vermicompost = 100%

T3: Soil : Vermicompost = 1:1

T4: Soil : Sand : Vermicompost = 1:1:1

T5: Soil : Cocopeat = 1:1

T6: Vermicompost : Cocopeat = 1:1

T7: Soil : Vermicompost : Cocopeat = 1:1:1

Cauliflower seed was taken for the experiment. Single seed was sown in each cell of the seed starter tray. The trays were covered with black polythene sheet for 2-3 days and after that the trays were placed on the raised bed. Irrigation was done regularly. The seedlings were allowed to grow for 7 days.

Key findings:

From the result it was observed at seventh day that treatment T2 showed the 100% germination with highest height (3 cm) of seedling. So that farmers can easily produce seedling at their homestead utilizing their own cowdung through vermicomposting at raised bed. This will reduce cost of homestead vegetables production and ensure early vegetables production by getting healthy seedling just after recession of flood water. It could be concluded that in a raised nursery bed farmers can grow their seedlings themselves timely even during flood to grow vegetables at their homestead just after removal of flood water. It also ensures healthy seedlings and reduces cost of production in sustainable way.

Keywords: Mini nursery, Seed starter, Seedling, Healthy seedlings

FSRD Site: Padma Char (BSRI)**12.7. Title: Year round vegetables production in homestead****Background:**

In the Padma char, Ishurdi Pabna there were fallow and un-utilized homestead areas. Farmers have very few fruits trees and vegetables at their homestead. To bring this unused land in to exploited scientifically in considering time and space. Bangladesh Agricultural Research Institute (BARI) developed a vegetables production model “Goyespur” model was followed for vegetables production in the homestead of selected 12 farmers with some modifications according the choice of the farmers and suitability of the char land area.

Objective: To improve farmers’ economy and nutrition from vegetables production by efficient utilization of homestead.

Methodology:

The area of each vegetables garden was about 6.0 to 6.5 decimal land at homestead. For implementing “Goyespur” model, in sunny places, 4 beds were prepared by each farmer, three trellis were prepared in each homestead for creeper crop cultivation. The crops were selected for different production unit on the basis of the model with some modifications according to the choice of the farmers and suitability of the char land area. Fertilizers N, P and K were applied in each crop at recommended rates. Irrigation was applied as and when necessary.

Table 12.7.1. Proposed cropping patterns of year round profitable vegetables and fruits production in different niches at FSRD site Padma Char, Ishurdi, Pabna

SI No.	Space		Rabi	Kharif-I	Kharif-II
			October 2018 – March 2019	April 2019 – June 2019	July 2019 – September 2019
1	Open land	Bed-1	Tomato (Hybrid)	Onion (BARI Pijaj-2)	Water spinach
		Bed-2	Chilli (Hybrid)	Lady’s finger (Hybrid)	Indian spinach
		Bed-3	Cauliflower (Hybrid)	Carrot (Hybrid)	Stem amaranth
		Bed-4	Brinjal (Islampuri) + Red amaranth (Hybrid)	Indian spinach (Hybrid)	Lady’s finger
2	Roof top		White gourd (Hybrid)	White gourd (Hybrid)	White gourd (Hybrid)
3	Trellis	Trelly-1	Country bean (BARI Sheem-1)	Cucumber (Hybrid)	White gourd (Hybrid)
		Trelly-2	Bitter gourd (Hybrid)+Spinach (Hybrid)	Sponge gourd (Hybrid)	Bitter gourd (Hybrid)
		Trelly-3	Bottle gourd (Hybrid)	Snake gourd (Hybrid)	Sponge gourd (Hybrid)
4	Tree support		-	-	-
5	Partial shady area		Spinach (Hybrid)/Red amaranth (Hybrid)/Jute leaves (Binapatshak-1)	Turmeric (BARI Halud-1) Leaf aroid (Moulavi kachu)	

SI No.	Space	Rabi	Kharif-I	Kharif-II
		October 2018 – March 2019	April 2019 – June 2019	July 2019 – September 2019
6	Marshy land	Latiraj (BARI Panikachu-1)		
7	Fence	Bitter gourd (Hybrid)	Bitter gourd (Hybrid)	
8	Homestead boundary	a. Papaya (3-5 plant) (Red lady) b. Guava (1-2 plant) (Thai Guava-7) c. Lemon (1-2 plant) (Binalebu-1)		
9	Back yard/waste land	1. Drumstick 2. Chewing type sugarcane (Amrita)		

Key findings:

By utilizing 6.0 to 6.5 decimal land of the homestead and used 9 different production unit, each farmer produced avg. 1238 kg vegetables among which they consumed 321 kg, distributed 177 kg and sold 735 kg vegetables whereas before intervention production, consumption, distribution and selling were 216 kg, 78 kg and 118 kg, respectively. Among the niches roof top give the highest vegetables production 379 kg, 331kg and 405 kg during the 2018-19, 2019-20 and 2020-21, respectively and lowest production was found from fence 26 kg, 32 kg and 21 kg during 2018-19, 2019-20 and 2020-21, respectively. From vegetables and fruit production in the homestead each farmers earned Tk. 18565 which was 125% higher than before intervention.

Key words: Homestead, Char land, Goyespur model, Vegetables

12.8. Title: Year round fruit production in homestead at FSRD site

Background: In the Padma Char, Pakshi Ishurdi there was some fallow and un-utilized homestead areas. Farmers have very few fruits trees in their homestead. To bring this unused land for fruit production, Bangladesh Agricultural Research Institute (BARI) developed “Goyespur” model was followed for fruit production in homestead boundary of 12 selected farmers with some modifications according the choice of the farmer and suitability of the char land area.

Objective: To improve farmers’ economy and nutrition from fruit production by efficient utilization of homestead.

Methodology:

The area of each homestead was about 6.0 to 6.5 decimal. For implementing “Goyespur” model some fruit sapling (papaya, Guava and lemon) were planted at the homestead of 12 farmers. The fruit saplings were selected according the choice of the farmer and suitability of the char land area. Fertilizers N, P and K were applied in each crop at recommended rates. Irrigation was applied as and when necessary.

Key findings:

After intervention each farmer produced Avg. 246 kg fruits among which they consumed 185 kg, distributed 28 kg and sold 32 kg fruits whereas before intervention production, consumption, distribution and selling were 162 kg, 98 kg, 17 kg and 47 kg, respectively. After intervention, each farmer earned Tk. 4926 homestead⁻¹ which is 52% higher than before intervention.

Key words: Homestead, Char land, Goyespur model, Fruits

12.9. Title: Performance of chewing cane variety cultivation in homestead at FSRD Char land ecosystem

Background: Chewing cane is very popular in Bangladesh and a number of varieties of chewing cane are being cultivated from the very old days in different part of the country, which is grown mostly following local and inappropriate production technologies resulting poor yield and quality of chewing cane. The management practices for chewing cane vary from place to place and even to farmers to farmers. The present study areas farmers are cultivated local chewing varieties but they do not follow proper management

practices from planting to harvesting. Therefore, the present study was undertaken to select suitable chewing varieties for chewing purpose in char land eco system under AEZ 11 for higher economic return.

Objectives:

- i) To Select Suitable chewing cane varieties for increasing the yield and quality of chewing cane in char land eco system
- ii) To increase farmers income through chewing cane cultivation.

Methodology:

Chewing type sugarcane variety BSRI Akh 42 (Rongbilash) were planted at 12 selected farmer's homestead of FSRD site Ishurdi, Pabna during 2018-2019, 2019-2020 and 2020-2021 cropping season. The program was under taken to observed performance of chewing type sugarcane, increase nutritional status as well as income of farm family at homestead of Char land ecosystem.

Table 12.9.1. Homestead chewing cane cultivation cost and returns analysis (av. of three years)

No. of farmers	No. of pit/homestead	No. of settling/ pit	No. of cane/ farmer	Gross Return (Tk.)/farmer	Total variable cost (Tk.)	Gross Margin (Tk.)
12	15	5	310	6200	1020	5180

Key findings: The program was undertaken to observed performance of chewing type sugarcane BSRI Akh 42 (Rongbilash), increase nutrition status as well as income of farm family at homestead of Char land ecosystem. It was found that each farm family earned Tk. 3450, Tk. 5495 and Tk. 7180, respectively during three consecutive year.

Keywords: Chewing cane, Char land, Sugarcane, Productivity

12.10 Title: Distribution of fruit saplings

Background: Farmers have very few fruits at the boundary of their house. They were not aware to intake sufficient fruits for nutrition. They did not buy enough fruits and take small amount of fruits, which are not sufficient for nutrition. Sapling of fruit trees were distributed among the farmers to increase homestead fruit production and to meet up malnutrition of their family members.

Objective: To improve farmers' economy and nutrition from fruits production by utilizing boundary and backyard unused land.

Methodology: Seventeen hundred saplings were distributed among the farmers to get fruits for year round. Survival rate of different fruit saplings ranged from 70-100 percent. For ensure nutritional security of the member of the households, cutting of chewing sugarcane were also distributed to the farmers.

Table 12.10.1. Sapling distribution of fruit trees at FSRD site Padma Char, Ishurdi, Pabna

Name of fruit sapling / Species	Variety	Sapling (No.)	Planting month	Survivability (%)
Mango	BARI Aam-3	100	April, 2018 May, 2019	80
Litchi	BARI Litchi-3	100		75
Guava	BARI Peyara-2	100		85
Lemon	BARI Lebu-1	200		85
Indian Olive	Local	100		75
Rose apple	Local	100		90
Golden apple	Local	100		85
Coconut	Local	100		95
Custard apple	Local	100		88
Carambola (Kamranga)	Hybrid	100		85

Name of fruit sapling / Species	Variety	Sapling (No.)	Planting month	Survivability (%)
Wood apple	Hybrid	100	March, 2020	77
Bullock's heart (Ata)	Local	100		70
Papaya	Local	100		100
Indian dillenia (Chalta)	Local	100		92
Pummelo	BARI Batabilebu-3	100		87
Aonla	BARI Amloki-1	100		85
Total		1700		Range 70-100

Key findings: Farmers all have few fruit plants in their homestead area. But lack of proper management they could not get proper yield. For doing proper management of old fruit plants and motivational work to eat nutritious food, the consumption of fruits by family members were increased than before intervention. Saplings of fruit trees were distributed among the farmers of the sub-project to increase homestead fruit production and meet up malnutrition of their family members. Survivability of different kind of fruit saplings were ranged from 70-100%.

Key words: Fruit, Management, Nutrition and Plantation

FSRD Site: Baghabari, Sirajganj (BLRI)

12.11. Title: Year round vegetables and fruit production at homestead

Background:

In the Baghabari, Shahajadpur, Sirajganj there were found fallow and un-utilized land at homestead areas. Farmers have very few fruits trees and vegetables at their homestead. To bring this unused land in to exploited scientifically in considering time and space. Bangladesh Agricultural Research Institute (BARI) developed vegetables production model "Goyespur" model was followed in vegetables production systems by 12 farmers with some modifications according the choice of the farmers and suitability of the char land area.

Objective: To improve farmers' economy and nutrition from vegetables production by efficient utilization of homestead.

Methodology:

The area of each vegetables garden was about 5.0 to 7.0 decimals at homestead. For implementing "Goyespur" model, in sunny places, four beds were prepared by each farmer for cultivation of different short duration vegetables. The crops were selected for different production unit on the basis of the model with some modifications according the choice of the farmers and suitability of the char land area. Fertilizers N, P and K were applied in each crop at recommended rates. Irrigation was applied as and when necessary.

Table 12.11.1. Vegetables based cropping pattern and fruits production in homestead at FSRD Site, Baghabari, Sirajganj.

Sl. No.	Spaces		Cropping patterns
1.	Open land	a.	Radish - Stem Amaranth - Indian spinach
		b.	Cauliflower - Brinjal - Red Amaranth
		c.	Tomato - Spinach - Okra
2.	Roof	a.	Bottle gourd - Wax gourd
3.	Trellis	a.	Bottle gourd - sweet gourd
4.	Tree support	a.	Bitter gourd - Ridge gourd - Sponge gourd
		b.	Snake gourd - Potato Yam
		c.	Country bean - Yard long bean
5.	Partial shady area	a.	Elephant foot yam
		b.	Leafy aroid (Moulavikachu)
		c.	Turmeric

Sl. No.	Spaces		Cropping patterns
		d.	Perennial chilli
6.	Marshy land	a.	Panikachu (Latiraj)
7.	Fence	a.	Bitter gourd - Yard long bean - Bitter gourd
8.	Homestead boundary	a.	Papaya
		b.	Guava
		c.	Lemon
9.	Back yard/waste land	a.	Drumstick
		B	Banana

Key findings:

By utilizing 5 to 7 decimal land of the homestead, each farmer produced Avg. 536 kg vegetables among which they consumed 96 kg, distributed 45 kg and sold 395 kg vegetables whereas before intervention production, consumption, distribution and selling were 84 kg, 38.5 kg, 11.5 kg and 34 kg, respectively. From house boundary by growing fruits farmer produced Avg. 427 kg fruits among which they consumed 211 kg, distributed 63 kg and sold 163 kg whereas before intervention production, consumption, distribution and selling were 220 kg, 90 kg, 20 kg and 110 kg, respectively. By growing vegetables and fruits utilizing 9 different production units of homestead farmers earned Tk. 18490 which is 145% higher than before intervention.

Key words: Homestead, Char land, Goyespur model, Vegetables and Fruits

B. Crops and Cropping System

FSRD site: Char Kharicha Mymensingh and Chapara, Sonatola Bogura (BARI)

12.12. Title: Development of alternate cropping pattern against existing cropping pattern

Background:

In both sites, Boro - Fallow - T. Aman rice is the predominant cropping pattern and, in most cases, farmers are using local cultivar of those crop that are the key barriers for improvement of the existing cropping system. Adopting more crops with higher yield potentials having short lifespan according to the suitability of the local ecosystem along with better management practices play significant role in the development of the traditional systems.

Objective: To increase crop productivity and cropping intensity in the char lands ecosystem of Mymensingh and Bogura.

Methodology:

The study was conducted at two FSRD sites Bogura and Mymensingh during 2018-20. According to the suitability of the land, three crop based two cropping patterns viz. Mustard - Boro -T. Aman rice and Potato - Boro - T.Aman rice were studied against the existing cropping pattern Boro - Fallow- T. Aman rice at FSRD site, Mymensingh. On the other hand, a 4-four crop based cropping pattern Mustard - Boro - T. Aus -T. Aman rice and a 3-crop based cropping pattern Wheat - Jute - T. Aman rice was tested against Mustard - Boro - T. Aman rice and Boro-Fallow-T. Aman rice, respectively at FSRD site, Bogura.

Key findings:

- At FSRD site Mymensing considering average of two years, REY in improved cropping pattern (Mustard - Boro -T. Aman rice) was 13.58 tha^{-1} against 9.06 in existing pattern that contributed higher gross margin (Tk. 111691 ha^{-1}), while Potato - Boro - T. Aman rice produced higher REY (35.68 tha^{-1}) over 9.15 tha^{-1} in existing pattern that contributed higher gross margin (Tk. 414236 ha^{-1}).
- On the other hand, at FSRD site Bogura average REY of 4 and 3 crop based cropping pattern were 16.23 and 11.08 tha^{-1} and gross margin were Tk. 155645 and Tk. 102135 ha^{-1} , respectively.

Key word: Cropping pattern, REY and Grossmargin

FSRD Site: Nawvanger Char Jamalpur (BINA)

12.13. Title: Improvement of cropping pattern Jute (var. JRO 524)-T. Aman (var. Binadhan-11)-Maize (var. Hybrid 981)

Background:

Three crops cropping pattern was followed by the char land farmers. Farmers cultivated Sharwna variety as T. Aman rice. In this area flash flood is regular phenomena which damaged rice seedling at early stage. This variety is also not yielded high. On the other hand as a third crop farmers produced grasspea just to grazing their cattle and also sold some of them as fodder. As a result, total income from these crops growing round the year was not satisfactory. In this 3crops cropping pattern short duration submergence tolerance rice variety Binadhan-11 was introduced in the kharif-II and maize hybrid variety Hybrid 981 was introduced instead of grasspea in rabi season.

Objective: To increase and sustain farm productivity and income of the farmers

Methodology:

Cropping pattern of Jute (var. JRO 524)-T. Aman (var. Sharwna/Hori)-Grasspea (BARI Ksheshari-3) was improved by inclusion of Jute (var. JRO 524)-T. Aman (var. Binadhan-11)-Maize (var. Hybrid 981) at the FSRD site, Nawvanger char, Jamalpur sadar. Varieties developed by BINA were chosen to cultivate in kharif-II season of the cropping sequence.

Table 12.13.1. Crop managements of alternate cropping pattern and existing cropping pattern at FSRD site Nawvanger Char, Jamalpur

Observation	Improved cropping pattern			Existing cropping pattern		
	Jute	T. Aman	Maize	Jute	T. Aman	Grasspea
Crop	Jute	T. Aman	Maize	Jute	T. Aman	Grasspea
Variety	JRO 524	Binadhan-11	Hybrid 981.	JRO 524	Sharwna	BARI Ksheshari-3
Date of sowing/ Transplanting	05 April	10 July/ 05 August	08 November	05 April	10 July/ 05 August	15 November
Seed rate (kg ha ⁻¹)	7.5	30	20	7.5	30	40
Spacing	30cm x 5cm	20cm x 15cm	75cm x 25cm	30cm x 5cm	20cm x 15cm	-
Fertilizer dose (urea-TSP-Mop- Gyp-Zn-B (kg ha ⁻¹)	225-150- 112-75-7.5- 7.5	160-120-80- 60-7.5-7.5	512-275-200- 222-14-6	220-150-115- 75-7.5-7.5	150-100-120- 80-7.5-7.5	50-80-30
Date of harvesting	10 July	30 October	30 March	10 July	08 November	25 March
Field duration (days)	95	85	142	95	93	130
Turned around time	25	8	5	25	7	10

Key findings:

Bangladesh Institute of Nuclear Agriculture developed submergence tolerance rice variety Binadhan-11 and maize hybrid variety Hybrid 981 tremendously increased the system productivity and economic return of the three crops pattern. Average gross margin Tk. 2,44,525 ha⁻¹ obtained from improve cropping pattern which was higher than existing cropping pattern (Tk. 79950 ha⁻¹). Gross margin increased 206% in improved cropping pattern compared to existing cropping pattern

Keywords: Cropping pattern, Binadhan-11, Jute, Maize and Productivity

12.14. Title: Improvement of cropping pattern Aus (var. Binadhan-19)-T. Aman (var. Binadhan-7)-Mustard (var. Binasarisha-9)-Mungbean (var. Binamoog-8)

Background:

Two crops cropping pattern was followed by the char land farmers. Farmers cultivated Sharwna variety as T. Aman rice. Due to cultivation of two crops land was kept unused 77 days after T. Aman harvest and 94 days

after Boro rice harvesting. For keeping fallow for one season and growing local rice variety the productivity as well as income was not found satisfactory. The existing cropping pattern Fallow-T. Aman (var. Sharwna)-Boro (var. BRRIdhan 28) was improved by inclusion of Aus (var. Binadhan-19)-T. Aman (var. Binadhan-7)-Mustard (var. Binasarisha-9)- Mungbean (var. Binamoog-8) at the FSRD site, Nawvanger Char, Jamalpur.

Objective: To increase and sustain total farm productivity and income of the farmers

Methodology:

Varieties developed by BINA were chosen to cultivate in cropping sequences. The details of crop management of different crops under proposed and existing cropping pattern are shown in the Table 11.14.1. Total field duration of four crops cropping pattern Mustard-Mungbean-T Aus-T. Aman will need 303 days (excluding seedling age of rice) to complete the cycle. In Kharif-I season Aus rice was grown instead of keeping fallow the land, in Kharif-II season short duration high yielding T. Aman rice variety Binadhan-7 was grown instead of local variety Sharwna and in rabi season Boro rice was replaced by growing mustard and mungbean in improved cropping which increased yield.

Table 12.14.1. Crop managements of alternate cropping pattern and existing cropping pattern at FSRD site Nawvanger Char, Jamalpur

Observation	Improved cropping pattern				Existing cropping pattern		
	Aus	T. Aman	Mustard	Mungbean	Fallow	T. Aman	Boro
Crop							
Variety	Binadhan-19	Binadhan-7	Binasarisha-9	Binamoog-8	-	Sharwna	BRRIdhan 28
Date of sowing/ Transplanting	02-25April	20 July- 15 August	10 November	13 February	-	10 July- 05 August	25 December- 25 January
Seed rate (kg ha ⁻¹)	30	30	7.5	30	-	30	30
Spacing	20cm x 15cm	20cm x 15cm	30cm x 5cm	30cm x 5cm	-	20cm x 15cm	20cm x 15cm
Fertilizer dose (Urea-TSP-Mop- Gyp-Zn-B kg ha ⁻¹)	174-87-70- 77-5-0	160-120-80- 60-7.5-7.5	85-75-50-55- 4-3	35-60-37-0- 0-0	-	150-100-120- 80-7.5-7.5	104-12-5-38- 20-5
Date of harvesting	07 July	30 October	02 February	17 April	-	08 November	01 May
Field duration (days)	72	85	82	64	-	93	95
Turned around time	38	10	11	8	-	77	94

Key findings:

The rice equivalent yield was increased due to cultivation of 4 crops by replacing 2 crops in the cropping year and also growing improved aman and aus rice variety at the Kharif-I and Kharif-II season. The improved cropping pattern need 322 days (excluding seedling age of rice) to complete the cycle. Average gross margin Tk. 1,22,174 ha⁻¹ was obtained from improve cropping pattern which was higher than existing cropping pattern (Tk. 78,200 ha⁻¹). Gross margin increased 56% in improved cropping pattern compared to existing cropping pattern

Keywords: Cropping pattern, Binadhan-7, Binadhan-19, Binasarisha-9 and Binamoog-8

FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

12.15. Title: Improved cropping pattern Radish (Mollica) - Radish (Mollica) - Carrot (Orange king) - Wheat (BARI Gom 31)

Background:

Three crops cropping patterns were followed by the char land farmers. The existing cropping pattern Aus (BRRIdhan48) - Blackgram (BARI Mash-3) - Lentil (BARI Masur-6) was improved by four crops, Radish (Mollica) - Radish (Mollica) - Carrot (Orange king) - Wheat (BARI Gom-31) at the FSRD site, Padma Char, Ishurdi Pabna.

Objective: To increase and sustain farm productivity and income

Methodology:

Varieties developed by BARI were chosen to cultivate in cropping sequences. The details of crop management of different crops under proposed and existing cropping pattern are shown in the Table 12.15.1. Total field duration of four crops cropping pattern Radish (Mollica) - Radish (Mollica) - Carrot (Orange king) - Wheat (BARI Gom-31) needed 300 days to complete the cycle.

Table 12.15.1. Crop managements of improved and existing cropping pattern at FSRD site, Padma Char, Ishurdi, Pabna

Observation	Improved cropping pattern				Existing cropping pattern		
	Radish	Radish	Carrot	Wheat	Aus	Blackgram	Lentil
Crop	Radish	Radish	Carrot	Wheat	Aus	Blackgram	Lentil
Variety	Mollica	Mollica	Orange king	BARI Gom-31	BIRRI dhan48	BARI Mash-3	BARI Masur -6
Date of sowing/ Transplanting	15.05.2019	06.07.2019	28.08.2019	30.11.2019	15.04.2019	20.08.2019	01.11.2019
Seed rate (kg ha ⁻¹)	4	4	3.5	120	60	35	30
Spacing	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast
Fertilizer dose (N-P-K-S-Zn kg ha ⁻¹)	45-15-40-6	45-15-40-6	40-13-30-6	40-8-30-5	32-4-20-3	6-5-6-3	7-6-7-3
Date of harvesting (range)	30.06.2019	21.08.2019	25.11.2019	28.03.2020	14.08.2019	25.10.2019	20.02.2020
Field duration (days)	45	45	90	120	121	76	111

Key findings: The rice equivalent yield was increased due to cultivation of 4 crops by replacing 3 crops in the cropping year. The improved cropping pattern needed 300 days to complete the cycle. Average gross margin Tk. 7,83,400 ha⁻¹ was obtained from improve cropping pattern which was higher than existing cropping pattern (Tk. 2,38,418 ha⁻¹). Gross margin increased 228% in improved cropping pattern compared to existing cropping pattern

Keywords: Cropping pattern, Radish, Carrot, Wheat, Blackgram, and Lentil

12.16. Title: Improved cropping pattern Radish (Mollica)-Carrot (Orange king) - Ground nut (BARI Chinabadam-8)

Background:

Two crops cropping pattern was followed by the char land farmers. The existing cropping pattern Aus (BIRRI dhan48) - Mustard – Fallow was improved by three crops, Radish (Mollica)- Carrot (Orange king)- Ground nut (BARI Chinabadam- 8) at the FSRD site, Padmar Char , Pakshi, Ishurdi.

Objective: To increase and sustain farm productivity and income

Methodology:

The details of crop management of different crops under proposed and existing cropping pattern are shown in the 12.16.1. Total field duration of three crops cropping pattern Radish (Mollica)-Carrot (Orange king) - Ground nut (BARI Chinabadam -8) needed 312 days to complete the cycle.

Table 12.16.1. Crop managements of improved and existing cropping pattern at FSRD site, Padma Char, Ishurdi, Pabna

Observation	Improved cropping pattern			Existing cropping pattern		
	Radish	Carrot	Ground nut	Aus	Mustard	Fallow
Variety	Mollica	Orange king	BARI Chinabadam -8	BRRI dhan48	Local	-
Date of sowing/ Transplanting	9-15 May	6-8 July	10-15 Nov.	15-20 April	28-30 Oct.	-
Seed rate (kg ha ⁻¹)	4	3.5	100	120	7	-
Spacing (cm)	Broadcast	Broadcast	15 × 30	Broadcast	45 × 100	-
Fertilizer dose (N- P-K-S-Mn kg ha ⁻¹)	45-15-40- 6	40-13-30-6	12-12-15-12	40-8-30-5	60-20-45-15-10	-
Date of harvesting	28-30 June	04-06 Oct.	18-20 May	14-15 August	20-22 December	-
Field duration (days)	45	90	189	121	53	

Key findings:

The rice equivalent yield was increased due to cultivation of 3 crops by replacing 2 crops in the cropping year. The improved cropping pattern needed 314 days to complete the cycle. Average gross margin Tk. 8,83,250 ha⁻¹ was obtained from improve cropping pattern which was higher than existing cropping pattern (Tk. 2,18,288 ha⁻¹). Gross margin increased 304% in improved cropping pattern compared to existing cropping pattern.

Keywords: Cropping pattern, Radish, Carrot, Groundnut, Mustard

FSRD Site: Baghabari, Sirajganj (BLRI)

12.17. Title: Improvement of the existing Boro-Fallow-T. Aman cropping pattern through inclusion of oil seed and pulse crops

Background:

There is very little scope to increase the area under rice cultivation rather there is a great demand to release some land for non-rice crops to meet the diversified needs of the farmers. So, it is essential to increase the productivity of rice and non-rice crops by utilization of fallow period in the cropping pattern. Mustard is one of the most important oil seed crops in Bangladesh and now-a-days is successfully cultivated in wet-dry transition period between T. Aman and Boro in many locations of the country. BARI has developed short duration, pest and disease resistant mustard varieties which are agro economically suitable and profitable.

Objectives:

- a) To validate different cropping patterns by introducing short duration variety of mustard.
- b) To increase land productivity by introducing new crops in the existing pattern.
- c) To increase overall farm income.

Methodology:

The experiment was conducted during 2018 to 2020 at the FSRD site Baghabari, Shahajadpur Sirajganj. Two alternate cropping patterns viz., CP1: Mustard- Boro-T. Aman, CP2: Onion-Sesame -T. Aman were tested against existing CP1: Boro - Fallow-T. Aman cropping pattern. For each pattern three farmers were treated as replication. Rice variety BRRI dhan74 was used in Boro season, BRRI dhan28 was used in T. Aus and BRRI dhan 51 was used in T. Aman season. In case of mustard; BARI Sarisha-14 was used. Average size of the plot was one bigha (33 dec.) per farmer. The management practices followed in this experiment has been given in Table 12.17.1 and 12.17.2. The yield of each crop was converted to rice equivalent yield for comparing the system productivity.

Table 12.17.1. CP-1 Crop managements of alternate and existing cropping pattern at FSRD site Baghabari, Sirajganj

Observation	Improved cropping pattern			Existing cropping pattern		
	Mustard	Boro	T. aman	Fallow	Boro	T. aman
Variety	BARI Sarisha-14	BRRRI dhan 74	BRRRI dhan51	-	BRRRI dhan28	Local
Date of sowing/ Transplanting	17-20 November	4-10 February	15-20 July	-	5-10 February	16-25 July
Seed rate (kg ha ⁻¹)	8.0	40.0	40.0	-	50.0	50.0
Spacing (cm)	Broadcast	20 × 15	20 × 15	-	20 × 15	Broadcast
Fertilizer dose (N-P-K-S-Zn-B kg ha ⁻¹)	115-34-40-24-2-1	135-20-60-18-4	80-22-35-1	-	115-19-60-17-2	70-16-30-0-0
Date of harvesting (range)	6-10 Feb.	15-22 May	12-15 Nov.	-	10-17 May	10-18 Nov.

Table 12.17.2. CP-2 Crop managements of improved and existing cropping pattern at FSRD site Baghabari, Sirajganj

Observation	Improved cropping pattern			Existing cropping pattern		
	Onion	Til	T. aman	Onion	Jute	Fallow
Crop	Onion	Til	T. aman	Onion	Jute	Fallow
Variety	BARI Piaj- 4	BARI Til- 4	BRRRI dhan51	Taherpuri	Local	-
Date of sowing/ Transplanting	15-30 Dec.	5-15 April	15-20 July	10-15 Dec.	10-15 July	-
Seed rate ((kg ha ⁻¹)	7.5	7	40	-	50	50
Spacing (cm)	5 × 4	Broadcasting	Broadcasting	5 × 4	20 × 15	-
Fertilizer dose (N-P-K-S-Zn-B kg ha ⁻¹)	120-50-110-24-4-2	135-20-60-18-4	80-22-35-1	120-50-110-24-4-2	115-19-60-17-2	-
Date of harvesting	20 March	15 July	12 November	25 March	15 November	-

Key findings:

Alternate cropping pattern-1: Mustard (BARI Sarisha-14)-Boro (BRRRI dhan74)-T. Aman (BRRRI dhan51).

The rice equivalent yields of alternate and existing cropping pattern were 12.37 t ha⁻¹ year⁻¹ and 9.42 t ha⁻¹ year⁻¹, respectively. From the cost and return analysis, it was observed that alternate cropping pattern performed better than the existing cropping pattern. The gross margin was higher in alternate cropping pattern (Tk. 60370 ha⁻¹) compared to the existing cropping pattern (Tk. 21000 ha⁻¹). It was mainly influenced by the additional mustard crop in the pattern. The marginal benefit cost ratio (MBCR) was found 1.95 which indicated the superiority of the three crops pattern over farmers' pattern.

Alternate cropping pattern-2: Onion (BARI Piaj -4)-Sesame (BARI Til -4) -T. Aman (BRRRI dhan51)

The rice equivalent yields of alternate and existing cropping patterns were 14.75 t ha⁻¹ year⁻¹ and 10.80 t ha⁻¹ year⁻¹ respectively. From the cost and return analysis, it was observed that, improved cropping pattern performed better than the existing cropping pattern. The gross margin was higher in improved cropping pattern (Tk. 180700 ha⁻¹) compared to the existing cropping pattern (Tk. 156750 ha⁻¹). It was mainly due to inclusion of improved variety of sesame and T. Aman in the cropping pattern. The marginal benefit cost ratio (MBCR) was found 1.30 which indicated the superiority of the three crops pattern over farmers' pattern. Farmer's opinion that cultivation of three crops in a year increased crop productivity.

Key words: Gross margin, Yield, Alternate cropping pattern, REY, MBCR and Farm Income.

12.18. Title: Replacement of existing sugarcane varieties by newly developed BSRI varieties in FSRD Char land Eco system (BSRI)

Background:

Sugarcane is cultivated both mill and non-mill zone mainly for sugar and gur purpose. Bangladesh Sugarcrop Research Institute developed 46 cane varieties so far of which only the oldest and mixed varieties are occupying in FSRD site. The yield of cane of the existing cultivated varieties in FSRD site is very poor. The progress of dissemination of recently developed sugarcane varieties in FSRD site is not satisfactory. It is needed to replace the existing sugarcane varieties by newly released/developed varieties of BSRI. Therefore, the experiment was undertaken to demonstrate superiority of these varieties and to replace of existing sugarcane varieties by introducing newly developed BSRI varieties.

Objectives:

- i. To replace the existing traditional sugarcane varieties by high yielding new sugarcane varieties developed by BSRI
- ii. To increase the farmers income by cultivating sugarcane

Methodology:

Sugarcane varieties Isd 34, Isd 39, Isd 40, BSRI Akh 43, BSRI Akh 44, BSRI Akh 45 and BSRI Akh 46 were planted at 12 selected farmer's field of FSRD site Ishurdi, Pabna during 2018-2019, 2019-2020 and 2020-2021 cropping season. The program was under taken to replace the existing traditional sugarcane varieties by high yielding new sugarcane varieties developed by BSRI in Char land ecosystem. The Plot size was 0.14 hectare per farmer.

Key findings:

The tested varieties were Isd 34, Isd 39, Isd 40, BSRI Akh 43, BSRI Akh 44, BSRI Akh 45 and BSRI Akh 46. Among the seven varieties, BSRI Akh 46 gave the highest yield (98.56 tha^{-1}) and maximum gross margin (Tk. 149929 ha^{-1}) during three cropping season.

Keywords: Sugarcane, Charland, Setts and Settling

Production Program

12.19. Title: Production program with HYVs of different crops under existing cropping pattern at FSRD site, Mymensingh and Bogura (BARI)

Background:

Farmers are usually used their land for growing crops as a sequence in a year. Uses of traditional varieties or under knowledge about the modern cultivation practices are the key barriers for improvement of the existing cropping system. Adopting more crops with higher yield potentials having short lifespan according to the suitability of the local ecosystem along with better management practices play significant role in the development of the traditional systems. With the view of increasing system productivity through inclusion of more crops in a year sequence on the same piece of land following optimized production technologies, different crops were tested in the both FSRD sites.

Objectives:

- i) To increase total productivity of land by replacing local rice variety with high yielding variety.
- ii) To increase farm income.

Methodology:

FSRD site, Mymensingh: Production program were conducted with vegetables, quick growing fruits, mustard and potato during 2018 to 2021. Production program with HYV of Okra (var. BARI Dherosh-2), Bottle gourd (var. BARI Lau-3), Snake gourd (var. Local), Stem amaranth (var. BARI Danta-1), Bitter gourd (var. BARI Korola-2), Potato (var. BARI Alu-25), Mustard (var. BARI Sarisha-14), Papaya (var. Local) and

Brinjal (var. Local) were produced at FSRD site, Mymensingh during the year of 2018-2021. On the other hand, production program with HYV of potato (BARI Alu-25 and BARI Alu-36), mustard (BARI Sarisha-14), sweet potato (BARI Misti Alu-8), wheat (BARI Gom-28, BARI Gom-30 and BARI Gom-33) and maize (BARI Hybrid Maize-9) were conducted at FSRD site, Mymensingh. Application of recommended doses of fertilizer with cultural management practices enhanced the yield of respective crops.

FSRD site, Bogura: Production programs were conducted with potato, sweet potato, mustard, wheat and maize during 2018 to 2021. Application of recommended doses of fertilizer with cultural management practices enhanced the yield of respective crops.

Key findings:

FSRD site, Mymensingh: Average yield, gross margin and BCR were found in Okra (19.58 tha^{-1} , Tk. 207755 ha^{-1} and 4.74), Bottle gourd (28.90 tha^{-1} , Tk. 209850 ha^{-1} and 2.72), Snake gourd (20.35 tha^{-1} , Tk. 180000 ha^{-1} and 2.96), Stem amaranth (33.75 tha^{-1} , Tk. 234710 ha^{-1} and 5.44), Bitter gourd (19.96 tha^{-1} , Tk. 213050 ha^{-1} and 2.54), Potato (26.97 tha^{-1} , Tk. 183966 ha^{-1} and 2.51), Mustard (1.66 tha^{-1} , Tk. 4027 ha^{-1} and 2.28), Papaya (35.00 tha^{-1} , Tk. 332250 ha^{-1} and 2.72) and Brinjal (28.00 tha^{-1} , Tk. 440000 ha^{-1} and 3.66), respectively during the year of 2018-21.

FSRD site, Bogura: Average yield of potato, mustard, sweet potato, wheat and maize was 26.65, 1.47, 24.52, 3.62 and 7.50 t ha^{-1} respectively and gross margin were Tk. 150000, Tk. 44740, Tk. 143480, Tk. 33510 and Tk. 56760 ha^{-1} , respectively during the year of 2018-21.

Farmer's opinion: Both potato and mustard varieties were high yielder than the local cultivar and thus farmers were very happy to cultivate those crop varieties in between two rice crops. The variety of sweet potato (BARI Misti Alu-8) was higher yielder than local cultivar and orange fleshed with better taste. The wheat varieties were higher yielder as well as rust, blast resistant and heat tolerant. Yield of maize varieties was not up to mark, moreover they had lodging tendency to storm. Fall army worm is a new threat for maize cultivation.

Key word: Yield, Production program, Grossmargin and BCR

12. 20. Title: Production program with HYVs of different crops at FSRD site Nawvanger Char, Jamalpur (BINA)

Background:

Jute, rice, groundnut, mustard and banana crops were grown for increasing area and production of these crops. Jute, BINA released T. Aman. rice (Binadhan-11), groundnut (Binachinabadam-4), mustard (Binasarisha-4 and Binasarisha-9) and banana (sabri) varieties were grown by the farmers to extend the varieties among the Char land farmers as they can be benefited more by getting higher yield.

Objectives:

- i) To increase total productivity of land by replacing local rice variety with high yielding variety.
- ii) To increase farm income.

Methodology:

The variety viz. JRO-524, Binadhan-7, Binadhan-11, Binachinabadam-4, Binasarisha-4, Binasarisha-9 and sabri banana were grown under production program.

Table 12.20.1. Production programme of jute, rice, groundnut and mustard at FSRD site Nawvanger Char, Jamalpur

Name of crops	Variety	Farmers (no)	Area (ha)	Date of sowing	Date of harvesting
Jute	JRO 524	8	5.6	04 April 2020	10 July 2020
Rice	Binadhan-11	4	5.6	20 July 2020	12 November 2020
Groundnut	Binachinabadam-4	2	1	15 September 2020	25-28 January 2021

Name of crops	Variety	Farmers (no)	Area (ha)	Date of sowing	Date of harvesting
Mustard	Binasarisha-4	4	1.4	10 November 2020	2-5 March 2021
	Binasarisha-9	4	2.0	10 November 2020	5-10 March 2021
Banana	Sabri	6	5 dec.farmer ⁻¹	20 September 2018	October 2019 and July 2020

Key findings: The gross return, total cost and gross margin of jute were found 147500 ha⁻¹, 105000 ha⁻¹ and Tk. 42000 ha⁻¹, respectively. The benefit cost ratio was 1.4. The average yield of Binadhan-11 was 4.8 t ha⁻¹ with gross margin was Tk. 41400 ha⁻¹. The benefit cost ratio was 1.7. The average yield of banana was 53 bunches per 5 decimal area. The gross return, total variable cost and gross margin were 15900, 4750 and Tk. 11150 ha⁻¹, respectively at 1st harvest and 16200, 3300 and Tk. 12900 ha⁻¹, respectively at the 2nd harvest. The benefit cost ratio was 3.3 at 1st harvest and 4.9 at 2nd harvest. The average yield of Binasarisha-4 and Binasarisha-9 was observed 1.42 and 1.46 t ha⁻¹ respectively along with gross margin in 30952 and Tk. 32572 ha⁻¹. The benefit cost ratio was found 2.12 and 2.18 for Binasarisha-4 and Binasarisha-9. The average yield, gross return, gross margin and BCR of Binachinabadam-4 were found 2.4 t ha⁻¹, Tk. 120000 ha⁻¹, Tk. 54000 ha⁻¹ and 1.81, respectively.

Keywords: Production programm, Rice, Groundnut, Mustard. Banana Gross return, Grossmargin and BCR

C. Livestock component

FSRD Site: Char Kharicha Mymensingh and Charpara, Sonatola (BARI)

12.21. Title: Deworming of cattle followed by vaccination at FSRD site, Mymensingh

Background:

The cattle is the key part of livestock component under FSRD program. Most of the farm families having some cattle those are suffering from parasitic infestation that hampers the proper growth and development of cattle. The profitability of livestock mostly depend on animal health and is thus farmers would be economically benefitted through deworming of cattle and as well as vaccination against some major diseases.

Objective: To increase farm productivity as well as livelihood improvement of farm family in the Char lands ecosystem of Mymensingh.

Methodology:

For deworming, a number of feces samples of cattle were selected by the symptomatic parasitic infection and then investigated the parasites through feces sample analysis. After confirmation of parasitic infestation, the test animal was de-wormed by broad spectrum anthelmintics i.e. Trilev-vet. Livamisole for round worm and Triclabendazole were provided for liver fluke as per recommendation of the body weight. After deworming, Vitamin A, D and E containing injections were also being injected in cattle.

Key findings:

The test animal was de-wormed by broad spectrum anthelmintics i.e. Trilev-vet (Livamisole & Triclabendazole) for round worm and liver fluke as per recommendation for the body weight. After deworming, Vitamin A, D and E containing injections were also being injected in cattle. A total 13 cattle of 8 farm families were dewormed under this program. After applying all sorts of interventions, the average body weight (40 g/day/cattle), lactation yield (up to 0.4 L/day) and the lactation period were increased and disease incidence decreased as compared to the controlled cattle.

Key words: Deworming, Cattle, Lactation

12.22. Title: Vaccination of cattle, goats, sheep and poultry birds at FSRD site, Mymensingh and Bogura

Background:

The livestock is an integral part of a farm family and an important component of FSRD program. Proper vaccination against major diseases may reduce the mortality rate of cattle, poultry, goats and sheep. For this purpose a short FGD was conducted to identify the disease severity and mortality after vaccination. The

vaccinated group Anthrax vaccine, Foot and mouth disease (FMD) vaccine were injected as per recommended schedule.

Objective: To increase farm productivity as well as livelihood improvement of farm family in the char lands ecosystem of Mymensingh and Bogura.

Methodology:

This program was conducted at FSRD site, Mymensingh and Bogura during 2018-2021. After FGD in both sites, frequency of disease incidence of livestock was listed out from the cooperative farmers and then vaccines were injected to cattle, poultry, goats, and sheep. Four types of vaccines as BCRDV, RDV, Fowl Pox, Fowl Cholera were vaccinated in this program. Vaccination of poultry birds was created a great awareness to the cooperator farmers and neighborhood of farm families. A total of 220 cattle and 1320 poultry birds were vaccinated under this program in FSRD site, Mymensingh. On the otherhand, a total of 920 livestock and 2934 poultry birds were vaccinated under this program in FSRD site, Bogura.

Key findings:

- A total of 220 cattle were vaccinated against major diseases i.e. Anthrax and FMD at FSRD site, Mymensingh, during 2018-2021. At FSRD Site Bogura, a total of 670 cattle were vaccinated against Anthrax and FMD and 200 goat and 120 sheep were vaccinated against PPR during 2018-20. Vaccination against major diseases reduce mortality rate upto nil (0%) instead of 15%.
- Different types of vaccines as BCRDV, RDV, Fowl Pox, Fowl Cholera, and Duck Plague were used for vaccination of poultry birds. Irrespective of location, RDV and Fowl Cholera vaccine reduced the mortality rate 78-86%, while BCRDV and Fowl pox vaccine could reduce the mortality rate at about 80-88%. After vaccination of poultry birds, all of the diseases frequency reduced drastically and mortality rate was about less than 5-6%.

Key words: BCRDV, RDV, Fowl pox and Fowl cholera

12.23. Title: Rearing of cattle, poultry birds at FSRD site, Mymensingh and Bogura

Background:

Cattle and poultry rearing is one of the vital parts of livestock and a common practice in rural Bangladesh while, duck rearing is the counterpart of livestock. On the other hand, turkey rearing is a new farming activity in Bangladesh. But diseases are the main problem for livestock rearing and it causes a great loss due to mortality rate and only proper vaccination can reduce the mortality rate of poultry.

Objective: To increase farm productivity as well as livelihood improvement of farm family in the char lands ecosystem of Mymensingh and Bogura.

Methodology:

Rearing of cattle, poultry birds conducted at FSRD site, Mymensingh and Bogura during 2018-2021. The success of livestock rearing mostly depends on proper vaccination. A good number of livestock populations were vaccinated during the sub-project period in both FSRD sites. In the vaccinated group BCRDV, RDV, Fowl pox and Fowl cholera vaccine were used as per recommended schedule. The vaccinated livestock were offered commercial feed, fodder and sufficient clean drinking water with dextrose saline twice a day. Rice husk with sand used as litter materials and changed twice in every week. During the day time those were kept in the open space nearby homestead and at night in their small house. Suggestions were made to the facilitator as and when necessary to solve the specific problem by regular contacting.

Key findings:

- Different poultry bird's viz. turkey, duck and sonali chicken rearing were done to produce meat and egg purpose at FSRD site, Mymensingh, while only duck rearing was done at FSRD site, Bogura during 2018-20. After providing supplementary feeds and proven technology body weight of poultry bird gained significantly along with laid eggs per bird (ave. 112 -120 eggs/ month) and consequently nutrient intake was increased in each farm family.
- Goat and sheep rearing were done at FSRD site, Bogura and only goat rearing was done at FSRD, Mymensingh to earn income as well as livelihood improvement of farm family. On an average each sheep produced 2 offspring (kids) at FSRD site, Bogura and earned gross margin Tk. 4333 per farmer. On the contrary, the income from goat rearing Tk. 4550 and Tk. 5120 farm⁻¹ at Bogura and Mymensingh, respectively.

Key words: Rearing, Cattle, Poultry birds and Duck, BCRDV, RDV, Fowl pox and Fowl cholera

12.24. Title: Beef fattening program at FSRD site, Mymensingh**Background:**

Beef is the culinary name for meat from cattle, particularly skeletal muscle. Humans have been eating beef since prehistoric times. Beef is the major source of protein and nutrients in Bangladesh and its demand is increasing day by day. Therefore, beef fattening program was carried out at FSRD site, Bogura during February 2020 to January 2021.

Objective: To increase farm productivity as well as livelihood improvement of farm family in the Char lands ecosystem.

Methodology:

At first 8 cattle were selected for fattening based on their age, size and shape. On an average each animal was 2 years old with squire shaped. After selection, animals went under deworming treatment as per suggestion of Department of Livestock Services (DLS). Thereafter, the cattle were fed with urea molasses straw, green grass, granular feed, @ 2-3, 5-6, 1 kg and water @10-15 L as per 100 kg body weight. The composition of urea molasses straw were 82% dry straw, 22% molasses, 2% urea and water 70%. To make 1.0 kg granular feed, 250 g wheat bran, 150 g rice bran, 200 g mustard oilcake, 150 g boiled broken rice grain, 200 milled pulses husk, 20 g salt, 25 g DCP and 0.05g vitamins were mixed. The animals were vaccinated against FMD and Anthrax. The animals were reared in confined condition. Water was given just after supply of granular feed. Vitamin-B was supplied as regular basis with the increased body weight. Initially the animals were fed with 2 kg sliced straw, 6 kg green grass and 1.5 kg granular feed. Molasses mixed water at the ratio of 20:1 was provided to the animals.

Key findings:

After 160 days rearing, weight of cattle increased remarkably ranged from 55 -140 kg with an average increased body weight 85.67 kg. The average increment of body weight was 50.17%. Initially the mean value of each cattle was Tk. 51833 which was increased to Tk. 67166 with an average increased value of 29.58%.

Key words: Beef, Fattening, Vaccination.

FSRD Site: Nawvanger Char, Jamalpur (BINA)

12.25. Title: Vaccination and deworming program of cattle and poultry birds**Background:**

The profitability of livestock mostly depends on animal health. There are some common diseases that animals should be routinely protected. Char land farmers conducted rearing of chicken; and cattle in less scientific manner; and mortality was a major challenge. A wide range of diseases causes the reduction of production, fertility or death in cattle, goat and chicken and economic losses to the farmers. Vaccines are expected to reduce the severity of disease in infected animals or limit the frequency of disease. Vaccination program was conducted at the FSRD sites of Nawvanger Char recommended by concerned personnel of livestock sector.

Objective: To increase animal productivity by reducing mortality of cattle and poultry birds

Methodology:

For success and effectiveness of cattle and poultry birds rearing vaccination program was conducted at the FSRD sites of Nawvanger char. Farmers selected for sub-project activities along with farmers lived around them were selected for vaccination program. Two doses of deworming were given at 35-40 days interval as per body weight of the cattle recommended by concerned personnel of ULO, Sadar, Jamalpur. Different types of vaccination were also done to control diseases of poultry birds as per schedule.

Key findings:

It was observed that dewormed cattle produce more milk (1.6 L/day) than controlled cattle (1.0 L/day). Average body weight was increased in dewormed cattle than the controlled. After vaccination of poultry bird's, frequency and mortality rate reduced significantly.

Keywords: Cattle, Poultry, Vaccination, Deworming and Health

12.26. Title: Fattening of cattle under farmers condition

Background:

At the Char area farmers reared cattle but in less scientific manner. By rearing cattle throughout the year, they could not profit enough. Farmers were not known about beef fattening program of livestock. To achieve the highest live weight in the shortest time, in the most economical way cattle fattening was conducted.

Objective: To increase animal productivity and income of the farmers

Methodology:

Beef fattening technique is introduced at Char land farming system. Twelve cattle from 12 farmers were selected for beef fattening program. Two round beef fattening activities were done in each year. In each year, first round beef fattening was done just before 3 to 4 months of Eid-ul-Adha when farmer sell the animal with profitable prices and second round beef fattening was done at the end of the year. Cattle fattening period is 3 to 4 months.

Key findings:

After 3-4 month of fattening body weight of the cattle was increased than initial body weight. Average gross margin per farmer was calculated Tk. 53,800 after deducting all cost including feed and medicine. Farmers are very happy due to getting higher profit from cattle fattening.

Keywords: Cattle, Fattening, Body weight and Income

12.27. Title: Rearing of Sonali chicken at farmers household

Background:

Marginal and small farmers of the FSRD site had few stocks of deshi chicken at their homestead but they do not have much knowledge on different aspects of poultry management. They are not well known about new varieties of poultry sonali chicken. Through this sub-project Sonali chicken were reared round the year to increase the income of the farmers.

Objective: To improve and sustain existing poultry production system.

Methodology:

Sonali chickens were reared for meat purpose. Chickens were reared in a small scale under semi-scavenging system. For improved rearing, two-chambered chicken coops were provided to each farmer. Farmers were provided 20-25 days old 20 chickens at each batch collected from hatcheries. Farmers feed the chickens about

25-30 g extra boiler starter feed 2 times daily. Technical supports (feeding, vaccination etc.) and advices were also given. Necessary treatment was also given as per requirement. They reared the chickens up to 80-85 days. They reared 3 batch chickens in each year.

Key findings:

Farmers invested Tk. 5,050 each year for feed supplement cost along with one month old birds buy, medicine and vaccination. By selling the chickens reared 3 times during each of the year farmers earned on average Tk. 7,067.

Keywords: Poultry, Sonali, Rearing, Chicken and Coops

12.28. Title: Rearing of pigeon at farmers' household

Background:

Farmers of the sub-project area reared pigeon in a very small scale. They were not aware about proper management of pigeon. Pigeon is a very good source of protein and also income generating. Cooperator farmers of Char area were provided local breed of pigeon with cage, feed and medicine etc. The rearing of pigeon would aware farmers about the benefits of pigeon rearing.

Objective: To increase income and nutritional status of the household.

Methodology

Five pairs of local breed of pigeon were distributed to each of 12 farmers. Cage and feeds were provided each farmer. Vaccination, necessary treatments and technical support were provided as and when necessary.

Key findings:

Survivability rate of distributed pigeon was found 94%. Every month the pigeon has produced squab. The growth rate of squab was very much faster within 12-14 days after hatching from egg it became ready to consumable/ marketable. Selling price per pair of squabs is Tk. 150 and farmers could earn Tk. 1800 per year from per pair of pigeon.

Keywords: Pigeon, Squab, Rearing, Income, Poultry and Survivability

FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

12.29. Title: Improvement of cattle health through deworming and dewormed + vitamin ADE injection

Background:

The profitability of livestock mostly depends on animal health. There are some common diseases that animals should be routinely protected. Char land farmers perform rearing of cattle in less scientific manner and mortality was a major challenge. A wide range of diseases causes the reduction of production, fertility or death in cattle and economic losses to the farmers. Vaccines are expected to reduce the severity of disease or limit the frequency of disease. Vaccination program was conducted and recommended by concerned personnel of livestock sector.

Objective: To increase animal productivity by improvement of cattle health

Methodology: For success and effectiveness of cattle rearing vaccination program was conducted at the FSRD sites. Farmers selected for sub-project activities along with farmers lived around them were selected for vaccination program. Two doses of deworming medicine were provided to the cattle at 35-40 days interval and one dose of vitamin ADE injection was given as per body weight of the cattle recommended by concerned personnel of livestock department.

Key findings:

Deworming of cattle and subsequently feeding of urea molasses treated straw, vitamin injection is the

important method for improvement cattle health. After 90 days of rearing due to Dewormed + Vitamin ADE injection body weight of cattle was increased over initial weight (27.04%). The result showed that body weight gained (442 g/day) and milk production (2.96 L/day) increased by dewormed and vitamin injected cattle whereas only dewormed and non-treated cattle showed lower performance.

Keywords: Cattle, Vaccination and Deworming

12.30. Title: Vaccination on cattle to reduce mortality rate

Background:

The profitability of livestock mostly depends on animal health. There are some common diseases that animals should be routinely protected. Char land farmers are reared cattle in less scientific manner and mortality is a major challenge. A wide range of diseases causes the reduction of production, fertility or death in cattle and economic losses to the farmers. Vaccines are expected to reduce the severity of disease in infected animals or limit the frequency of disease. Vaccination program was conducted at the FSRD sites of Padmar char recommended by concerned personnel livestock department.

Objective: To increase animal productivity by reduce mortality of cattle

Methodology:

For success and effectiveness of cattle rearing vaccination program was conducted at the FSRD sites. Cooperator farmers along with farmers lived around them were selected for vaccination program of their cattle. Routine vaccination on cattle were done as per recommended of concerned personnel of livestock department.

Key findings:

Before vaccination mortality rate against the disease Anthrax, FMD, HS and BQ of cattle were 7, 15, 18 and 9% but after vaccination it reduced to 0, 3%, 1 and 0%, respectively.

Keywords: Cattle, Vaccination, Anthrax, FMD, BQ and HS

12.31. Title: Vaccination on poultry at FSRD Site

Background:

The profitability of livestock mostly depends on animal health. There are some common diseases that animals should be routinely protected. Char land farmers reared poultry birds but mortality rate is a major challenge. A wide range of diseases causes the reduction of production, fertility or death of poultry birds and economic losses to the farmers. Vaccines are expected to reduce the severity of disease or limit the frequency of disease. Vaccination program was conducted at the FSRD sites of Padmar char recommended by concerned personnel of livestock department.

Objective: To increase poultry birds productivity by reduce mortality of poultry birds.

Methodology:

For success and effectiveness of Poultry vaccination program was conducted at the FSRD sites. Cooperator farmers along with farmers lived around them were selected for vaccination program of their poultry birds. BCRDV, RDV, Fowl pox and Fowl Cholera were vaccinated on poultry birds. Routine vaccination on poultry birds were done as per recommended of concerned personnel of livestock department.

Key findings:

Before vaccination mortality rate of poultry birds due to different diseases was higher (17-39%). After vaccination of poultry birds, all of the diseases reduced drastically and mortality rate was recorded about 1-11%.

Keywords: Poultry, Vaccination, BCRDV, RDV, Fowl pox, Fowl cholera. and Duck plunge

12.32. Title: Chicken rearing in farmers house hold for income generation

Background:

Marginal and small farmers of the FSRD site had few stocks of local chicken at their homestead but they do not have much knowledge on different aspects of poultry management. They are not well known about new breeds of poultry. Through this sub-project chicken were reared round the year to increase the income of the farmer.

Objective: To improve and sustain existing poultry production system and income of the farmers

Methodology:

Chicken was reared for meat and egg purpose. Chickens were reared in a small scale under semi-scavenging system. For improved rearing, two-chambered chicken coops were provided to each farmer. Farmers were provided 20-25 days old 15 chickens at each batch collected from hatcheries. Farmers feed the chickens about 25-30 g extra boiler starter feed 2 times daily. Technical supports (feeding, vaccination etc.) and advices were also given. Necessary treatment was also provided as and when required. They reared the chickens up to 80-85 days. They reared 3 batch's chickens in each year.

Key findings:

The average initial body weight of per pullet was recorded 0.533 kg which was increased 1.15 kg after 6 months of rearing. The hen started laying eggs at the age of 15-20 weeks. It was observed that by rearing of 15 pullets within a period of eight months, a farmer could earn gross margin Tk. 6349.

Keywords: Poultry, Pullet Rearing, Chicken and Coops

FSRD Site: Baghabari, Sirajganj (BLRI)

12.33. Title: Improvement of cattle health and reduced mortality of poultry birds by deworming and vaccination

Background:

The profitability of livestock mostly depends on animal health. There are some common diseases that animals should be routinely protected. Char land farmers were rearing chicken and cattle in less scientific manner and mortality was a major challenge. A wide range of diseases causes the reduction of production, death in cattle, goat and chicken and economic losses to the farmers. Vaccines are expected to reduce the severity of disease in infected animals or limit the frequency of disease. Vaccination program was conducted as per recommendation by concerned personnel of livestock department.

Objectives:

1. To improve cattle health and productivity
2. To reduce mortality rate of poultry

Methodology:

For success and effectiveness of cattle health and poultry rearing deworming and vaccination program was conducted at the FSRD sites. Farmers selected for sub-project activities along with farmers lived around them were selected for vaccination program. Two doses of deworming were given at 30-35 days interval as per body weight of the cattle recommended by concerned personnel of livestock department. The poultry birds vaccinated different types of vaccinations likes, BCRDV, RDV, Fowl pox and Fowl cholera to control diseases as per schedule suggested by respected personnel of livestock department.

Key findings:

It was observed that dewormed cattle produce more milk (2.65 L/day) than controlled cattle (2.5 L/day). Average body weight was increased in dewormed cattle than controlled. After vaccination of poultry birds frequency of diseases and mortality rate reduced significantly. Before vaccination mortality (%) of poultry

frequency of diseases and mortality rate reduced significantly. Before vaccination mortality (%) of poultry birds due to different diseases was higher (8-25%). After vaccination of poultry, all of the diseases reduced drastically and mortality rate was recorded about 1- 4%.

Keywords: Cattle, Poultry, Vaccination, Deworming, BCRDV, RDV, Fowl pox and Fowl cholera

12.34. Title: Beef fattening at farmers household

Background:

Farmer of Char land ecosystem reared cattle but in less scientific manner. By rearing cattle whole, the year they could not profit enough. Farmers were not known about beef cattle fattening program of livestock. To achieve the highest live weight in the shortest time, in the most economical way cattle fattening was conducted.

Objective: To increase animal productivity and income of the farmers

Methodology:

Beef fattening technique was fitted at char land farming system. Twelve cattle from 12 farmers were selected from two villages for beef cattle fattening program. Two round beef fattening activities were done in each year. In each year first round beef fattening was done just before 3 to 4 months of Eid-ul-Adha when farmer sell the animal with profitable prices and second round beef fattening was done at the end of the year. Cattle fattening period is 3 to 4 months.

Key findings:

Body weight of the cattle was increased 50% than initial body weight. Average profit per farmer was calculated avg. Tk. 59,800 after deducting all cost including feed and medicine. Farmers are very happy due to getting higher profit from cattle fattening.

Keywords: Beef, fattening, Body weight, Income and Profit

12.35. Title: Sheep rearing in the farmer's household for increase income of farmers

Background:

The program was conducted at FSRD site, Baghabari, Sirajganj, with a view to increase income of Char dweller by sheep rearing. Twelve farmers, each was provided with three (2F, 1M) ewes for rearing at the sub-project site.

Objectives:

1. To increase productivity of sheep to meet up nutritional status and also increase income of Char dweller
2. To involve women participation in Char land area

Methodology:

The program was conducted at FSRD site, Baghabari, Sirajganj, with a view to increase income of Char dweller by sheep rearing. Twelve farmers, each was provided with three (2F, 1M) ewes for rearing at the sub-project site. Six months aged sheep were distributed among the 12 farmers during 2018-2019. Average initial body weights of distributed sheep were 5.0- 6.0 kg. The animals were vaccinated and provided feed and treatment etc. The adult ewe gave birth new offspring after six months of rearing.

Key findings:

Average initial body weights of distributed sheep were 5.0- 6.0 kg and after six months of rearing average body weight gained 8- 15 kg of those sheep. The sheeps were highly prolific in nature give birth twice in a year. From 12 house hold a total of 248 lambs were found from February 2018 - January 2021. Gross margin was earned Tk. 23945 per household from sheep rearing. Some sheep had third progeny and some had second. Farmers were very enthusiastic in adopting this program and also like to continue this program

Key words: Sheep, Lamb, Grossmargin and Body weigh

12.36. Title: Goat rearing in the farmer's household for increase income of farmer's

Background:

The programme was initiated at the FSRD Site, Baghabari, Sirajganj during 2018-20. Twelve farmers were selected and each of them had given two Black Bengal doe collected from the local market.

Objectives:

1. To increase income and productivity of goat at Char land ecosystem
2. To involve women participation in Char land area

Methodology:

The programme was initiated at the at FSRD site, Baghabari, Sirajganj during 2018-20. Twelve farmers were selected and each of them had given two Black Bengal doe collected from the local market. Four to six months aged goat were distributed among the 12 farmers during 2018-2019. Average initial body weight of distributed goats was 5.0- 6.0 kg. All goats were vaccinated against PPR disease. Extensive and semi-intensive system of goat rearing was followed. Technical support (feeding, vaccination etc.) were provided regularly. Treatments were also provided as and when necessary. Data on body weight increase and kid production were also recorded regularly.

Key findings:

Average initial body weight of distributed goats was 5.0- 6.0 kg. After six month of rearing average body weight gained 10-15 kg. The goat was highly prolific in nature and gave birth twice in a year. From 12 house hold a total of 239 kids were found from February 2018 - January 2021. Gross margin was found from goat rearing was Tk. 21,344 per household during 2018-2021. Some goat had third progeny and some had second. Farmers were very enthusiastic in adopting this program and also like to continue this program

Keywords: Black Bengal goat, Doe and Household

12.37. Title: Performance of Turkey at farmer's level for egg and meat purpose

Background:

Turkey rearing has been introduced very recently in Bangladesh. Although mass people are still hesitating to accept it, it is rapidly gaining popularity among consumers. Turkey farming is more profitable than poultry farming as it takes less space, higher growth rate and higher market price of meat. Turkey birds mainly eat grasses and vegetables. As a result, farmers do not have to depend only on market's food. Besides, it can be kept in open areas, not like the poultry farm. There is a great demand of turkey meat in the markets, especially in the restaurants.

Objectives

1. To check the feasibility of Turkey rearing under Char land ecosystem
2. To increase household income and improve the livelihood
3. To increase the nutritional status of the Char land people

Methodology:

Seventy two Turkey chicks were distributed among twelve farmers. Average initial body weights of the chicks were 0.55-0.56 kg. The routine works of vaccination were followed regularly and natural feeds (grass, and vegetables) were provided as food. Some household gave commercial market food as supplemental feed. After 4-5 months' age female birds started laying eggs. Egg production and body weight gained was monitored regularly. At about 4-5 month's duration Turkey birds gained commercial weight and ready to sale. Technical supports (feeding, vaccination, treatment etc.) were provided to the farmer as and when required.

Key findings:

After 4-5 months of rearing average body weight was gained per bird 3.0-3.2 kg under farmer's condition following semi scavenging system. Average gross margin (egg + chick + adult) from turkey rearing was recorded Tk.38906 per house hold.

Key words: Turkey, Gross margin, Body weight, Egg, Chick and Adult

12.38. Title: Hilly chicken rearing at farmers household for meat purpose

Background:

Marginal and small farmers of the FSRD site had few stocks of local chicken at their homestead but they do not have much knowledge on different aspects of poultry management. They were not well known about new breeds of poultry hilly chicken. Through this sub-project hilly chicken were reared round the year to increase the income of the farmer.

Objectives:

- i) To improve and sustain existing poultry production system at Chair land ecosystem.
- ii) To ensure the nutritional requirements of farm families
- iii) To make the female participants to engage in income generation

Methodology:

Hilly chicken were reared for meat and egg purpose. Chickens were reared in a small scale under semi-scavenging system. For improved rearing, two-chambered chicken coops were provided to each farmer. Among the 12 farmers were provided day old 25-40 chickens for each batch collected from hatcheries of BLRI. Average initial body weight was 45g per chicks. Farmers feed the chicks about 25-30 g extra boiler starter feed 2 times daily. Technical supports (feeding, vaccination, treatment etc.) were provided as and when necessary. They reared the chickens up to 80-85 days and 3 batch's chickens in a year.

Key findings:

Average body weight gained after six months of rearing 1.72 kg per bird. Rearing cost of three batches in a year per farmer was Tk. 22873 (feed supplement cost along with day old chick price, medicine and vaccination) and earned gross margin Tk. 55620. The increase of gross margin mainly due to improved breed, adequate feed supplement and proper management. Farmers showed their interest in rearing hilly chicken for their faster growth and soft meet.

Keywords: Poultry, Hilly, Rearing and Chicken

12.39. Title: Rearing of pigeon at farmer's household

Background:

Farmers of the sub-project area reared pigeon in a very small scale. They were not aware about proper management of pigeon. Pigeon is a very good source of protein and also income generating.

Objectives:

1. To increase farmers income
2. To ensure the nutritional requirements of farm families
3. To make the female participants to engage in income generation

Methodology:

Farmers were provided local pigeon breed with cage, feed and medication. Three pairs of pigeon were distributed to each of 6 farmers. Local breeds of pigeons were distributed among them. Feeding, vaccination, necessary treatments were provided as and when necessary.

Key findings:

Survivability rate of distributed pigeon among the farmers were found 95%. Every month the pigeon has produced squab. The growth rate of squab was very much faster within 12-14 days after hatching from egg it became ready to consumable/ marketable. Selling price per pair of squab was Tk. 160 and farmers could earn Tk.1920 per year from a pair of pigeon.

Keywords: Pigeon, Squab, Rearing, Income, Poultry and Survivability

D. Fisheries component

12.40. Title: Maximization of farmers' income through the technique of carp polyculture at low cost management at FSRD site: Char Kharicha, Mymensingh and Charpara, Sonatala, Bogura (BARI)

Back ground:

Proper management is the key factor for getting profitability of fish culture in pond under homestead area. The program of carp polyculture in seasonal pond of FSRD site was undertaken with the view to increase concern farmer's income and to boost up the protein consumption. Before conducting the fish culture in pond, following activities were done chronologically Pond selection, Pond preparation, Lime application, Stocking density, Fertilizer and manure management, Supplementary food.

Objective: To improve the livelihood of households by increasing farm income

Methodology:

Carp polyculture was conducted in both the sites (Mymensingh and Bogura) as well as monosex tilapia was grown only at FSRD site, Mymensingh. A total of 4 and 12 ponds having pond size averagely 20 and 12 decimal areas were taken under the study of carp polyculture system at FSRD site, Mymensingh and Bogura, respectively during 2018-20.

Key findings:

- After intervention of improved feeds, technological support and modern pond management technique, fish's production was 6020 kg ha⁻¹ by carp poly culture method against 3507 kg fish ha⁻¹ was found under farmer's traditional practice and income as gross margin was Tk. 360767 ha⁻¹ instead of Tk. 187563 ha⁻¹ at FSRD site, Mymensingh. On the contrary, fish production was 1588 kg ha⁻¹ by adopting carp poly culture method against 454 kg fish ha⁻¹ under farmer's traditional technique and income as gross margin was Tk. 148088 ha⁻¹ by using improved method of fish culture at FSRD site, Bogura. The disposal pattern of fish were 89% selling in local market, 9% consumption by themselves and distributed about 2% among their neighbors, relatives and well-wishers at FSRD site, Mymensingh, while these were 25%, 65%, and 10% at FSRD site, Bogura, respectively.

Key words: Carp polyculture, Seasonal pond and Annual pond

12.41. Title: Maximization of farmers' income through carp polyculture technique at low cost management at FSRD Site: Padma Char, Ishurdi, Pabna (BSRI)

Background:

Fisheries sector is a source of animal protein as well as in providing rural employment and poverty alleviation. Due to unavailability of water in pond round the year and lack of credit and modern technologies, fish culture in pond was not observed at the FSRD site. Consultation with the people living in the FSRD site they agreed fish culture in their pond nearby the homestead.

Objective: To increase fish consumption and income of the farmers

Methodologies:

Three perennial ponds were selected which comprised of average 41 decimal areas and average 1.33 m depth at FSRD site. The fish culture was started from August and harvested during the month of February. Carp polyculture system was introduced in the selected ponds. In this program, farmers were stocked larger size fingerling. Carp fishes like Silver carp, Katla, Rajputi, Rui, Mrigal, Mirrorcarp and Grass carp were cultured in the ponds.

Key findings:

The average survivability rate of various carp fishes was 64.53%. The average production of fish was obtained 460 kg per pond (2771 kg ha⁻¹). With the average gross margin Tk. 68,520 per pond (Tk. 412791 ha⁻¹) and the benefit cost ratio was 2.91. Among the total production farmers consumed, distributed to relatives and sold their products in local market. It was observed that, farmers sold most of the portion (Avg. 416 kg), consumed (Avg. 27.67 kg) and distributed (Avg. 17.33 kg). They distributed fishes among their neighbors, relatives and well-wishers of the produced fish. The farmers were benefitted by carp polyculture system and they showed further interest for farming of carp polyculture.

Keywords: Fish, Fingerling, Carp, Polyculture and Survivability rate

12.42. Title: Maximization of farmers' income through carp polyculture technique at low cost management at FSRD Site: Baghabari, Sirajganj (BLRI)**Background:**

Fisheries sector is a source of animal protein as well as play role to provide rural employment and poverty alleviation. Due to unavailability of water in pond round the year fish culture in pond was not observed at the FSRD site. Due to conflict with multiple uses of natural waters, ownership of land and risk of theft farmers were not interested to culture fish in the open water sources. Considering above point in mind polyculture in fish farming was under taken in the seasonal pond near the homestead.

Objective: Fish production through utilization of available technologies to increase income and protein availability

Methodologies:

One seasonal pond was selected which comprised of 11 decimal area and 1.35 m depth at FSRD site, Baghabari, Sirajganj during 2018-2021. The fish culture was started from September after recession of flood water and harvested during the month of February. Polyculture of carp fish was introduced in the selected pond. In this program farmers released larger size fingerlings. In carp polyculture system (Rui, Catla, Mrigal and Sorputi) fingerlings were released in the pond.

Key findings:

The results revealed that, average survival rate of various fishes was 66- 88%. Before intervention 160 kg per 11 decimal fish was found with the gross margin Tk. 11100 per 11 decimals whereas after intervention 284 kg per 11 decimals fish was found with the gross margin Tk. 35020 per 11 decimals. The BCR was 1.95 before intervention and it was 3.5 after intervention. Among the total production farmers consumed, distributed to relatives and sold their fishes in the local market. It was observed that, farmers sold most of the portion (Avg. 200 kg), consumed about (Avg. 67 kg) and distributed (Avg. 17 kg) to their neighbors, relatives and well-wishers of the produced fish. The farmers were benefitted by carp polyculture system and they showed further interest for farming of carp polyculture.

Keywords: Fish, Fingerling, Polyculture and Survivability rate

12.43. Title: Maximization of farmers' income through the culture of monosex Tilapia at low cost management at FSRD site: Char Kharicha, Mymensingh (BARI)**Background:**

Proper management is the key factor for getting profitability of fish culture in pond under homestead area. The program of culture of monosex tilapia in seasonal pond of FSRD site was undertaken with the view to increase concern farmer income and to boost up the protein deficiency. Before conducting the fish culture in pond, following activities were done chronologically pond selection, pond preparation, lime application, stocking density, fertilizer and manure management, supplementary food.

Objective: To improve the livelihood of households by increasing farm income

Methodology:

Three seasonal ponds were selected for fish culture with mono sex tilapia in FSRD site, Char Kharicha, Mymensingh during 2019-2021. The ponds were average 20 decimal sized with a 1.45 m depth.

Key findings:

- After imposing modern techniques in mono sex tilapia culture, the production and income both were increased as compare to that of farmer's traditional method. In the improved method, the fish production and gross margin were 3268 kg fish ha⁻¹ and Tk. 206900 ha⁻¹, while these were 2507 kg fish ha⁻¹ and Tk. 150750 ha⁻¹ by farmer's existing method. The disposal pattern of tilapia fish was 79% selling in local market, 16% consumption by themselves and distributed about 3% among their neighbors, relatives and well-wishers.

Key words: Mono sex tilapia and Seasonal pond

12.44. Title: Fish culture in backyard pond after recession of flood water at FSRD Site: Nawvanger Char, Jamalpur (BINA)**Background:**

The Char land of sub-project area flooded every year. It was observed that the flood water filled the backyard pond and water stay 4 to 5 months. Some natural traditional fishes trapped in the backyard pond after recession of flood water.

Objective: To improve the livelihood of households by increasing farm income

Methodology:

After recession of flood water modern management practices (liming, feeding etc.) provided in the two backyard ponds for fish culture. Average size of backyard pond was 12 decimal and depth 1.25m. Fish culture was started in the month of September and harvested in the month of February.

Key findings:

After 5 months of fish culture in the backyard pond average production of fishes was found 160 kg/12 decimal and earned gross margin Tk. 24,000 by selling of them. Sub-projects personnel motivated farmers to use this pond under fish culture. From the next year, after recession flood water farmers will culture fish of that pond.

Keywords: Fish, Flood water, Traditional natural fish, Back yard pond, Water resource and Gross margin

12.45. Title: Fish cultivation in open water sources through net pen fish culture at FSRD Site: Nawvanger Char, Jamalpur (BINA)**Background:**

Fisheries sector is a source of animal protein as well as in providing rural employment and poverty alleviation. Due to unavailability of water in pond round the year and lack of credit, fish culture in pond was not observed at the FSRD site. Some of them catch fish in the river. Due to conflict with multiple uses of natural waters, ownership of land and risk of theft, farmers were not interested to culture fish in the open water sources.

Objective: Fish production through utilization of available technologies to increase income and protein availability

Methodology:

After recession of flood (September to February) farmer's cultured fishes in the open water resources at the FSRD site. The fish culture was conducted from October and harvested in January 2021. For culture fish in the open water resources, farmers were made their pen using nylon net at the two side of the canal. They usually stocked larger size fish. A mixture of carp fishes (silver carp, catla, rui, Mrigal, grasscarp) with mono sex tilapia was to culture.

Key findings:

After 5 months culture of fish, a total of about 568 numbers of different type of fishes were harvested with survival rate 80-86%. Total amount of fishes was found 163.80 kg farmer⁻¹ among which they consumed 16.38 kg, distributed 4.91 kg and sold 142.51 kg. The average gross margin and BCR were recorded Tk. 21161 and 3.91 farmer⁻¹, respectively.

Keywords: Fish, Fingerling, Net pen, Culture and Water resource

B. Implementation Status

1. Procurement

Table B.1.1 BARC procurement information

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No)	Financial (Tk.)	Physical (No)	Financial (Tk.)	
(a) Office equipment					
1. Furniture	12	352500	12	338800	
2. Computer and accessories	6	490000	6	487900	

Table B.1.2 BARI procurement information

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No)	Financial (Tk)	Physical (No)	Financial (Tk)	
(a) Office equipment					
1. Laptop computer	3 pcs	180000	3	180000	
2. Desktop computer	2 pcs	120000	2	120000	
3. Laser printer	2 pcs	40000	2	40000	
3. UPS	2 pcs	20000	2	20000	
4. Scanner	2 pcs	20000	2	20000	
(b) Lab & field equipment					
1. Soil Ph meter	2	140000	2	140000	
2. Soil moisture meter	2	135000	2	135000	
3. Digital camera & accessories	2	50000	2	50000	
(c) Other capital items					
1. Bicycle	4	60000	4	60000	
2. Motor cycle	2	350000	2	350000	

Table B.1.3 BINA procurement information

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
Office equipment				99900	
i. Sitting chair (revolving)	02	50000	02	33400	
ii. Sitting chair (Normal)	05	30000	05	20000	
iii. Table	02	20000	02	46500	
Lab equipment				99800	
i. Desktop computer/Laptop	01	50000	01	55000	
ii. Laser printer	01	25000	01	17900	
iii. Digital camera	01	25000	01	26900	
Other capital items				165800	
Small Transport (Two-wheeler: Motorcycle/bycle					
i. Motor Cycle	01	165000	01	150900	
ii. Bicycle	01	10000	01	14900	

Table B.1.4 BSRI procurement information

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
a) Office Equipment					
i. Executive Table	1	20,000	1	20,000	
ii. Computer Table	1	5,000	1	5,000	
iii. Visitor/ Front Chair	3	12,000	3	12,000	
iv. Computer Chair	1	3,500	1	3,500	
v. File Cabinet	1	20,000	1	20,000	
vi. Almira	1	24,000	1	24,000	
b) Lab Equipment & field					
i. Desktop	1	60,000	1	60,000	
ii. Laptop	1	60,000	1	60,000	
iii. Laser Printer	1	20,000	1	20,000	
iv. Scanner	1	10,000	1	10,000	
v. Ups	1	10,000	1	10,000	
vi. Sub-projector with Screen	1	60,000	1	60,000	
i. Digital Camera Soil Moisture Meter	1	25,000	1	25,000	
ii. Hand Refractometer	1	30,000	1	30,000	
iii. Hand Refractometer	1	10,000	1	10,000	
iii. Top Loading Balance	3	15,000	3	15,000	
vii. Measuring Tape	4	6,000	4	6,000	
c) Other Capital items					
i. Motor Cycle	1	1,60,000	1	1,60,000	
ii. Bicycle	1	20,000	1	20,000	

Table B.1.5 BLRI procurement information

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment					
Scientist table	01	15000	01	14955	
Scientist chair	01	10000	01	9970	
Visitor Chair	02	8000	02	7950	
File cabinets	01	17000	01	16970	
(b) Lab &field equipment					
Laptop computer	01	60000	01	59900	
Printer	01	20000	01	19950	
Scanner	01	10000	01	9960	
Balance	01	10000	01	9890	
Total		150,000		149,545	

2. Establishment/renovation facilities: (Not applicable)

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/seminar/workshop/conference organized:

Table B.3.1 Information on training/workshop/meeting organized by BARC

Description	Number of participants			Duration (Days/weeks /months)	Remarks
	Male	Female	Total		
(a) Training	111	14	125	12 Days	Participants were scientist and scientific assistant
(b) Workshop	166	22	188	4 Days	Participants were scientists, Expert members and PIU-BARC, NATP-2 personnels
(c) Other (if any) Coordination meeting	35	5	40	3 Days	Sub-project scientist

Table B.3.2 Information on training/workshop/field days arranged by BARI

Description	Number of participants			Duration (Days/weeks /months)	Remarks
	Male	Female	Total		
(a) Training	80	80	160	8	Farmers
(b) Workshop	30	15	45	2	Scientist, DAE, DOF and DLS personnels
(c) Other (if any) Field day	500	300	800	8	Farmers, DAE and NGO

Table B.3.3. Information on training/workshop/method demonstration/field day/meeting organized by BINA

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
i) চরাঞ্চলে কৃষি প্রযুক্তি ব্যবহারের মাধ্যমে খামারের উৎপাদনশীলতা উন্নয়ন শীর্ষক প্রশিক্ষণ	16	4	20	1 day	Training room, BINA Sub- station, Jmalpur (3 June 2018)
ii) চরাঞ্চলের জনগোষ্ঠীর জীবনযাত্রার মান উন্নয়নে সমন্বিত খামার উৎপাদন ব্যবস্থার গুরুত্ব শীর্ষক প্রশিক্ষণ	30	10	40	1 day	Training room, BINA Sub- station, Jmalpur (22 September 2019)
iii) পারিবারিক খাদ্য, পুষ্টি ও আয় বৃদ্ধিতে বন্যা পরবর্তী বসত বাড়িতে আগাম রবি সবজি এবং মাঠে স্বল্প মেয়াদী আমন ধান চাষে করণীয় শীর্ষক প্রশিক্ষণ	48	12	60	1 day	Training room, BINA Sub-station, Jmalpur (18 August 2020)
(b) Workshop					
-					
(c) Method demonstration					
i) Beef Fattening Method Demonstration	10	02	12		BINA Sub- station, Jmalpur (18 September 2018)
(d) Field day					
i) Field day (22 January 2020)	35	65	100	-	FSRD site (22 January 2020)
ii) Field day (13 December 2020)	60	50	110	-	FSRD site (13 December 2020)
(e) Meeting to exchange views					
i) Exchange of views on farm activities with farmers	22	8	30	-	FSRD site (18 June 2020)
ii) Exchange of views on farm activities with farmers	20	10	30	-	FSRD site (13 December 2020)



Picture B.3.3.1. Training for the char land farmers at FSRD site Nawvanger Char, Jamalpur



Picture B.3.3.2. Meeting to exchange views with the farmers at FSRD site Nawvanger Char, Jamalpur



Picture B.3.3.3. Field day organized at FSRD Nawvanger Char, Jamalpur

Table B.3.4. Information on training/workshop/method demonstration/field day/meeting organized by BSRI

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
(b) Workshop	-	-	-	-	
(c) Method demonstration					
(i) Beef Fattening Method Demonstration	18	02	20	Day long	
(d) Field day					
(i) Field day	35	45	80	Day long	FSRD site (17.12.2019)
(ii) Field day	53	27	80	Day long	FSRD site (18.06.2020)
(e) Meeting to exchange views					
(i) Exchange of views on farm activities with farmers	12	6	18	-	FSRD site
(ii) Exchange of views on farm activities with farmers	17	7	24	-	FSRD site



B.3.4.1 Field days and meeting with farmers at FSRD site Padma Char, Ishurdi, Pabna

BLRI Component: Not Applicable**C. Financial and physical progress****Table C.1 Combined financial and physical progress**

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual Staff salary	8524060	8389506	8389506	0	100	
b. Field research/lab expenses and supplies	12586823	12377737	12377737	0	100	
c. Operating expenses	3193008	3069439	3069439	0	100	
d. Vehicle hire and fuel, oil & maintenance	2320603	2208207	2208207	0	100	
e. Training/workshop/ seminar etc.	2586400	2577950	2577950	0	100	
f. Publications and printing	1094145	1060018	1060018	0	100	
g. Miscellaneous	607747	522962	522962	0	100	
h. Capital expenses	3037215	3027245	3027245	0	100	
Total	33950001	33233064	33233064	0	100	

Table C.2. Financial and physical progress of BARC Component

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual Staff salary	2914065	2914065	2914065	0	100	
b. Field research/lab expenses and supplies	396528	396528	396528	0	100	
c. Operating expenses	699403	692059	692059	0	100	
d. Vehicle hire and fuel, oil & maintenance	236899	236899	236899	0	100	
e. Training/workshop/ seminar etc.	1632800	1632800	1632800	0	100	
f. Publications and printing	896200	894500	894500	0	100	
g. Miscellaneous	297405	294351	294351	0	100	
h. Capital expenses	826700	826700	826700	0	100	
Total	7900000	7887902	7887902	0	100	

Table C.3. Financial and physical progress of BARI Component

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual Staff salary	1665292	1665292	1665292	0	100	
b. Field research/lab expenses and supplies	3528803	3528803	3528803	0	100	
c. Operating expenses	1299573	1299573	1299573	0	100	
d. Vehicle hire and fuel, oil & maintenance	851983	851983	851983	0	100	
e. Training/workshop/ seminar etc.	683000	683000	683000	0	100	
f. Publications and printing	40950	40950	40950	0	100	
g. Miscellaneous	65400	65400	65400	0	100	
h. Capital expenses	1115000	1115000	1115000	0	100	
Total	9250001	9250001	9250001	0	100	

Table C.4. Financial and physical progress of BINA Component**Fig in Tk**

Items of expenditure/activities	Total approved budget	Fund Received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	1340571	1221621	1221621	0	100	
b. Field research/lab expenses and supplies	2819657	2874892	2874892	0	100	
c. Operating expenses	335048	301502	301502	0	100	
d. Vehicle hire and fuel, oil & maintenance	407085	387085	387085	0	100	
e. Training/workshop/ seminar etc.	270600	262150	262150	0	100	
f. Publications and printing	55000	25000	25000	0	100	
g. Miscellaneous	106539	103739	103739	0	100	
h. Capital expenses	365500	365500	365500	0	100	
Total	5700000	5541489	5541489	0	100	

Table C.5. Financial and physical progress of BSRI Component**Fig in Tk**

Items of expenditure/activities	Total approved budget	Fund Received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	858413	840145	840145	0	100	
b. Field research / lab expenses and supplies	3017943	2950510	2950510	0	100	
c. Operating expenses	555896	544130	544130	0	100	
d. Vehicle hire and fuel, oil & maintenance	327825	320773	320773	0	100	
e. Training/workshop/seminar	0	0	0	0	100	
f. Publications and printing	101995	99568	99568	0	100	
g. Miscellaneous	57458	56472	56472	0	100	
h. Capital expenses	580470	570500	570500	0	100	
Total	5500000	5382098	5382098	0	100	

Table C.6. Financial and physical progress of BLRI Component**Fig in Tk**

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	1745719	1748383	1748383	0	100	
b. Field research/lab expenses and supplies	2823892	2627004	2627004	0	100	
c. Operating expenses	303088	232175	232175	0	100	
d. Vehicle hire and fuel, oil & maintenance	496811	411467	411467	0	100	
e. Training/workshop/seminar etc.	0	0	0	0	100	
f. Publications and printing	0	0	0	0	100	
g. Miscellaneous	80945	3000	3000	0	100	
h. Capital expenses	149545	149545	149545	0	100	
Total	5600000	5171574	5171574	0	100	

D. Achievement of Sub-project by objectives (Tangible form): Technology generated/ developed

Table D.1.1. Technology generated/ developed by BARI Component

General/specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
1. To maximize the farm productivity with efficient utilization of farm resources	<p>Homestead</p> <ul style="list-style-type: none"> Homestead and its resources were efficiently used by <i>Goyeshpur</i> and <i>Narkeli</i> model to produce fruits and vegetables round the year. Improved production package were imposed to respective crop under each model. 	<ul style="list-style-type: none"> Vegetable production and income were increased about 996.5 kg and Tk. 7960 per homestead per year, respectively at Mymensingh. While at Bogura, vegetable production was increased by 305.07% from 117.4 kg (baseline) to 475.56 kg (average of 2018-20) and income was increased from Tk. 1174 to Tk. 6003 per homestead per year. At Mymensingh, average fruit production was 403.30 kg homestead⁻¹ year⁻¹ that was 102% higher compare to 200 kg homestead⁻¹ year⁻¹ (as per base line) and gross margin was Tk. 4484 of per homestead per year. On the contrary, average production was 96 kg homestead⁻¹ year⁻¹ which was much higher than that of 31 kg homestead⁻¹ year⁻¹ at before intervention of model and the remarkable average increment of vegetable production (209.68%) gross margin (Tk. 2873 per year) were observed at Bogura, 	<ul style="list-style-type: none"> Safe and fresh vegetables and fruits intake were increased in both sites. Vegetable's intake were increased from 10.00 to 106.67 and 60.06 to 277.32 kg per family per year at Mymensingh and Bogura, respectively. Likewise, fruit intake was 140 and 63.93 kg per homestead per year which was 40% and 312.47% higher compare to before intervention at Mymensingh and Bogura, respectively.
	<p>Cropping pattern</p> <ul style="list-style-type: none"> Improved cropping pattern were developed by inclusion of new crops and HYVs in the existing pattern. Improved production package was used for respective crop under each cropping pattern. 	<ul style="list-style-type: none"> Two improved cropping patterns viz. Mustard-Boro-T.aman rice and Potato-Boro-T.aman rice were developed over Boro-Fallow-T.aman rice cropping pattern at FSRD site, Mymensingh. Likewise, a 4-four crop based Mustard-Boro-T. aus - T. aman over Mustard-Boro-T. Aman rice and a 3-crop based Wheat-Jute-T. Aman patterns were against Boro-Fallow-T. aman were developed at FSRD site, Bogura. 	<ul style="list-style-type: none"> Cropping intensity of respective farmers' field was increased. At FSRD site Mymensingh, REY in improved cropping patterns were 13.58 t ha⁻¹ & 35.68 tha⁻¹ against 9.06 & 9.20 tha⁻¹ in existing pattern. Consequently, higher GM Tk. 111691 & Tk. 414236 ha⁻¹ were obtained from those pattern, respectively. At FSRD site, Bogura REY of 4 and 3 crop based cropping pattern 16.23 and 15.35 tha⁻¹ and gross margin were Tk. 155645 and Tk. 188680 ha⁻¹, respectively,

General/specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
	<p>Livestock Different activities were done under this component to boost up their livestock productivity.</p> <ul style="list-style-type: none"> • Deworming of cattle • Vaccination of cattle, goat, sheep and poultry • Provided improved feeds for rearing of duck, turkey and sonali chicken <p>Fisheries</p> <ul style="list-style-type: none"> • Improved fish culture technique viz. carp poly culture and mono sex tilapia in the seasonal to increase fish production. • Fish feeds were provided for fish culture in the seasonal to increase fish production 	<ul style="list-style-type: none"> • A total of 13 cattle were dewormed along with vitamin A, D and E containing injections. • A total of 220 cattle were vaccinated in FSRD, site, Mymensingh against FMD and Anthrax whilst, 890 cattle against Anthrax and FMD, 200 goat and 120 sheep against PPR were vaccinated in both FSRD site, Bogura. • A good number of poultry birds were vaccinated with different types of vaccine as BCRDV, RDV, Fowl Pox, Fowl Cholera, and Duck Plague etc. in both sites. <ul style="list-style-type: none"> • It was produced 6020 kg fish ha⁻¹ by carp poly culture method against 3507 kg fish ha⁻¹ under farmer's traditional practice and the gross margin was Tk. 360767 ha⁻¹ instead of Tk.187563 ha⁻¹ at FSRD site, Mymensingh. • On the contrary, fish production was 1588 kg fish ha⁻¹ by adopting carp poly culture method against 454 kg fish ha⁻¹ under farmer's traditional technique and income as gross margin was Tk. 148088 ha⁻¹ by using improved method of fish culture at FSRD site, Bogura. • At Bogura, tilapia fish production and gross margin were 3268 kg fish ha⁻¹ and Tk. 206900 ha⁻¹, while these were 2507 kg fish ha⁻¹ and Tk. 150750 ha⁻¹ by farmer's existing method. 	<ul style="list-style-type: none"> • After deworming, the average body weight (40 g/day/cattle), disease incidence, lactation yield (up to 0.4 L/day) and the lactation period increased as compared to controlled cattle at FSRD site, Mymensingh. • Vaccination in cattle, goat and sheep against major diseases reduce mortality rate upto nil (0%) instead of 15%. • Irrespective of location, poultry vaccine reduced the diseases frequency drastically as well as mortality rate 78-88%. <ul style="list-style-type: none"> • The disposal pattern of fish were 89% selling in local market, 9% consumption by themselves and distributed about 2% among their neighbors, relatives and well-wishers at FSRD site, Mymensingh, while these were 25%, 65%, and 10% at FSRD site, Bogura, respectively. • The disposal pattern of tilapia fish was 79% selling in local market, 16% consumption by themselves and distributed about 3% at Bogura.
2. To generate system-based technologies for the char land.	Improved cropping pattern were developed by inclusion of new crops and HYVs in the existing pattern of respective site.	<ul style="list-style-type: none"> • Developed Mustard-Boro-T.Aman rice over Boro-Fallow-T.Aman rice cropping pattern at FSRD site. • Potato-Boro-T.aman rice were developed over Boro-Fallow-T.Aman rice cropping pattern at FSRD site Mymensingh. • Developed four-four crop based Mustard-Boro-T.Aus- T. Aman over Mustard-Boro-T. Aman rice • Developed Wheat-Jute-T. Aman patterns were against Boro-Fallow-T. aman were developed at FSRD site, Bogura. 	<ul style="list-style-type: none"> • REY and GM in Mustard-Boro-T. Aman rice cropping pattern were 13.58 t ha⁻¹ and Tk. 111691 ha⁻¹ at Mymensingh • REY and GM in Potato-Boro-T.aman rice were 35.68 tha⁻¹ higher Tk. 14236 ha⁻¹ at Mymensingh. • At Bogura, REY and GM of Mustard - Boro - T.Aus - T. Aman rice cropping pattern were 16.23 tha⁻¹ and Tk. 155645 ha⁻¹, respectively. • At Bogura, REY and GM of Wheat -Jute - T. aman rice cropping pattern were 15.35 tha⁻¹ and Tk. 188680 ha⁻¹, respectively.

General/specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
3. To create awareness about modern Agricultural Technologies among the participating farmers.	<ul style="list-style-type: none"> Holistic approach was used in a farm for integration of different farming component. Selection of suitable cultivars, with modern cultivation techniques Rearing of farm animal, feeding them in a proper way, timely vaccination of farm animals and bird Practicing carp poly culture techniques and mono sex tilapia culture. 	<ul style="list-style-type: none"> After intervention of proven technologies at Mymensingh, average income from different component viz. homestead, field crops, livestock, fisheries and off-farm activity were Tk. 14010, 65498, 15050, 12240 and 7700 per farm⁻¹ year⁻¹ per year and after integration of all those components farm income raised as Tk. 114498 farm⁻¹ year⁻¹ which was higher than that of Tk.64182 farm⁻¹ year⁻¹ (Before intervention). On the contrary in Bogura, the total farm income was increased from pre-intervention to after-intervention of technologies as Tk. 60688 to Tk. 109127 which come from homestead (Tk. 13008), field crops (Tk. 61498), livestock (Tk. 13050), fisheries (Tk. 12240) and off-farm activity (Tk. 9333). 	Total net income was increased by 80.44% and 82.68% at FSRD site, Mymensingh and Bogura, respectively.
	<ul style="list-style-type: none"> Workshop Farmers' training Field days 	<ul style="list-style-type: none"> A total of 2 workshops, 8 batch of farmer's training and 8 field days were organized in both sites. A harmonic linkage among different stakeholders like farmers, extension personnel (DAE, DLS & DOF), researcher, policy makers and NGO representative had created in each event in the respective site. 	<ul style="list-style-type: none"> Created local service provider (LSP) in each site for different farming activities. Farmers awareness build up regarding fruit and vegetables cultivation in homestead, vaccination to cattle, goat, sheep and chicken, deworming of cattle, fish culture in seasonal pond etc.

Table D.2.1 Technology generated/ developed by BINA Component

Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (Short term effect of the research)
To develop system-based technologies for the char land	<p>1. An improved cropping pattern for char land soil</p> <p>Jute (var. JRO 524) - T. Aman (var. Binadhan-11) - Maize (var. Hybrid 981)</p>	Gross margin increased 206% in improved cropping pattern compared to existing cropping pattern. Submergence tolerance rice variety Binadhan-11 and maize tremendously increased the system productivity and economic return of the three crops pattern.	Crop production as well as income of the farmers could be raised

Table D.2.2 Technology validated by BINA Component

Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visibl, measurable)	Outcome (short term effect of the research)
To develop system-based technologies for the char land	1. Year round vegetables production in homestead	Goyespur model with some modification used for year round vegetable production fitted nicely in the location. Vegetable's production, consumption, distribution and selling was increased 537%, 183%, 291% and 1060% respectively. Farmer income increased 145% compared to before intervention.	Income and family nutrition could be raised
	2. Production program of BINA released submergence tolerant rice variety Binadhan-11	The average gross margin was observed Tk.41400 . ha ⁻¹ with benefit cost ratio 1.75	Rice production and farmers income could be raised
	3. Production of BINA released short duration mustard variety Binasarisha-4 and Binasarisha-9	.The average yield , gross margin and BCR of Binasarisha-4 were found 1.42 t ha ⁻¹ Tk. 30952 ha ⁻¹ and 2.12, respectively. The average yield , gross margin and BCR of Binasarisha-9 were found 1.46 t ha ⁻¹ Tk. 32572 ha ⁻¹ and 2.18, respectively.	Oil seed production and farmers income could be raised
	4. Production of BINA released groundnut variety Binachinabadam-4	The average yield , gross margin and BCR of Binachinabadam-4 were found 2.4 t ha ⁻¹ Tk. 54000 ha ⁻¹ and 2.81, respectively	Ground nut production and farmers income could be raised
	5. Fattening of beef cattle	Farmer achieved the highest live weight in the shortest time, in the most economical way. Farmers earned on an average Tk. 53800 per year by accepting beef cattle fattening programme.	Farm family income could be raised by short term management of beef cattle through fattening technique
	6. Net pen fish culture in open water sources	Average fish production was recorded 164 kg. The average gross margin was observed Tk. 21161 with benefit cost ratio 3.91	Fish production, income and daily consumption by farmer could be raised.
	7. Fish culture in in backyard pond	Average fish production was recorded 80 kg 12 dec ⁻¹ The average gross margin was observed Tk. 12,000 12 dec ⁻¹ .	
		8. Vermicomposting in the farmer's household	Vermicomposting is a women friendly technology to earn money along with sustainable vegetable production at homestead. Every 50-60 days each farmer are producing 100-110 kg vermicompost and earned average Tk. 1838 per year.

Table D.3.1 Technology generated/developed by BSRI Component

Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
To develop system based technologies for the char land	1. Improved cropping pattern for char land i) Radish (Mollica)-Radish (Mollica)-Carrot (Orange king)-Wheat (BARI Gom-31) and ii) Radish (Mollica)-Carrot (Orange king) - Ground nut (BARI Chinabadam-8) developed	Gross margin were increased 228% and 304% respectively in improved cropping pattern compared to existing cropping pattern. Productivity and economic return of the four crops and three crops pattern has been increased.	Crop production as well as income of the farmers could be raised

Table D.3.2 Technology validated by BSRI Component

Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
To develop system based technologies for the char land	1. Year round homestead vegetable production following “Goyeshpur” model	BARI developed homestead vegetable production model disseminated to cooperative farmers. Each farmer sells some of their produced vegetables approximately Tk.2619 to Tk.3728 per farmer. Vegetables consumption was increased about 43% per farm family.	Income and family nutrition could be raised
	2. Replacement of existing Sugarcane varieties by newly developed BSRI varieties in FSRD char land eco system	Newly released sugarcane variety BSRI Akh 46 performed better. It gives higher yield (about 30 %) as well as higher benefits over farmers used traditional variety.	Sugarcane production and farmers income could be raised
	3. Chewing cane cultivation in homestead at FSRD Char land	Chewing cane BSRI Akh 42 cultivations in homestead was profitable it gave higher gross margin average Tk. 5375 per farmer.	Sugarcane production and frame family income could be increased.
	4. Cultivation of Napier grass in FSRD site	Twelve farmers were cultivated Napier grass nearby their homestead and on the pond bank. The average yield of green fodder was 52 th ⁻¹ . Average gross margin was earned Tk.10,500 from 33 decimal of land.	Cattle food scarcity could be minimized.
	5. Improvement of cattle health through deworming and vitamin ADE injection	Total 133 cattle are dewormed at the FSRD site. Dewormed + Vitamin ADE cattle produce more milk (2.96 L/day) than nonrelated. Average body weight was increased (27.04%) in dewormed+ vitamin injected cattle over non treated cattle.	Family income of the farmer is increased.
	6. Vaccination on cattle to reduce mortality rate	Total 753 cattle were vaccinated during the sub-project period mortality rate of the cattle was 0-3% after vaccination which was lower than before (7-18%) vaccination.	Mortality rate of cattle could be reduced which lead to family income.

Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
	7. Vaccination on poultry to reduce mortality rate	Total 1510 poultry birds were vaccinated during the sub-project period mortality rate of the cattle was 1-11% after vaccination which was lower than before (17-39%) vaccination.	Mortality rate of poultry could be reduced.
	8. Pigeon rearing in the farmer's household	Twenty-four pairs of pigeon were given to 12 selected farmers. Every month the pigeon produced squab. After eight months of rearing average number of pigeon (40) per farmer.	Meat production and daily consumption by poor farmer could be raised.
	9. Chicken (Sonali) rearing in the farmer's household for income generation	Twelve selected farmers were given 180 chicks (each farmer 15) and 70% chicks survived. After six month of reared average body weight was increased 1.15kg/ bird and number of egg production 366/ frame family.	Meat production and daily consumption by farmer could be raised.
	10. Maximization of farmers income through carp polyculture technique at low cost management	Six species of carp fishes were stocked in 3 ponds. Production of fishes and BCR were 460kg pond ⁻¹ and 2.90, respectively.	Fish production, income and daily consumption by farmer could be raised.
	11. Distribution of fruit sapling and management of existing fruit tree	Total 1800 saplings of different fruits distributed among 12 farmers and 140 fruit trees sprayed with insecticide and pesticide at FSRD sites. Survival rate of distributed trees is 83.76%	Income and family nutrition could be raised

Table D.4.1. Technology generated/ developed by BLRI Component

General/specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
1.To maximize the farm productivity with efficient use of farm resource in the Char land eco-system.	Sheep rearing in the farmers' household for increase income of farmers	Increased number of lamb and found gross margin Tk.25611 per farm family/year	Production and income of farm family could be increased as well as involvement of women participation will be increased
	Goat rearing in the farmers' household for increase income of farmers	Increased number of kid and found gross margin Tk.20861 per farm family/year	Production and income of farm family could be increased as well as involvement of women participation will be increased
	Duck rearing in the farmers' household for increase income of farmers	Increased number of egg production (127/ farm family) and egg consumption (128%) compared to before intervention. The average income from egg was found Tk.1200/ farm family/ month	Egg production, income and daily consumption by farmer could be raised as well as involvement of women participation will be increased
	Hilly chicken rearing in farmers household for meat purpose	Average body weight gained (1.12kg/chicken) and farm family was earned gross margin Tk. 5061/year (from two batches reared in a year)	Meat production, daily consumption and income by farmer could be raised. Involvement of women participation will be increased

E. Information/knowledge generated/policy generated

Table E.1. Information/knowledge generated/policy generated by BARI Component

General/Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (Short term effect of the research)
1. To maximize the farm productivity with efficient utilization of farm resources	Vegetables and fruit production round the year in homestead at FSRD site Mymensingh and Bogura	<ul style="list-style-type: none"> • Vegetable production was increased about 996.5 kg and 475.56 kg per homestead per year at Mymensingh and Bogura, respectively. • Income from vegetables selling were increased about Tk. 7960 and Tk. 6003 per homestead per year at Mymensingh and Bogura, respectively. • Average fruit production enhanced as 403.30 and 96 kg homestead⁻¹ year⁻¹ at Mymensingh and Bogura respectively. • GM from fruits selling were obtained Tk. 4484 and Tk. 2873 per homestead per year at Mymensingh and Bogura, respectively. 	<ul style="list-style-type: none"> • Fruits and vegetables intake increased remarkably. • Enhanced total farm productivity and income
	Chewing type sugarcane cultivation in house boundary at FSRD site Mymensingh	Each farmer harvested on an average 275 sugarcane of which they consumed 75, distributed 50, and rest produces sold in local market and thus income generated as Tk. 3000 per farmer	<ul style="list-style-type: none"> • Enhanced total farm productivity and income • Increased intake of nutrition in each farm family.
	Fodder production near homestead at FSRD site Mymensingh.	Farmer already harvested 250 kg grasses and sold it Tk. 2500 @ Tk.10 per kg and still it is in good condition for grass production	<ul style="list-style-type: none"> • Enhanced total farm productivity and income
	Production program of different crops with HYVs at FSRD site, Mymensingh and Bogura	BCR ranged from 2.28-4.75	<ul style="list-style-type: none"> • Enhanced total farm productivity and income
	Deworming of cattle	The gaining body weight of dewormed milch cow was observed as 40 g/day/cow whose average lactation yield was increased up to 0.4 L/day over the controlled cows.	Average body weight, disease incidence, lactation yield and the lactation period increased over the controlled cows.
	Mass vaccination to domestic animal viz. cattle, goat, chicken, duck and pigeon at FSRD site, Mymensingh and Bogura	Remarkably reduced mortality rate of domestic animal.	Survival rate of cattle, goat, chicken, duck and pigeon could be increased

General/Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (Short term effect of the research)
	Duck rearing in the farmer's household at FSRD site, Mymensingh and Bogura.	<ul style="list-style-type: none"> • Average body weight gained around 1.57 and 2.2 kg at FSRD site, Mymensingh and Bogura, respectively • Some of the ducks are being laid to eggs and the average egg laid per month was 47 and 98 no/month at FSRD site, Mymensingh and Bogura, respectively. • Average earned money as Tk. 474 and 480 per month at FSRD site, Mymensingh and Bogura, respectively. 	<ul style="list-style-type: none"> • Consumption of eggs in farm family has been increased 49%. • It ensures the nutritional deficiency.
	Sheep and Goat rearing at FSRD site, Bogura.	<ul style="list-style-type: none"> • Each animal was produced 2 - 3 kids per farmer. • Gross value, rearing cost and gross margin of individual farmer was Tk 6333, Tk 2000 and Tk 4333 respectively. 	<ul style="list-style-type: none"> • Enhanced total farm productivity and income
	Beef fattening in farmer's household at FSRD site, Bogura	<ul style="list-style-type: none"> • After 160 days of rearing, cattle weight increased remarkably ranged from 55 kg to 140 kg with an average increased body weight 85.67 kg. • Initially the mean value of each cattle was Tk. 51833 which increased to Tk. 67166 with an average increased value of 29.58%. 	<ul style="list-style-type: none"> • Enhanced total farm productivity and income
	Maximization of farmer's income through carp poly culture at lowcost management in seasonal pond.	<ul style="list-style-type: none"> • At Mymensingh it was produced 6020 kg fish ha⁻¹ and the gross margin was Tk. 360767 ha⁻¹. • On the contrary, fish production was 1588 kg fish ha⁻¹ by adopting carp polyculture method and gross margin was Tk. 148088 ha⁻¹ at FSRD site, Bogura. • The disposal pattern of fish was 89% selling in local market, 9% consumption by themselves and distributed about 2% at FSRD site, Mymensingh, while these were 25%, 65%, and 10% at FSRD site, Bogura, respectively. 	<ul style="list-style-type: none"> • Enhanced total farm productivity and income • Increased intake of nutrition in each farm family.
	Fish culture with mono sex tilapia in seasonal pond at Mymensingh.	Fish production and gross margin were 3268 kg fish ha ⁻¹ and Tk. 206900 ha ⁻¹ . The disposal pattern were 79% selling in local market, 16% consumption by themselves and distributed about 3% among their neighbors, relatives and well-wishers.	<ul style="list-style-type: none"> • Enhanced total farm productivity and income • Increased intake of nutrition in each farm family.

Table E.2. Information/knowledge generated/policy generated by BINA Component

General/Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
To develop system based technologies for the char land	1. Production of vegetables at the land adjacent to homestead	Each farmer earned avg. Tk. 55714 per year by introducing the production of high value vegetables in an extended 1 bigha land near their homestead.	Income and family nutrition could be raised
	2. Improvement of cropping pattern Aus (Binadhan-19) - T. Aman (Binadhan-7) - Mustard (Binasarisha-9) - Mungbean (Binamoog-8)	Gross margin increased 56% in improved cropping pattern compared to existing cropping pattern	Crop production as well as income of the farmer could be raised
	3. Plantation and management of fruit trees	Farmer's house is now surrounded by 19 fruit saplings of 13 different types of fruits. Fruits production, consumption, distribution and selling were increased 99%, 134%, 215% and 48% respectively.	Income and family nutrition could be raised
	4. Raised mini nursery of vegetables seedling using vermicompost in seed starting cell tray	Farmers can grow their seedlings by themselves timely even during flood to grow vegetables at their homestead. It also ensures healthy seedling and reduce cost of production in sustainable way.	Early vegetables production could be ensured by avoiding flood damage. Farmer's income could also be raised.
	5. Rearing of sonali chicken in farmers household	Average gross margin was Tk. 7067 year ⁻¹	Meat production and daily consumption by poor farmer could be raised.
	6. Rearing of pigeon in farmers house hold	Average gross margin was Tk. 2427 year ⁻¹	Meat production and daily consumption by poor farmer could be raised.
	7. Off farm activates (Sewing katha)	Average gross margin was Tk. 2600 year ⁻¹	Women labour utilization along with income could be raised
	6. Integration of Crop + Livestock + Poultry + Fisheries + Vermicomposting + Household	The wastes of one subsystem become an input to a second subsystem. Net income increased 261% compared to before intervention.	Income and employment opportunity could be raised and getting balanced diet could be ensured

Table E.3. Information/knowledge generated/policy generated by BSRI Component

General/Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
1. To develop system based technologies for the char land	1. Year round homestead vegetable production following "Goyeshpur" model	BARI developed homestead vegetables production model disseminated to cooperative farmers. Each farmer sold some of their produced vegetables and approximately earned Tk. 2619 to Tk.3728 per farm family. Vegetables consumption increased about 43% per farm family.	Income and family nutrition could be raised

General/Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
	2. Replacement of existing Sugarcane varieties by newly developed BSRI varieties in FSRD char land eco system	Newly released sugarcane variety BSRI Akh 46 performed better. It gave higher yield (about 30 %) over traditional variety. Which led to higher benefits from sugarcane cultivation.	Sugarcane production and farmers income could be raised
	3. Chewing cane cultivation in homestead at FSRD Char land	Chewing type sugar cane BSRI Akh 42 cultivation in homestead was profitable it gave higher income Average Tk. 5375 per farmer.	Sugarcane production and farmers family income could be increased.
	4. Cultivation of Napier grass in FSRD site	Twelve farmers cultivate Napier grass nearby their homestead and on the pond bank through this program. The average yield of green fodder was 52 th ⁻¹ . Average gross margin Tk.10,500 from 33 decimal of land	Cattle food scarcity can be minimized.
	5. Development of CP technology and improvement of crop production	An improved CP: Radish (Mollica)-Radish (Mollica)-Carrot (Orange king)-Wheat (BARI Gom-31) developed.	Crop production as well as income of the farmer could be raised
	6. Development of CP technology and improvement of crop production	An improved CP: Radish (Mollica)-Carrot (Orange king) - Groundnut (BARI Chinabadam-8) developed.	Crop production as well as income of the farmer could be raised
	7. Improvement of cattle health through deworming and vitamin ADE injection	Total 133 cattle were dewormed at the FSRD site. Dewormed + Vitamin ADE cattle produce more milk (2.96 L/day) than nonrelated. Average body weight was increased (27.04%) in dewormed+ vitamin injected cattle over non treated cattle.	Family income of the farmer is increased.
	8. Vaccination on cattle to reduce mortality rate	Total 753 cattle were vaccinated during the sub-project period mortality rate of the cattle was 0-3% after vaccination which was lower than before (7-18%) vaccination.	Mortality rate of cattle could be reduced which lead to family income.
	9. Vaccination on poultry to reduce mortality rate	Total 1510 poultry birds were vaccinated during the sub-project period mortality rate of the cattle was 1-11% after vaccination which is lower than before (17-39%) vaccination.	Mortality rate of poultry can be reducing.
	10. Pigeon rearing in the farmer's household	Twenty-four pairs of pigeon were given to 12 selected farmers. Every month the pigeon produced squab. After eight months of rearing average number of pigeon (40) per farmer.	Meat production and daily consumption by poor farmer could be raised.
	11. Chicken (Sonali) rearing in the farmer's household for income generation	Twelve selected farmers were given 180 chicks (each farmer 15) and 70% chicks survived. After six month of reared average body weight was increased 1.15kg/ chicken and number of egg production 366/farm family.	Meat production and daily consumption by farmer could be raised.

General/Specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
	12. Maximization of farmers income through carp polyculture technique at low-cost management	Six species of carp fishes were stocked in 3 ponds. Production of fishes and BCR were 460kg/pond and 2.90 respectively.	Fish production, income and daily consumption by farmer could be raised.
	13. Distribution of fruit sapling and management of existing fruit tree	Total 1800 saplings of different fruits distributed among 12 farmers and 140 fruit trees sprayed with insecticide and pesticide at FSRD sites. Survival rate of distributed trees was 83.76%	Income and family nutrition could be raised
2. Creating awareness on system based agricultural technologies among the participating farmers.	1. Farmers field day	Two farmer's field days were completed.	

Table E.4 Information/knowledge generated/policy generated by BLRI Component

General/specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
1. To maximize the farm productivity with efficient use of farm resources 2. To improve family income.	Goat rearing in the farmer's household for increase income of farmers	Increased number of kids and gross margin earned Tk.20861 per farm family/year	Production and income of farm family could be increased as well as involvement of women participation will be increased
	Performance of Turkey at farmer's level for egg and meat purpose	Average body weight gained (3.0 kg/ bird) and farm family was earned gross margin Tk. 3242/year	Income and family nutrition of farmers could be raised
	Rearing of pigeon at farmers house hold	Average consumption was (25%) and earned gross margin Tk. 1600 per farm family	Involvement of women participation. Income and family nutrition of farmers could be raised
	Duck rearing in the farmer's household	Increased number of egg production (127/ farm family) and egg consumption (128%) compared to before intervention. The average income from egg was found Tk.1200/ farm family/ month	Egg production, income and daily consumption by farmer could be raised as well as involvement of women participation will be increased
	Hilly chicken rearing in farmers household for meat purpose	Average body weight gained (1.12kg/chicken) and farm family was earned gross margin Tk. 5061/year (from two batches reared in a year)	Meat production, daily consumption and income by farmer could be raised. Involvement of women participation will be increased

General/specific objectives of the sub-sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
	Vaccination program on livestock and poultry birds	Significantly reduced mortality rate from different diseases. Before vaccination mortality rate of livestock (10-15%) and poultry birds (8-25%) after vaccination mortality rate of livestock (1-2%) and poultry birds (1-4%)	Survival rate could be increased which lead to increase family income.
	Improvement of cattle health by deworming and injected ADE injection	Significantly increased body weight and milk production.	Income and family nutrition of farmers could be raised
	Fodder crop cultivation nearby homestead (BLRI-developed HYV Napier fodder)	Yield of fodder and gross margin were 80 kg and Tk.8000 per homestead (12 decimal of land)	Farm family income will be increased as well as scarcity of cattle feed will be removed.
	Year round homestead Vegetables production	From homestead, vegetables production was increased as all as consumption, distribution and selling of vegetables increased. Average gross margin Tk.11980 was earned by per farm family.	Involvement of women participation as well as income and family nutrition of farmers could be raised
	Cropping Patterns practiced by the cooperator farmers Mustard- Boro-T. Aman rice and Onion-Til -T. Aman rice	Range of gross margin was 60370 – Tk.180700/ha	Total productivity as well as income of farm family could be increased.
	Maximization of farmers' income through carp poly culture technique at low cost management	Total production fishes 6377 kg/ha and gross margin was Tk.786358 /ha	Farmers in come and family nutrition could be increased.
	Empowerment of rural woman through off-farm activities at FSRD Site, Bagabari, Sirajganj (Stitching of Khata and handicraft)	Average income was found Tk.6701 from off farm activities	Income and involvement of women participation could be increased.

F. Materials Development/Publication made under the Sub-sub-project

Table F.1. Materials Development/Publication made under the Sub-project by BARC Component

Publication	Number of publications		Remarks (e. g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Leaflet		01	Technology of Turkey Rearing Under Rural Condition
Video documentry		01	

Table F.2. Materials Development/Publication made under the Sub-project by BARI Component

Publication	Number of publications		Remarks (e. g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.	01 (one)	-	সম্বিত খামার ব্যবস্থাপনার মাধ্যমে চরাঞ্চলের জমে থাকা পানিতে হাঁস পালন একটি লাভজনক প্রযুক্তি “An good approach of duck rearing in stagnant water of char land through integrated farming system”
Journal publication		01 (one)	Khan, M. A. H; N. N. Aktar; N. Sultana; S. Akhter and M. F. Hossain. 2019. Baseline survey for farm productivity improvement through agricultural technologies in Charland of Mymensingh. Int. J. Bus. Manag. Soc. Res. 07(01): 395-411.
	01 (one)	-	Enhancing system productivity through transforming two crops to Potato-Boro-T.Aman rice cropping pattern in Mymensingh region.
Video clip	01 (one)	-	Video clips on sub-project activities.

Table F.3. Materials Development/Publication made under the Sub-project by BINA Component

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Leaflet	-	1	১। চরাঞ্চলে সম্বিত খামার ব্যবস্থাপনায় সোনালি জাতের মুরগি পালন ২। চরাঞ্চলে বসতবাড়িতে সবজি চাষে উচ্চ নার্সারী বেড ও ভার্মিকম্পোস্ট ব্যবহার
Factsheet		1	
Journal publication	03	-	Title: 1. Assessment of the profitability and productivity of Jute-T. Aman-Maize cropping pattern at char land in Jamalpur district of Bangladesh 2. Raised mini nursery with vermicompost: A profit maximizing sustainable approach for poor char dwellers impacted by regular flooding. 3. Integrated Farming System: An approach of increasing income for poor char dwellers
Video clip	-	2	1. Video clip on project activities done by the farmers (9 minute and 45 second) 2. Video clip on success story of 2 farmer (6 minute) 1.TV programm “Mati and Manus” at Bangladesh Television (BTv)
TV programme		1	
Newspaper/Popular article 1. Online News paper		i. বাংলার চিঠি.com (২২ সেপ্টেম্বর ২০১৯)	i. চরাঞ্চলে সম্বিত খামার ব্যবস্থাপনা পদ্ধতি প্রদর্শনের উপর মাঠ দিবস
2. News paper		i. দৈনিক কালের আলো (২৫ জানুয়ারি ২০২০) ii. দৈনিক আজকের ময়মনসিংহ (২৫ জানুয়ারি ২০২০)	i. চরাঞ্চলে সম্বিত খামার ব্যবস্থাপনা পদ্ধতি প্রদর্শনের উপর মাঠ দিবস ii. জামালপুরে চরাঞ্চলের জনগোষ্ঠির জীবনযাত্রার মান উন্নয়নে প্রশিক্ষণ কর্মশালা

Table F.4. Materials Development/Publication made under the Sub-project by BSRI Component

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Leaflet	1		Cultivation of chewing cane in homesteaded
Journal publication	1		Sugarcrop Based Farming System Research Achievement and Prospects Bangladesh Journal of Sugarcane
Video clip	-	2	1. Video clip on sub-project activities done by the farmers 2. Video clip on success story of 2 farmers
Other publications, if any	-	-	-

BLRI Component: Not done

Publication	Number of publications		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.			
Journal publication			
Video clip/TV program			
News Paper/Popular Article			
Other publications, if any			

G. Description of generated Technology/Knowledge/Policy

i. Technology Fact Sheet

Fact sheet-1

Title of the technology: Four crop-based alternate cropping pattern Mustard- Boro - T. Aus -T. Aman rice cropping pattern against Mustard - Boro - T. Aman rice under AEZ-4

Introduction

Bangladesh is a small but the most densely populated (about 843 persons per sq. km) country of the world. Population is increasing annually at the rate of about 1.37 percent. Total cultivable land of the country is about 8.44 million hectares. Demographic pressures and increased urbanization have caused cultivated area to decline at a rate of 1 percent per year. Food requirement of the country is estimated to be doubled in the next 25 years. The demand has to be met from our limited and shrinking land resources. Bangladesh is predominantly a rice growing country and rice is the staple food. Rice occupies about 80% of the total cropped area and is cultivated in three seasons a year. In rice-based cropping system Mustard-Boro-T. Aman is a dominant cropping pattern of the country. The present cropping intensity of the country is more than 191%. In order to produce more food within a limited area, it is very important to increase cropping intensity and for this reason more suitable crop(s) should be included in the cropping pattern. Therefore, the pattern was undertaken to develop four crops-based cropping pattern against the existing Mustard-Boro-T. Aman rice cropping pattern.

Description

Farmers used to grow the local Tori-7 cultivar for mustard in order to make sure Boro rice cultivation. After harvest of mustard, they go for Boro rice cultivation and thereafter the land remains fallow for a considerable period of time after harvest of Boro rice which could be utilized to grow an additional crop by adjusting the time and variety. Finally, they go for T. Aman rice with long duration Swarna cultivar. To enhance the system productivity, the existing system was improved by changing the traditional cultivars with high potential varieties as well as by altering the cropping pattern through inclusion of additional crop T. Aus rice in the system. BARI Sarisha-14 was used instead of local Tori-7, BRRI dhan75 was selected

against long duration Swarna and additional T. Aus rice (BRRI dhan48) was included in between Boro and T. Aman rice. BARI Sarisha-14 gave 55.49% higher seed yield over the local Tori-7. T. Aus rice in alternate cropping pattern contributed to 3.68t ha⁻¹ grain yield. The rice equivalent yield of improved and existing patterns is 16.23 t ha⁻¹ and 11.08 t ha⁻¹, respectively. REY of improved cropping pattern is 52.39% higher over existing pattern.

Cultivation procedure of mustard: Land is prepared by power tiller and mustard var. BARI Sarisha-14 seeds are sown in line at 25-28, November. The fertilizer doses are applied @ 250-170-85-150-5-10 kg ha⁻¹ of Urea, TSP, MOP, Gypsum, Zinc sulfate and Boron. All the fertilizers are applied as basal except half of the urea which is applied as top dress. The seed rate is @ 6 kg ha⁻¹. Half of the urea is top dressed at 25 days after sowing. Top dress is followed by thinning and weeding. Thin out seedlings are used as green vegetable. One or two irrigations are required and are applied as and when necessary. Curative measures are taken if mustard is infested by pest and diseases. Mustard is harvested within second week of January.

Cultivation procedure of Boro: After the harvest of mustard, land is irrigated and puddled by power tiller for Boro rice transplanting. Fertilizers are applied @ 217-150-80-56-10-0 kg ha⁻¹ of Urea, TSP, MOP, Gypsum, Zinc sulphate and Boron, respectively. All fertilizers are applied during final land preparation except urea. Urea was top dressed equally at 20 and 50 DAT. Top dress is followed by weeding. Thirty five to forty days old seedlings of Boro are transplanted at 3rd week of January. Irrigation is applied at 15-20 times after transplanting and continued up to 15 days before harvesting. The variety of Boro rice is BRRI dhan28. Seedling are transplanted at 20 cm x 15 cm apart with 2-3 seedlings per hill. Carbofuran @ 15 kg ha⁻¹ should be applied for controlling stem borer. Curative measures are taken if Boro rice is infested by pest and diseases. Boro is harvested at 2nd week of May.

Cultivation procedure of T. Aus rice: After harvest of Boro rice land is irrigated and puddled by power tiller for T. Aus transplanting. Fertilizers are applied @ 150-75-76-55 kg ha⁻¹ of Urea, TSP, MOP and Gypsum, respectively. All fertilizers are applied during final land preparation except urea. Urea was top dressed equally in two splits at 20 and 45 DAT. Top dress is followed by weeding. Twenty five days old seedlings of T. Aus rice are transplanted at 2nd week of May. The variety of T. Aus is BRRI dhan48. Seedlings are transplanted at 20 cm x 15 cm apart with 2-3 seedlings per hill. If necessary, irrigation is applied in the growing season. Curative measures are taken if Aus rice is infested by pest and diseases. T. Aus is harvested at 1st week of August.

Cultivation procedure of T. Aman rice: After harvesting of T. Aus rice, land is irrigated and puddled by power tiller for T. Aman transplanting at 2nd week of August. Seedling spacing is 20 cm x 15 cm and numbers of seedlings are 2-3 per hill. T. Aman variety is BRRI dhan75. Fertilizers are applied @ 80-15-35-8-1 kg ha⁻¹ of N-P-K-S-Zn. All P, K, S, and Zn fertilizers are applied as basal. N are applied in 3 equal splits, the 1st one as immediately after seedling establishment, the 2nd one at early tillering stage and 3rd one at 5-7 days before panicle initiation. Twenty days old seedlings of T. Aman are transplanted. Irrigation is applied as and when necessary. Two times hand weeding is done following the urea top dressing. Top dress is followed by weeding. Curative measures are taken if T. Aman rice is infested by pest and diseases. T. Aman rice is harvested in the 2nd week of November.

Suitable location/ecosystem

Char land of Bogura under AEZ-4 and similar areas

Benefits

- Gross return (Tk.ha⁻¹) : 324725/-
- Cultivation cost (Tk.ha⁻¹) : 155645/-
- Gross margin (Tk.ha⁻¹) : 169080/-

Name and contact address of author:

Dr. Md. Shahidul Alam, PSO and Md. Aminul Islam, SO
On Farm Research Division, BARI, Chelopara, Bogura
Phone: 051-65365, Mobile: 01712-166150
Email : alamsrc84 @ yahoo.com

Fact sheet-2

Title of the technology: Alternate cropping pattern Wheat - Jute - T. Aman rice cropping pattern against Boro-Fallow-T. Aman rice

Introduction

Boro- Fallow-T. Aman is also a major cropping pattern in the FSRD site, Bogura. After harvest of T. Aman rice, the land remains fallow for a considerable period of time. Then they go for Boro rice and thereafter which could be utilized to grow an additional crop by adjusting the fallow period and variety. Finally, they go for T. Aman rice with long duration Swarna cultivar. OFRD team, Bogura with the support of the sub-project tried to explore the avenues of increasing system production through inclusion of more crops in the existing system. Keeping this view in mind, a three-crop based pattern was tested by changing the traditional system. Boro rice was replaced by wheat and jute, BIRRI dhan75 was selected against long duration Swarna.

Description

Boro -Fallow-T. Aman rice is a major cropping pattern for medium high land in char areas of the FSRD site, Bogura. Farmers go for Boro rice cultivation in the month of January. After harvest of Boro rice in April, land remains fallow for a long period until T. Aman rice is planted in July and August. T. Aman is harvested in November. The pattern Boro-Fallow-T. Aman rice was improved by altering the traditional practices. Boro rice was replaced by Wheat and subsequent jute by adjusting the fallow period. BARI Gom-30 for wheat and O-9897 for jute was selected for the pattern. For Swarna a long duration T. Aman cultivar was changed by short duration variety BIRRI dhan75. BARI Gom-30 gave 3.76 t ha⁻¹ and Jute gave 2.43 t ha⁻¹ yields. The alternate pattern contributed to REY of 15.35 t ha⁻¹ that was 50.49% higher than existing cropping pattern (10.20 t ha⁻¹).

Cultivation procedure of wheat: Land is prepared by power tiller for wheat. Prior to land preparation if soil is very dry irrigation is applied. Land is prepared well and wheat is sown in line at field capacity of soil moisture at 20-28, November. Fertilizers are applied @ 175-150-110-125-0-7.5 kg ha⁻¹ of Urea, TSP, MOP, Gypsum and Boron, respectively. All the fertilizers are applied as basal except one third of the urea which is applied as top dress. The variety is BARI Gom-30. The seeds are sown @ of 120 kg ha⁻¹. Rest one third of the urea is top dressed at 17- 21 days after sowing. Top dress is followed by thinning and weeding. One or two irrigations are required and are applied as and when necessary. Curative measures are taken if wheat is infested by pest and diseases. Wheat is harvested last week of March.

Cultivation procedure of Jute: After harvesting of wheat, land is prepared by power tiller for Jute. If necessary, irrigation is applied bringing soil to good condition and seed is sown as broadcast @ 7.0 kg ha⁻¹. Seeds are sown on second week of April. The Jute variety is O-9897. Fertilizers are applied @ 140-30-25-15-4-2 kg ha⁻¹ of N-P-K-S-Zn-B. Half of N and all P, K, S, Zn and B are applied as basal during final land preparation. Remaining N are top dressed at 40-45 DAS under moist soil condition. Top dress of N is followed by thinning and weeding. Usually, irrigation is not necessary. However, if needed a light irrigation may be applied as and when necessary. Jute is harvested in the last week of July.

Cultivation procedure of T. Aman: After harvest of jute, land is puddled by power tiller for T. Aman transplanting at first week of August. Fertilizers are applied @ 90-12-53-12 kg ha⁻¹ of N-P-K-S. During final land preparation entire P, M and S are applied as basal. Twenty five days old seedlings of T. Aman rice is transplanted by the first week of August. The variety BIRRI dhan75 is transplanted with spacing 20 cm × 15 cm and number of seedlings 2-3 per hill. N fertilizer is applied in three equal splits, 1st top dress was done after seedling establishment, 2nd one at early tillering stage and 3rd one at 5-7 days prior to panicle initiation (PI) stage. Two times hand weeding is done following the urea top dressing. The weeding is done once at 20 days after planting and another at 35 DAP. The crop is usually grown as rainfed condition however, if there is a lack of rainfall irrigation is done as and when necessary. Curative measures are taken if T. Aman rice is infested by pest and diseases. The T. Aman rice is harvested in second week of November.

Suitable location/ecosystem

Char land of Bogura under AEZ-4 and similar areas

Benefits

- Gross return (Tk. ha⁻¹) : 307140/-
- Cultivation cost (Tk. ha⁻¹) : 118460/-
- Gross margin (Tk. ha⁻¹) : 188680/-

Name and contact address of author:

Dr. Md. Shahidul Alam, PSO and Md. Aminul Islam, SO
On Farm Research Division, BARI, Chelopara, Bogura
Phone: 051-65365, Mobile: 01712-166150
Email : alamsrc84 @ yahoo.com

Fact Sheet-3

Title of the technology: An improved cropping pattern for the char land of Mymensingh: Mustard-Boro- T.Aman rice against Boro - Fallow - T. Aman rice

Introduction

There is about 0.82 million ha of char land in Bangladesh of which 0.22 million ha is predominating in Mymensingh which is a stable char according to SRDI. Water does not stagnate in the char land round the year nor is the area flooded over every year. The soils of this area are medium highland to highland with loam to clay loam in texture. Presently in many of these areas irrigation facilities are available and in these areas upland crops like, vegetables are generally cultivated or often remain fallow. The area is mostly double cropped and Boro-Fallow-T. Aman is the dominating cropping pattern. Keeping view in mind, in order to bring this area in full fledge round the year cultivation, a upland oil seed crop was planned to include in between two rice crops in three crops cropping pattern and a new 3 crops based cropping pattern was developed. Short duration mustard variety was selected to fit well in the improved cropping pattern. In this cropping pattern, in Rabi season short duration BARI Sarisha-14 is cultivated followed by Boro. After harvesting of Boro, T.Aman rice is cultivated receiving rain water in rainy season or lack of enough water from rainfall may cultivated by irrigation water. Just after harvesting of T. Aman rice mustard is broadcasted in levelled field condition soil. Thus a new cropping pattern, Mustard-Boro-T. Aman is developed with combination of an oil seed crop.

Description

Boro - Fallow - T. Aman rice is the predominant rice based cropping pattern in char land ecosystem of Mymensingh region and a long time remain fallow after harvest of T. Aman rice. Therefore, short duration oil seed crop viz. mustard was included in between two rice crop in this pattern to increase the farm productivity for livelihood improvement. Just after harvesting of T. Aman rice the land is needed to prepare for upland mustard cultivation. Seeds of mustard are direct seeded at the field condition by breaking the soil clods and leveling. For wetland cultivation of Boro and T. Aman rice the land is ploughed and puddled with stagnant water accumulated from rainfall or irrigation sources and the seedling are transplanted. The cropping is started with mustard in the early rabi season followed by Boro and T.Aman rice. In the main field the total field duration of three crops are an average 272 days which is enough to establish the crop in timely. All the crops is harvested at the physiological maturity and 7 to 36 days are released to establish the preceding crops. The total turnaround time is 7-36 days varied to crops which is suitable for next crop planting. Sometimes rainfall delayed to establishing the next crop as of T. Aman which hampered the upland crop attained in field capacity for sowing. The fertilizer dose for cropping pattern based similar crops is followed according to FRG, 2018 rather than single crop. Micronutrient fertilizers were applied once in a year. Some biomass from mustard is added to soil is incorporated into the soil to improve the soil health and to reduce fertilizers requirements to some extents of the following crops. Residual effect of P, K and micronutrients become available for succeeding crops and was taken into account and accordingly the fertilizer dose was adjusted. Irrigation and water management schedule is important for sequential cropping is similarly followed as of individual crops. If the lands remain dry before land preparation additional irrigation may enhance to prepare land at field capacity. Delay in crop establishment is sometimes taken

place. Rainfall may interfere with the land preparation of upland crops. Continuous cultivation of crops allows less weed infestation. In most cases second weeding was not necessary except rice crops.

Cultivation procedure of T. Aman

At the time of stagnant water of rainy season or partial irrigation of delayed rain the land is puddled and prepared by power tiller for T. Aman transplanting. Fertilizers are applied @174-110-70-33-6 kg ha^{-1} of Urea, TSP, MOP, Gypsum and Zink sulfate. During final land preparation entire TSP, MoP, Gypsum and ZnSO₄ fertilizers are applied as basal. Twenty five days old seedlings of T. Aman rice is transplanted by the middle of August at 20 cm \times 15 cm. The variety BRRRI dhan56 is transplanted with the number of 2-3 seedlings per hill. Urea fertilizer is applied in three equal splits, 1st top dress was done after seedling establishment, 2nd one at early tillering stage and 3rd one at 5-7 days prior to panicle initiation (PI) stage.

Two times hand weeding is done following the urea top dressing. The weeding is done once at 20 days after planting and another 35 DAP. The crop is usually grown as rainfed condition however, if there is a lack of rainfall irrigation is done as and when necessary. Curative measures are taken if Aman rice is infested by pest and diseases. The T. Aman is harvested last week of October or first week of November.

Cultivation procedure of Mustard

Land is prepared prior to sowing the mustard seed by power tiller. The mustard seed is broadcasted in well prepared land at field capacity at around mid-November. The land is fertilized with recommended fertilizers dose as basal except half of urea. The fertilizer is applied at the rate of 250-170-80-133-6-6 kg ha^{-1} of Urea, TSP, MOP, Gypsum, Zink sulfate and Boric acid. The mustard variety is BARI Sarisha-14 is usually sown as broadcast @ 7.5 kg ha^{-1} . Half of the urea is top dressed at 25 days after sowing. Top dress is followed by thinning and weeding. Thin out seedlings are used as green vegetable. One or two irrigations are required and are applied as and when necessary. Curative measures are taken if mustard is infested by pest and diseases. Mustard is harvested within first week of February.

Cultivation procedure of Boro

After the harvest of mustard, the land is irrigated and puddled and prepared by power tiller for Boro transplanting. At final land preparation, fertilizers are applied as basal @303-100-120-111-19 kg ha^{-1} except urea. Other than urea entire amount of TSP, MoP, Gypsum and Zink sulfate are applied as basal. Thirty five days old seedling is transplanted in the main field on 1st week of February. The variety BRRRI dhan28 is transplanted at the spacing 20 \times 15 cm with the number of 2-3 seedlings per hill. Nitrogen fertilizer is applied in three equal splits, 1st top dress was done after seedling establishment, 2nd one at early tillering stage and 3rd one at 5-7 days prior to panicle initiation (PI) stage. Top dress is followed by weeding. Two times weeding is needed which is done either by herbicide at 7 days after transplanting and next one is followed on 30-35 DAT. Irrigation is applied 7-8 times during the whole growing period. Curative measures are taken to control the insect and pest. Boro rice is harvested on last week of May or first week of June.

Suitable location/ecosystem

Char land of Mymensingh under AEZ-8 & AEZ-9 and similar area.

Benefits

- REY : 13.58 tha^{-1}
- GM : 29% higher than traditional pattern
- BCR : 1.59

Name and contact address of author

Dr. Nargis Sultana, SSO and Dr. Md. Moniruzzaman, PSO,
On Farm Research Division
BARI, Mymensingh

Fact Sheet-4

Title of the technology: An improved cropping pattern for the char land of Mymensingh: T.

Aman-Potato-Boro against Boro- Fallow-T. Aman rice

Introduction

The Old Brahmaputra Floodplain belonging the Brahmaputra River in Mymensingh having 0.22 million ha of char land. In this area is however the stable char where water does not stagnant round the year nor is flooded over every year. The predominating medium to high land soils are loam to clay loam texture. The area is mostly double cropped and Boro-Fallow-T.Aman is the dominating cropping pattern. Presently in many of these areas are under irrigation facilities and in these areas upland crops like, vegetables are generally cultivated or often remain fallow. In this char area, rice is predominately cultivated in Boro and T.Aman rice season. Boro rice is cultivated completely by irrigation water whereas T.Aman is depend on rainfall or partial irrigation in delayed rainfall in periodic. Some of up lands are completely occupied by sporadic vegetable cultivation. Considering the views, to bring this areas in round the year cultivation as well as introducing a new crop variety in between two rice crops a three crops based cropping pattern was developed. A short duration potato variety BARI Alu-25 was introduced to fit well in the improved cropping pattern. In this cropping pattern, in Rabi season short duration BARI Alu-25 is cultivated followed by Boro. After harvesting of Boro, T. Aman rice is cultivated receiving rain water in rainy season or lack of enough water from rainfall may cultivated by irrigation water. Just after harvesting of T. Aman rice potato is planted in levelled field condition soil. Thus a new cropping pattern, T. Aman-Potato-Boro is developed with combination of a tuber crop.

Description

The cropping pattern is developed in following three crops based pattern including a short duration tuber crop. In this pattern two low land rice crops viz. Boro and T.Aman and one upland crop potato is cultivated. Just after harvesting of T.Aman rice the land is needed to prepare for upland potato cultivation. Potato tuber let is planted at the main field by ploughing and levelling of soil just after harvesting of T. Aman rice. For wetland cultivation of Boro and T. Aman rice the land is ploughed and puddled with stagnant water accumulated from rainfall or irrigation sources and the seedling are transplanted. The cropping is started with potato in the early rabi season followed by Boro and T.Aman. In the main field the total field duration of three crops are an average 276 days which is enough to establish the crop in timely. All the crops is harvested at the physiological maturity and 7 to 36 days are released to establish the preceding crops. The total turnaround time is 8-62 days varied to crops which is suitable for next crop planting. Sometimes rainfall delayed to establishing the next crop T. Aman which hampered the upland crop as of attained in field capacity for sowing. The fertilizer dose for cropping pattern based similar crops is followed according to FRG, 2018 rather than single crop. Micronutrient fertilizers were applied once in a year. Some biomass from mustard is added to soil is incorporated into the soil to improve the soil health and to reduce fertilizers requirements to some extents of the following crops. Residual effect of P, K and micronutrients become available for succeeding crops and was taken into account and accordingly the fertilizer dose was adjusted. Irrigation and water management schedule is important for sequential cropping is similarly followed as of individual crops. If the lands remain dry before land preparation additional irrigation may enhance to prepare land at field capacity. Delay in crop establishment is sometimes taken place. Rainfall may interfere with the land preparation of upland crops.

Continuous cultivation of crops allows less weed infestation. In most cases second weeding was not necessary except rice crops.

Cultivation procedure of T. Aman

At the time of stagnant water of rainy season or partial irrigation of delayed rain the land is puddled and prepared by power tiller for T. Aman transplanting. Fertilizers are applied @174-110-70-33-6 kg ha^{-1} of Urea, TSP, MOP, Gypsum and Zink sulfate. During final land preparation entire TSP, MoP, Gypsum and ZnSO₄ fertilizers are applied as basal. Twenty five days old seedlings of T. Aman rice is transplanted by the middle of August at 20×15 cm. The variety BRRI dhan56 is transplanted with the number of 2-3 seedlings per hill. Urea fertilizer is applied in three equal splits, 1st top dress was done after seedling

establishment, 2nd one at early tillering stage and 3rd one at 5-7 days prior to panicle initiation (PI) stage. Two times hand weeding is done following the urea top dressing. The weeding is done once at 20 days after planting and another 35 DAP. The crop is usually grown as rainfed condition however, if there is a lack of rainfall irrigation is done as and when necessary. Curative measures are taken if Aman rice is infested by pest and diseases. The T. Aman is harvested last week of October or first week of November.

Cultivation procedure of Potato

BARI Alu-25 tuber let is planted in well prepared soil at field capacity at around mid-November. The land is fertilized with recommended fertilizers dose as basal except half of urea. The fertilizer is applied at the rate of 325-200-220-100-8-6 kg ha^{-1} of Urea, TSP, MOP, Gypsum, Zink sulfate and Boric acid. The tuber let is planted maintaining the spacing 60×25 cm at the rate of 1600 kg ha^{-1} . Half of urea is top dressed at 35 days after planting. Top dress is followed by weeding. Two to three irrigations are required and are applied as 20-25 days after planting of stolon initiation, 40-45 DAP at tuberization and finally the growing stage of tuber. Curative measures are taken if potato is infested by insect as cut worm and the devastating disease late blight. Foggy weather and low temperature at night causes a serious damage to the crop. For controlling the disease fungicide is sprayed as of Secure @ 2g/L or Acrovet MZ @ 2g/L or Acrovet MZ @2g + Secure @1g per liter water or Meladiduo @1g + Acrovet MZ @ 2g per liter water or Meladiduo @ 4g + Secure @ 2g per liter water at an interval of 7 days. Potato is harvested within last week of January and first week of February.

Cultivation procedure of Boro Rice

After the harvest of potato, the land is irrigated and puddled and prepared by power tiller for Boro transplanting. At final land preparation, fertilizers are applied as basal @ 303-100-120-111-19 kg ha^{-1} except urea. Other than urea entire amount of TSP, MoP, Gypsum and Zink sulfate are applied as basal. Thirty five days old seedling is transplanted in the main field on 1st week of February. The variety BRRI dhan28 is transplanted at the spacing 20×15 cm with the number of 2-3 seedlings per hill. Nitrogen fertilizer is applied in three equal splits, 1st top dress was done after seedling establishment, 2nd one at early tillering stage and 3rd one at 5-7 days prior to panicle initiation (PI) stage. Top dress is followed by weeding. Two times weeding is needed which is done either by herbicide at 7 days after transplanting and next one is followed on 30-35 DAT. Irrigation is applied 7-8 times during the whole growing period. Curative measures are taken to control the insect and pest. Boro rice is harvested on last week of May or first week of June.

Suitable location/ecosystem

Char land of Mymensingh under AEZ-8 & AEZ-9 and similar area.

Benefits

- REY : 35.68 tha $^{-1}$
- GM : 479% higher than traditional pattern
- BCR : 3.47

Name and contact address of author

Dr. Nargis Sultana, SSO and Dr. Md. Moniruzzaman, PSO,
On Farm Research Division
BARI, Mymensingh

Fact Sheet-5

Title of the technology: An improved cropping pattern for the char land of Jamalpur: Maize (var. Hybrid 981) - Jute (var. JRO 524) - T. Aman (var. Binadhan-11)

Introduction

Bangladesh is predominantly rice growing country and rice based cropping pattern are mostly following all over the country. In Jamalpur more than 50% followed cropping pattern is Rice-Fallow-Rice. But in the char area among the surveyed farmer the major cropping pattern was observed Jute - T. Aman rice –

Grasspea (used for grazing). Cropping patterns depend on soil, land and farmers type (marginal, small and medium). Choosing good variety of different crops is needed to consider importantly for getting higher yield within short time. Three crops cropping pattern with BINA developed rice varieties and high yielding jute and maize is promising for this area. So that three crops cropping pattern was changed by growing maize crops instead of growing pulse crop grasspea which was grown by farmer as fodder crop for their cows and BINA developed submergence tolerant T. Aman rice variety Binadhan-11 instead of rice variety Sharwna.

Description

Rice varieties developed by BINA along with jute and maize are chosen to cultivate in cropping sequences. In this 3 crops cropping pattern maize hybrid variety is cultivated followed by Jute and then short duration submergence tolerance rice variety Binadhan-11. Maize is produced in Rabi season which tremendously increases the system productivity and economic return of the three crops pattern. Jute variety JRO-524 is produced in kharif-I season followed by maize. Harvesting of jute depends on the availability of water for jute retting. At the harvesting time of jute farmers used flooded water to ret their crop. In this area flood is regular phenomena which damage rice seedling at early stage. For this reason, submergence tolerance short duration rice variety of BINA i.e, Binadhan-11 is produced in the kharif-II season. Rice equivalent yield was increased due to cultivation of hybrid maize (11.81 t/ha) by replacing pulse crop (1.73 t/ha) in Rabi season. Total rice equivalent yield is 96% more than existing cropping pattern. Improved cropping pattern Jute (var. JRO 524)-T. Aman (var. Binadhan-11)-Maize (var. Hybrid 981) increased gross margin 206% compared to existing cropping pattern Jute (var. JRO 524)-T.Aman (var. Swarna)-Khesari (BARI Khesari-1). The crop duration of the pattern is 349 days among which field duration is 324 days. Total turned around time is 41 days.

Cultivation procedure of maize

Land is prepared by power tiller for maize. Prior to land preparation if soil is very dry irrigation is applied. Seeds are sowed on 06-08 November with 75 cm x 25 cm spacing. The crop is fertilized with 512-275-200-222-14-6 kg/ha of NPKSZnB. One third N and full amount of other fertilizers are applied at the time of final land preparation in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and Boron. Rest amount of N are applied in two equal splits at 30 and 60 DAS. Irrigations is given when necessary. Other intercultural operations are done as and when necessary. One hand weeding and earthing up is done at 20 and 40 DAS. The crop is harvested at maturity stage on 28-30 March at 140-142 DAS.

Cultivation procedure of Jute

Land is prepared finely with 3-4 ploughing and cross ploughing by power tiller for jute. Prior to land preparation if soil is very dry irrigation is applied. Seeds are sowed on 05 April with 30 cm x 5 cm spacing. The residues of the previous crop are cleaned properly. Farmers' sown jute seeds after application of recommended doses of different fertilizers. The crop is fertilized with 225-150-112-75-7.5-7.5 kg/ha of NPKSZnB. One third N and full amount of other fertilizers are applied at the time of final land preparation in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and Boron. Rest amount of N are applied in two equal splits at 30 and 60 DAS. Irrigations is given when necessary. Other intercultural operations are done as and when necessary. The crop is harvested at maturity stage at 95 DAS.

Cultivation Procudure of T. Aman

After the harvest of jute, land is irrigated and puddled and prepared by power tiller for T. Aman transplanting. At final land preparation fertilizers are applied as basal fertilizer except 2/3 of the urea which is applied as top dress two times at about 15 and 30 DAT. Fertilizers are applied @ 160-120-80 kg/ha of Urea, TSP and MoP. Twenty day old seedlings of T. Aman is transplanted at 05 August. If necessary, irrigation is applied in the first month of transplanting. Two times hand weeding is done following the urea top dressing. T. Aman variety is Binadhan-11. Seedling spacing is 20 cm x 15 cm and numbers of seedlings are 2-3 seedlings per hill. One third of the urea is top dressed at 15 and 25 days after sowing. Top dress is followed by weeding. Curative measures are taken if Aman is infested by pest and diseases. Aman rice is harvested at end of October.

Suitable location/ecosystem

Char area Jamalpur (AEZ-8)

Benefits

Total income: Per hectare land Tk. 4,71,427

Production cost: Per hectare land Tk. 2,26,901

Benefit: Per hectare land Tk. 2,44,526

Name and contact address of author

Dr. Reema Ashrafi

Senior Scientific Officer

Planning and Development Section

BINA, Mymensingh

Mobile : 01745749881

Email: reema_ashrafi@yahoo.com

Fact Sheet-6

Title of the Technology: Four Crops Based Cropping Pattern Radish-Radish-Carrot-Wheat in Padma Char Region

Introduction

Bangladesh is predominantly rice growing country and rice based cropping pattern are mostly following all over the country. In Ishurdi region more than 50% followed cropping pattern is Rice-Fallow-Rice. But in the char area of Padma the major cropping pattern is Aus - Blackgram - Lentil. The total productivity is very much low compare to other area of the country. Short duration, high value and high yielding variety of different crops are needed to fit in the existing cropping pattern. Which could be increased the total productivity in the char land of Padma at Ishurdi, Pabna. The four crops in cropping pattern concept developed by BARI to introduced in this area for increase higher system productivity. So the three crops cropping pattern was changed by Radish (Mollica) - Radish (Mollica) - Carrot (Orange king) - Wheat (BARI Gom- 31) for higher system productivity.

Description

In the new cropping pattern Radish-Radish-Carrot-Wheat (four crops) can be produced in a year. Productivity increases in this cropping pattern and cropping intensity increases by 400%. The equivalent yield of Wheat in the improved cropping pattern (Radish-Radish-Carrot-Wheat) was found to be 54.06 t / ha / year whereas in the conventional cropping pattern (Aus Rice-Blackgram-Lentil) the equivalent yield of Rice was 15.38 t / ha / year. Improved cropping patterns make it possible to earn more than 252% profit.

Cultivation procedure of Radish (First time)

Land is prepared by power tiller for radish cultivation. Prior to land preparation if soil is very dry irrigation is applied. First time seed are sown in second week of May in broadcasting methods. Fertilizer is applied @ 300-225- 240- 100- 13 kg ha⁻¹ of Urea, TSP, MoP, Gypsum and Zinc Sulphate. One-third of all fertilizers should be applied during final land preparation and remaining fertilizers should be applied in two equal portions 15 and 30 days after seed sowing. The variety is commercial hybrid Mollica. The seedling should be thinned, irrigated and kept free from weeds as required. In case of infestation of Jassid insects, 2 ml of malathion should be applied in per liter of water. Radish is harvested last week of June (45 days after sowing).

Cultivation procedure of Radish (Second time)

After harvest of radish in first time the land is prepared by power tiller for second time radish cultivation. Prior to land preparation if soil is very dry irrigation is applied. Second time seed are sown in first week of July in broadcasting methods. Fertilizer is applied @ 300-225- 240- 100- 13 kg ha⁻¹ of Urea, TSP, MoP, Gypsum and Zinc Sulphate. One-third of all fertilizers should be applied during final land preparation and remaining fertilizers should be applied in two equal portions 15 and 30 days after seed sowing. The variety

is commercial hybrid Mollica. The seedling should be thinned, irrigated and kept free from weeds as required. In case of infestation of Jassid insects, 2 ml of malathion should be applied in per liter of water. Radish is harvested third week of August (45 days after sowing).

Cultivation procedure of Carrot

After harvest of radish in Secon time the land is prepared by power tiller for carrot cultivation. Prior to land preparation if soil is very dry irrigation is applied. Seed are sown on last week of August with 25 cm x 25 cm speaking. Fertilizer is applied @ 260- 195- 180- 100- 9 kg ha⁻¹ of Urea, TSP, MoP, Gypsum and Zinc Sulphate. One-third of all fertilizers should be applied during final land preparation and remaining fertilizers should be applied in two equal portions 15 and 30 days after seed sowing. The variety is commercial hybrid Orange king. The seedling should be thinned, irrigated and kept free from weeds as required. In case of infestation of Jassid insects, 2ml of malathion 57EC should be applied in per liter of water. Carrot is harvested third week of November (87 days after sowing).

Cultivation procedure of wheat

Prior to land preparation if soil is very dry irrigation is applied. The residues of the previous crop is cleaned properly. Seeds are sown @ 140 kg ha⁻¹ on last week of November to first week of December with broadcasting method. The variety was BARI Gom- 31. Farmers' sown wheat seeds after application of recommended doses of different fertilizers. The crop is fertilized with 150-135-100-110-6kg ha⁻¹ of urea, TSP, MoP, gypsum, and Boron. One third urea and full amount of other fertilizers are applied at the time of final land preparation. Rest amount of urea are applied in two equal splits at 17-21 DAS and 60 DAS after irrigation. Further irrigations are given as and when necessary. Other intercultural operations are done as and when necessary. The crop is harvested at maturity stage (105-110 DAS).

Suitable Location/ecosystem

Suitable areas are similar to Padma Char, Pabna and AEZ-11.

Benefits

The yield of first time radish, second time radish, carrot and wheatis found 36 t ha⁻¹, 41 t ha⁻¹, 15 t ha⁻¹ and 4.23 t ha⁻¹ ,respectively.

Gross return (Tk. ha-1) : 12, 31,600/-

Cultivation cost (Tk. ha-1) : 4,48,200/-

Gross margin (Tk. ha-1) : 7,83,400/-

MBCR :3.61

Name and address of the researcher:

Dr. Md. Jahangir Alam, Cheif Scientific Officer (C.C.), Agronomy and Farming Systems Division, Bangladesh Sugarcrop Research Institute, Ishurdi-6620, Pabna, Phone: +88-07326-63579; Mobile: +8801716229375; E-mail: alammjsri@gmail.com

Fact Sheet-7

Title of the Technology: Three crop based Cropping Pattern Radish-Carrot- Groundnut in Padma Char Region

Introduction

Bangladesh is predominantly rice growing country and rice based cropping pattern are mostly following all over the country. At Char area of Padma major crops are pulses and oil seeds. Only one or two crops are cultivated in a year at the char land of Padma. Recently farmers of this area cultivated radish, carrot and groundnut (local variety) following poor management. As a result they got low yield from these crops. So this study is undertaken for increasing total productivity same piece of land in a year.

Description

In the new cropping pattern Radish-Carrot- Ground nut (three crops) can be produced in a year. Productivity increases in this cropping pattern and cropping intensity increases by 300%. The equivalent yield of Ground nut in the improved cropping pattern (Radish-Carrot- Groundnut) was found to be 30.60 t / ha / year whereas in the conventional cropping pattern (Aus-Mustard-Fallow) the equivalent yield of Rice was 13.98 t / ha / year. Improved cropping patterns make it possible to earn more than 120% profit.

Cultivation procedure of Radish

Land is prepared by power tiller for radish cultivation. Prior to land preparation if soil is very dry irrigation is applied. Seed are sown @ 4.0 kg ha⁻¹ in second week of May in broadcasting methods. Fertilizer is applied @ 300-225- 240- 100- 13 kg ha⁻¹ of Urea, TSP, MoP, Gypsum and Zinc Sulphate. One-third of all fertilizers should be applied during final land preparation and remaining fertilizers should be applied in two equal portions 15 and 30 days after seed sowing. The variety is commercial hybrid Mollica. The seedling should be thinned, irrigated and kept free from weeds as required. In case of infestation of Jassid insects, 2 ml of malathion should be applied in per liter of water. Radish is harvested last week of June (45 days after sowing).

Cultivation procedure of Carrot

After harvest of radish the land is prepared by power tiller for carrot cultivation. Prior to land preparation if soil is very dry irrigation is applied. Seed are sown @ 3.5 kg ha⁻¹ on first week of July following broadcast method. Fertilizer is applied @ 260- 195- 180- 100- 9 kg ha⁻¹ of Urea, TSP, MoP, Gypsum and Zinc Sulphate. One third of all fertilizers should be applied during final land preparation and remaining fertilizers should be applied in two equal portions 15 and 30 days after seed sowing. The variety is commercial hybrid Orange king. The seedling should be thinned, irrigated and kept free from weeds as required. In case of infestation of Jassid insects, 2ml of malathion 57EC should be applied in per liter of water. Carrot is harvested first week of October (88 days after sowing).

Cultivation procedure of Groundnut

After harvest of carrot the land is prepared by power tiller for groundnut cultivation. Prior to land preparation if soil is very dry irrigation is applied. Fertilizers are applied @ 80 - 180- 90- 200-9 - 9 kg ha⁻¹ of Urea, TSP, MoP, Gypsum, Zinc Sulphate and Boron. Half of the urea fertilizer and all other fertilizers should be applied during final land preparation and the rest of urea fertilizer should be applied after 40-50 days after planting. Seed are sown @ 100 kg ha⁻¹ on second week of October with 15 cm x 30 cm spacing. Three to four irrigations should be provided for groundnut cultivation. Other intercultural operation should be done as per required. Groundnut is harvested second week of March (138 days after sowing).

Suitable location/Ecosystem

Suitable areas are similar to Padma Char, Pabna and AEZ-11.

Benefits

Yield of radish, carrot and groundnut is found 36 t ha⁻¹, 15 t ha⁻¹ and 1.45 t ha⁻¹, respectively in the cropping pattern.

Gross return (Tk. ha ⁻¹)	:11,99,000/-
Cultivation cost (Tk. ha ⁻¹)	:3,15,750/-
Gross margin (Tk. ha ⁻¹)	:8,83,250/-
MBCR	:3.61

Name and address of the researcher:

Dr. Md. Jahangir Alam, Chief Scientific Officer (C.C.), Agronomy and Farming Systems Division, Bangladesh Sugarcrop Research Institute, Ishurdi-6620, Pabna, Phone: +88-07326-63579; Mobile: +8801716229375; E-mail: alammjsri@gmail.com

Fact Sheet-8

Title: Sheep rearing in the farmers' household for increase income of livelihood

Introduction

Rural livelihood is agro based and families operate on a small piece of landless than one hectare for crop and fodder production. Livelihood diversification may take place when rural producers change the composition of agricultural products they produce in terms of on-farm or off farm activities. Livelihood or occupational diversification has two key components which are usually related Multiple livelihoods (jobs, incomes etc.) requiring several part-time, concurrent activities and change, transformation or Adaptation usually from an essentially subsistence agricultural sector to non-subsistence, non-agricultural sectors, part of which we might call the rural non-farm economy. Small ruminants especially sheep can be a very effective source of quality protein supply through meat and milk. Nearly 70% of total small ruminants of the country belong to landless, marginal and small farmers. Improvement in the productivity of small ruminants especially sheep directly benefits the poorest part of the society, through poverty alleviation, employment generation, improving nutrition of human diet. The current annual growth rate of national sheep herd is above 5%, which is nearly 8 times than that of the growth rate of national cattle herd (0.6%).

Sheep rising in Bangladesh is mainly for meat and wool. Native sheep are small (18-25 kg adult weight), highly prolific (2-3 lambs per lambing and two lambing per year), meat type (7-10 kg meat per sheep) animals. Native sheep are extremely resistant to infectious diseases including PPR. Lamb mortality rate is less than 5%. They can be reared harsh management condition and can utilize relatively poor quality feed. Unlike goat they are nondestructive social animal with relatively easy management. Despite all these qualities sheep has never attract the attention of the scientist or planner to be used as a tool for poverty alleviation, employment generation and improving nutrition of the country.

Description

The program was conducted at FSRD site, Baghabari, Sirajganj during 2018-2020 with a view to improvement of rural people by sheep rearing. Six farmers, each was provided with three sheep (2 ewes and 1 ram) for rearing at the sub-project site. The animals were vaccinated and supplemented with feed. Both the income/value Tk. 2500 followed by Tk. 25000 rearing cost Tk. 7000 and Grsoss Margin 18000 Performances of Sheep at farmers' level at FSRD site Baghabari, Sirajganj during February 2018-December 2020 adult ewe gave birth to new offspring. A total of 33 lamb were born. Overall, the net present increases of new kids 67. A highest market value Tk. 352000 rearing cost Tk. 42000

Suitable location/ecosystem

The technology is suitable in the charland of Baghabari, Sirajganj where Baghabari is a flood-prone area and characterized by a unique milk pocket area due to the existence of high yielding "Pabna dairy breed", bathan (traditional grazing land of about 1600 ha.) but year-round feeding system and preservation techniques was not available & diseases outbreak eg. Mastitis, brucellosis and other reproductive diseases including crossbred dairy calf diseases are rampant in the dairy cattle at Baghabari. These problems are also causing reduced milk production and serious health hazards. To replace the sheep rearing technology farmers will benefited economically. The technology can also be followed in the other char land areas.

Benefits

Performances of Sheep at farmers' level at FSRD site Baghabari, Sirajganj during February 2018-December 2020. Adult ewe gave birth to new offspring. A total of 33 lamb were born. Overall, the net present increases of new kids 67. Highest market value was found Tk.352000, while rearing cost was Tk. 42000.

Name and contact address of author

Dr. Md. Abdul Jalil
Director General
Bangladesh Livestock Research Institute

Savar, Dhaka-1341.
Phone: +88027791696 (Office)
E-mail: jalilgene@gmail.com

ii) Effectiveness in Policy Support:

BARI Component: N/A

BINA Component: N/A

BSRI Component: N/A

BLRI Component:

- Increase production and farmers income
- Insecticide free agriculture produces environmentally sustainable farming
- Integrated cultivation ensures better management of resources
- Better resource utilization
- Household farming pattern diversification

H. Technology/Knowledge generation/policy Support

i. Immediate impact on generated technology

- Increased cropping intensity and productivity at Charland ecosystem.
- Increases total farm productivity and farmers' income.
- Creates employment opportunities for day labors at Char land ecosystem.
- Increase production and farmer's income as well as nutritional status of Char dweller.
- Increase women participation in homestead production system including livestock production.
- Farming system approach to Agricultural research will accelerate agricultural growth and there by leverage for transforming poverty-prone rural Char land into a prosperous Char land area. It will improve livelihood through income enhancement, labour utilization, employment generation, family nutrition and improvement of soil health and resource pattern

ii. Generation of new knowledge that helps in developing more technology in future

BARI Component

- Duck rearing in the farmer's household
- Turkey rearing under scavenging system:
- Production program with BARI developed HYVs can increase system productivity:
- Chewing type sugarcane cultivation in house boundary
- Management of fruit trees increases production and income

BINA Component

- Round the year homestead vegetables production utilizing different units of homestead.
- Rearing sonali chicken as meat purpose round the year by semi-scavenging system.
- Utilize backyard pond and open water resources to increase farm income and family consumption through fish culture.
- Growing vegetables seedling in raised mini nursery using single cell.

BSRI Component

- Year round vegetables and fruit production at homestead utilizing different units of homestead.
- Chicken rearing as meat purpose round the year by semi-scavenging system.
- Utilize seasonal and perennial pond for fish culture following carp polyculture system to increase farm income and family consumption.

BLRI Component

- Cultivation of newly BLRI released fodder variety can increase production
- Turkey rearing under scavenging system
- Duck (Khaki Campbell) and hilly chicken rearing in Char land ecosystem
- Management of spice and fruits trees increases production and farmers income
- Inclusion of mustard in Fallow-Boro-T. Aman cropping pattern could be increased the total productivity
- Chewing type sugarcane cultivation at homestead area
- Inclusion of BARI and BIRRI high yielding released varieties in easing cropping pattern can increase total productivity

iii. Technology transferred that help increased agricultural productivity and farmers' income

BARI Component

- Year round vegetables production in homestead following “Narkeli model and Goyeshpur model”
- Existing fruit trees management for increasing farm productivity and income.
- Maximization of farmer's income through carp polyculture at low-cost management in seasonal pond
- Fish culture with monosex tilapia in seasonal pond
- Sheep and Goat rearing under farmers management condition
- Beef fattening in farmer's household

BINA Component

- Improved cropping pattern of Jute (var. JRO 524) - T. Aman (var. Binadhan-11) - Maize (var. Hybrid 981)
- Homestead vegetables production by following vegetable production model
- Vermicomposting
- Cattle fattening

BSRI Component

- Improved cropping pattern Radish (Mollica) - Radish (Mollica) - Carrot (Orange king) - Wheat (BARI Gom - 31)
- Vegetables and fruit production at homestead by following modified Goyeshpur model.
- Cattle fattening followed by deworming, vitamin ADE injection and UMS diet

BLRI Component

- Year-round vegetables production in homestead following Goyeshpur model
- Production system of vegetables and fruit, spice culture of high value fish and rearing of Turkey, hilly chicken, Khaki Campbell duck, Black Bangal goat and sheep rearing.

iv. Policy Support :

From the research achievements, some policy recommendation can be stated which are as follows:

1. Appropriate pre-disaster and post-disaster measures should be properly implemented by government. Non flood prone area can be properly utilized to grow agricultural inputs like rice seedlings to the farmers of flood prone area after flood. For that measures should be taken through government
2. The traditional systems have been replaced by the establishment of commercial cash and staple crop production systems that have been promoted by governments.
3. As integrated farming is economically and environmentally sound, the motivation for integration would appear to be the national policy

I. Information regarding Desk and field Monitoring

i. Desk Monitoring

Table I.1.1 Desk Monitoring of BINA Component

Monitoring team	Date(s) of visit	Total visit till date (No.)
Internal Monitoring 1. Director General of BINA	03.06.2018 18.06.2019 18.09.2018	05
2. Director General of BINA with CSO of BINA	21.11.2019	
3. Director General of BINA with Director (Training & Planning)	22.01.2019	
Other visitor 1. Dr. Nurul Islam, DLO, DLS, Jamalpur	03-06-2018	
2. Md. Aminul Islam, DD, DAE, Jamalpur	03-06-2018	03
3. Dr. Md. Shahidur Rahman, Associate Professor, BAU, Mymensingh	06-12-2018	

Table I.1.2 Desk Monitoring of BSRI Component

Monitoring team	Date(s) of visit	Total visit till date (No.)
Internal Monitoring 1. Director General of BSRI	01/06/2018	03
2. Director General of BSRI with Director Research	17/12/2019	
3. Director General of BSRI With Agronomy and Farming Systems Division, BSRI Scientists	18/06/2020	
Other visitor <u>1st Visit</u> 1. Kamalaranjan Das, Additional Secretary, MoA	04/10/2019	01

BLRI Component

BARC have regularly arranged monitoring workshops to identify the different problems in each FSRD sites and to provide suggestions accordingly to the specific problems. Consultants and scientists of FSRD have regularly shared their experiences to help us understand more about the FSRD approach.

ii. Field monitoring

BARI Component

Table I.2.1.1. Field Monitoring at FSRD site Mymensingh

Sl. No.	Date	No. of visit	Name and addresses of team visit	Output
01		01	Site working group: Livestock officer, Agriculture Officer, Sadar, Mymensingh, PSO, SRDI, Scientist of OFRD, BARI, Mymensingh	The team sharing opinion with farmers and BARI FSRD team and provided valuable suggestions for further improvement of FSRD activities.
02	28.04.2018	03	Dr. Apurbo Kanti Chowdhury, CSO, Seed Technology Division, BARI, Gazipur Dr. M. Shahiduzzaman, CSO, Spices Research Center, BARI, Gazipur	The team sharing opinion with farmers and BARI FSRD team and provided valuable suggestions regarding nutrition aspects of different pulse crops and pest management for integrated farming.
03	11.06.2018	01	Dr. Shamsur Rahman, PSO, OFRD, Sherpur	

Sl. No.	Date	No. of visit	Name and addresses of team visit	Output
04	14.09.2018	01	Dr. ASM Mahbubur Rahman Khan, CSO, OFRD, BARI, Gazipur. Dr. Faruque Hossain and Md. Akhtar Hossain, SSO, OFRD, BARI, Gazipur	
05	16.01.2019	01	Dr. M. Akkas Ali, CSO, OFRD, BARI, Gazipur	
06	24.02.2019	01	Md. Akhtar Hossain SSO, OFRD, BARI Gazipur Dr. Mohiuddin Ahmed, SSO, OFRD, BARI Kishoregonj Agriculture Officer and Fisheries Officer, Sadar, Mymensingh, Dr. Abdul Helim Khan and Dr. Nargis Sultana, SSO, OFRD, BARI, Mymensingh	The team sharing opinion with farmers and BARI FSRD team and provided valuable suggestions for dissemination of viable IF technologies and making the site as learning centre of IF technologies.
07	02.10.2019	01	Dr. Shaikh Md Bokhtear, Chairman BARC, Dr. ASM Mahbubur Rahman Khan Farming System Expert, FSRD sub sub-project Dr. M Kabir Uddin Ahmed, CSO, BARC	
08	21.04.2019	01	Dr. Subhash Chandra Sarkar	
09	21.08.2020	01	Dr. Abdus Salam, Member Director, Planning & evaluation, BARC, Dhaka Dr. ASM Mahbubur Rahman Khan, Farming System Expert, FSRD sub sub-project , Dr. Kabir Uddin Ahmed, CSO, BARC	

Table I.2.1.2. Field Monitoring at FSRD site Bogura

Sl. No.	Date	No. of visit	Name and addresses of team visit	Output
01	30.08.2019	01	i. Dr. A S M Mahbubur Rahman Khan, Farming Systems Expert, FSRD Sub-project, BARC, Farmgate, Dhaka	The team sharing opinion with farmers and BARI FSRD team and provided valuable suggestions for further improvement of FSRD activities.
02	13.11.2019	03	i. Dr. Nowsher Ali Sarder, NATP-2 BARC, Dhaka ii. Depok Kumar Mahatu, Monitoring Division, BARC, Dhaka iii. Abdur Rahman, Monitoring Division, BARC, Dhaka	The team sharing opinion with farmers and BARI FSRD team and provided valuable suggestions regarding nutrition aspects of different pulse crops and pest management for integrated farming.
03	29.12.2019	01	i. Dr. A S M Mahbubur Rahman Khan, Farming Systems Expert, FSRD Sub-project, BARC, Farmgate, Dhaka.	The team sharing opinion with farmers and BARI FSRD team and provided valuable suggestions for dissemination of viable IF technologies and making the site as learning centre of IF technologies.
04	21.7.2020	03	i. Dr. Md. Abdus Salam Member Director, Planning & evaluation, BARC, Dhaka ii. Dr. Kabir Uddin Ahmed Chief Scientific Officer Planning and Evaluation Division, BARC, Dhaka iii. Dr. A S M Mahbubur Rahman Khan, Farming Systems Expert, FSRD Sub-project, BARC, Farmgate, Dhaka	The team sharing opinion with farmers and BARI FSRD team and provided valuable suggestions regarding nutrition aspects of different pulse crops and pest management for integrated farming.

Sl. No.	Date	No. of visit	Name and addresses of team visit	Output
05	17-1-2021	03	1. Dr. M. Akkas Ali, CSO, OFRD, BARI 2. Dr Md. Faruk Hossain, SSO, OFRD, BARI 3. Sahadara Manann MP. Bogura-1,	Homestead, Field crop, Livestock, Fisheries and Off-farm activities

BINA Component

Table I.2.2. Field Monitoring at FSRD site Jamalpur

Monitoring team	Date(s) of visit	Total visit till date (No.)
Technical Division/Unit, BARC		05
1. Dr. Md. Abdul Awal Former Associate Coordinator and CSO Planning & Evaluation Division, BARC	03.06.2018 & 20.08.2018 18.04.2019	04
1. Monitoring team combined with BARC and PIU-BARC 2. Farming Systems Expert, NATP-2	07.09.2019	
PIU-BARC, NATP-2 BARC Monitoring Team No.-3	07.03.2019	01

BSRI Component

Table I.2.3. Field Monitoring at FSRD site Padma Char

Sl. No.	Date	No. of visit	Name and addresses of team visit	Output
01	01/06/2018	01	Dr. Md. Abdul Awal, CSO, Planning & Evaluation Division, BARC, Cell: 01713516217	Inauguration of baseline survey at FSRD site Year round homestead vegetable production following “Goyeshpur model”
02	18/1/2018	01	Dr. ASM Mahbubur Rahman Khan, Farming System Expert, FSRD Sub-project, Cell: 01712518035	Distribution of fruit seeding monitoring of Year round homestead vegetable production following “Goyeshpur model” at FSRD site.
			Dr. Kabir Uddin Ahemed, CSO (P & E), BARC, Cell: 01771777993	
03	27/01/2019	01	Dr. ASM Mahbubur Rahman Khan, Farming System Expert, FSRD Sub-project, Cell: 01712518035	Inauguration of vaccination program and field day on newly developed cropping pattern at FSRD site.
			Md. Akramul Haque, SO, BARI	
04	04/08/2019	01	Dr. Abdul Razzak, Ex EC, BARC	Visit FSRD work and advised to the farmers for better management
			Md. ASM Salauddin, Ex DG, BSRI	
			Dr. PK Das, Ex Director, BARI	



Picture I.2.3 Visitors at FSRD site Padma Char

BLRI Component

Table I.2.4. Field Monitoring at FSRD site Baghabari

Sl. No	Date	No. of visit	Name and addresses of team visit	Output
01	26-02-2019	01	Technical Division/Unit, BARC	Increase awareness among the farmers
02	02-12-2019	01	PIU-BARC, NATP-2	Identify the field problem with probable solutions
03		32	Internal Monitoring	Update all information
04	12-04-2020	01	DG,BLRI	Motivation of farmers

iii. Weather data, Flood/salinity/drought level and natural calamities

BARI Component

Flood: Continuous rainfall in September 2020 and severe flood occurred during late September 2020.

Table I.3.1.1. Weather data of Bogura during the years of February 2018 to December 2020.

Month	Temperature (°C)						Avg. RH (%)			Total rainfall (mm)		
	Avg. Max			Avg. Min			2018	2019	2020	2018	2019	2020
	2018	2019	2020	2018	2019	2020						
January	24.38	27.8	23.20	11.8	14.18	12.00	89.25	77.25	92.05	0	0	0
February	29.80	28.17	28.04	17.8	17.8	16.56	68.93	69.18	75.72	2.33	1.03	0
March	31.69	32.91	32.31	21.88	21.60	20.47	73.15	67.97	70.84	0	0.43	1
April	30.95	34.88	29.26	22.48	25.23	21.93	76.60	75.71	74.34	3.83	1.66	3.23
May	32.62	33.02	31.67	25.35	24.53	24.23	83.72	80.17	84.88	12.43	5.36	19.53
June	33.65	34.16	33.25	26.9	27.14	26.71	82.57	82.06	85.30	8.36	11.05	14.53
July	31.53	32.90	31.58	26.26	27.19	26.74	87.50	87.12	89.26	9.33	15	16.16
August	33.14	35.41	33.09	27.30	28.05	27.26	86.44	86.14	86.14	1.56	3.43	5.53
September	34.31	30.1	32.19	26.75	25.47	26.91	84.26	87.34	88.03	5.26	5.16	10.70
October	31.45	29.30	30.62	21.83	21.70	24.66	84.03	98.78	85.04	2.33	13.33	5.36
November	29.56	29.67	30.56	16.83	18.35	21.89	78.03	84.96	76.72	0	0	0
December	25.42	21.77	27.16	11.49	11.18	13.76	80.27	91.41	73.46	0	0	0

J. Sub-project Auditing

Table J.1. Sub-project auditing information of BARC

Types of audit	Major observation/ issues/objection raised; if any	Amount of Audit (Tk.)	Status at the sub-sub-project end	Remarks
GoB	N/A	6465306	Till June 2021	Satisfactory

Table J.2. Sub-project auditing information of BARI Component

Types of audit	Major observation/ issues/objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
GoB	No observation raised in 1 st , 2 nd and 3 rd financial year.	8972228	31 October 2021	Satisfactory

Table J.3. Sub- project auditing information of BINA Component

Types of audit	Major observation/ issues/objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Foreign Aided Sub-project Audit Directorate Audit Complex, Segunbagicha, Dhaka-1000 (FAPAD)	No objection raised in first financial year.	2211506	20-11-2019	Satisfactory
	No objection raised in second financial year.	1795085	10-11-2020	Satisfactory
	No objection raised in third financial year.	1591348	26-10-2021	Satisfactory
Total		5597939		

Table J.4. Sub- project auditing information of BSRI Component

Types of audit	Major observation/issues/objections raised; if any	Amount of Audit (Tk.)	Status at the sub-sub-project end	Remarks
Foreign Aided Sub-project Audit Directorate Audit Complex, 6 and 11 floor Segunbagicha, Dhaka-1000 (FAPAD)	No objection raised in first financial year.	3130600	20-10-2019	Satisfactory
	No objection raised in second financial year	1254375	06-12-2020	Satisfactory
	No objection raised in second financial year	997123	11-10-2021	Satisfactory
Total		5382098		

Table J.5. Sub- project auditing information of BLRI Component

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
GoB	No objection raised	1657971	30.10.2019	Satisfactory
	No objection raised	1998407	19.11.2020	
	No objection raised	1504707	11.10.2021	
Total		5161085		

K. Lessons Learned:

BARI Component

- Sub-project tenure for three years was limited but it needs minimum five years for refined technological development.
- Lack of strong multi-disciplinary scientific team to implement the program smoothly.
- Farmers training was not sufficient, so adequate number of farmers training should be included in the sub-project.
- There is ample scope to utilize the homestead area to increase farm family income
- Varietal combination and appropriate crop management can produce better yield than their existing cropping practice

BINA Component

- Natural calamities reduced farm production and increased cost of production. On the other hand it also increased water supply, improved soil fertility, increased soil moisture and enlarged water living space.
- Homestead vegetables production model (Goyespur Model) is suitable for the Char land but there is need some modification to select crops for different production.
- Jute-T. Aman-Maize is profitable cropping pattern. Flood water can be utilized for rotting jute fiber. Maize tremendously increased the system productivity and economic return of the three crops pattern
- Rearing sonali chicken as meat purpose round the year along with calf rearing and beef fattening boost up income and thus improve nutrition consumption and livelihood.
- There is ample scope to utilize backyard pond and open water resources to increase farm income and family consumption through fish culture.
- Mini nursery in the farm house reduces risk of seedling getting timely after flood water removal and cost of seedling.
- Generated information and technologies need to be further validated for refinement.

BSRI Component

- Homestead vegetables production model (Goyespur Model) is suitable for the Char land ecosystem but there is need some modification to select crops for different niches.
- Radish–Radish –Carrot –Wheat and Radish - Carrot - Ground nut are profitable cropping pattern for Char land ecosystem
- Rearing Sonali chicken as meat and egg purpose round the year along with deworming of cattle, vaccination on livestock and poultry birds, calf rearing with UMS diet, beef fattening and pigeon rearing boost up income and thus improve nutrition consumption and livelihood.
- There is ample scope to utilize seasonal and annual pond to increase farm income and family consumption through carp polyculture system of fish.
- Mini fruit orchard nearby homestead increase fruit production and to increase farm income and family consumption.
- Generated information and technologies need to be disseminated in large scale among the stockholder.

BLRI Component

- Vegetable's production in the homestead following modified Goyespur Model to increase production, consumption, as well as income of farm family
- Farmers were impressed with the yield performances and grain quality of newly introduced rice, mustard, sesame and onion variety varieties.
- Rearing of Turkey as meet and egg purpose along with hilly chicken rearing for meet purpose, sheep and goat rearing boost up income and thus improve nutrition consumption and livelihood.

L. Challenges:

- Lack of proper agriculture, livestock and fisheries knowledge about new crop varieties, animal breeds, high value fish species and their modern cultivation/rearing/culture technology among the stake holder
- Lack of mechanization and irrigation facility as well as knowledge on pest management of resource poor farmers.
- Lack of quality seeds /fingerlings of different high value crops and fishes.
- High price and less quality of inputs
- Farmers were not updated on high yielding crops, varieties and technologies suitable for the concerned Char area.
- Absence of proper storage and processing facilities at the local level due to lack of storage facility farmers were bound to sell their products during harvesting period at a lower price
- Poor marketing facility and low price of agricultural product at farm level.
- COVID-19 pandemic continued affecting key sub-project activities. Organization of field days and field visit programs etc.
- Sub-project period was limited it needs minimum five years for refined technological development.

M. Suggestions for Future Planning:

1. Char dwellers were recurrent victims of frequent natural calamities though they were in a struggle of coping with those climatic hazards with diversified production practices. There is need to research on the production of horticultural and field crops adjusting with the flash flood come.
2. Long term planning needs for implementing the FSRD activities for developed viable technology farming system research and development.
3. Adequate number of scientific personnel especially for livestock and fisheries component should be recruited at the each FSRD site.
4. Strong linkage should be developed among the NARS, DAE, DLS and DOF for dissemination of FSR technologies.
5. Monitoring /field visit/exchange visit should be more to evaluate the sub-project activities.
6. Multidisciplinary well experienced strong scientific team needed for successful integration of technologies.
7. Agricultural knowledge of farmers need to be developed through hands on training and need to make them aware about different agricultural technologies that will improve their productivity as well as income.
8. Farming system research unit with proper manpower should be developed in the institute after end of the sub-project.
9. Marketing support should be ensured to get proper prices of vegetables and fruits produced from homestead gardening. Farming System research should be give emphasis on combined production with storage and marketing procedure.
10. A permanent FSRD team comprises of crops, livestock and fisheries scientists should be placed permanently with supporting field staff.
11. To end all forms of hunger and malnutrition, farming system research should be emphasized on supporting small-scale farmer to have sufficient and nutritious food all the year round.

N. References

- Ahmed, A.K.M.M and M. J. Alam. 1989. Polyculture of cultivated fish species for optimizing production from ponds. Workshop on Contract Research Sub-project. Bangladesh Agri. Res. Coun. Dhaka, Bangladesh, 13 pp.
- Ali, M. Y; M.M. Ahmed and M.B Islam. 2008. Homestead Vegetable Gardening: Meeting the Need of Year Round Vegetable Requirement of Farm Family, National Workshop on multiple cropping held at Bangladesh Agricultural Research Council, Dhaka, 23-24 April 2008.
- Ali, M.Y; Waddington; D. Hodson; J.Timsina and J. Dixon. 2008. Maize-rice cropping systems in Bangladesh: Status and research opportunities. Mexico, D.F.: CIMMYT.
- Baqee, M.A. 1993. Barga and Bargadar, the case of the char-lands of Bangladesh. *Oriental Geographer*, 37(2): 1-17.
- Barrett, C.B. ; T. Reardon and P. Webb. 2001. Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics and Policy Implications. *Food Policy*, 26 (4): 315-331.
- Behera, U.K.; A.K Choudhury; DaAnchal and A.K. Vyas. (ed.). 2013. Integrated Farming Systems for livelihood security of small and marginal farmers. Division of Agronomy, IARI, New Delhi.
- Bangladesh Agricultural Research Council (BARC) . 2018. Fertilizer recommendation guide. Bangladesh Agricultural Research Council (BARC), Airport Road, Farmgate, Dhaka-1215.
- EGIS. 2000. Environmental and Geographic Information Service, Dhaka, Bangladesh.
- Hasan, N.M.; M.S. Hossain; M.R. Islam and M.A. Bari. 2013. Trend in availability of agricultural land in Bangladesh. National food policy capacity strengthening programme (NFPC-SP), FAO (Rome) pp. 1-72.
- Ishtiaque, S ; M.K. Ali; A.S.M.M.R. Khan; A.K. Choudhury; M.S.H Molla; M.S.Hossain; M.F.Hossain and T. Zahan. 2017. Utilization of Year- round Homestead Vegetables Production Model for Nutrition Security and Sustainable Development of Resource-poor Farmers in Bangladesh. Proceeding of the National Conference on Food and Nutrition Security in Bangladesh: 'Interdisciplinary Approach' , Dhaka Bangladesh.
- Islam, M.M.; S. Ali; M.M. Ali; M. Y. Ali. and M.B. Hossain. 2018. Jute fibre yield and economics in charland areas of Bangladesh. *Research in Agriculture & Veterinary Sciences*, 2(1):59-65.
- Kohinoor, A.H.M.; M. M. Rahman; H.M. Moniruzzaman and S.C.Chaakraborty. 2001. Production performance of pabda (Ompok pabda) and gulsha (*Mystus cavasius*) with GIFT strain (*Oreochromis niloticus*) in on- farm management. *Bangladesh j. Fish .Res.*, 15-16: 27-36.
- Khan, A. S. M. M. R.; M. M. Anwar; S. Akter; M. Z. H. Prodhan and M. H. Mondal. 2013. Identification of factors influencing yield gaps in mustard, potato and rice in some selected areas of Bangladesh and strategies to minimize the gaps. *Bangladesh J. Agril. Res.* 38(2): 227 -240
- Karim, M.A; M. A. Quayyum; S. Samsuzzaman; H. Higuchi and E. Nawata. 2017. Challenge and Opportunities in Crop Production in Different Types of Char Lands of Bangladesh: Diversity in Crops and Cropping. *Trop. Agr. Develop.* 61 (2): 77-93.
- Khan, M.A.H; M.S. Zaman ; M.K. Hasan and A.S.M.M.R. Khan. 2017. Increasing cropping intensity and productivity through Boro-T.Aus-T.Aman-Mustard cropping pattern in Bangladesh. *SAARC J. Agri.* 15(2): 103-112.
- Miah, M. S.; M. S. Uddin and M. S. Shah. 1993. Effects of supplementary feed in carps polyculture systems. *Bangladesh Journal of Agricultural Science.* 20 (2): 359-364.
- Miah, M.S.; M. Shahab Uddin and M.S. Shah. 1997. Effect of stocking ratios on the growth and production of fishes in mixed polyculture system. *Bangladesh J. Fish.* 20(1-2):135-138.
- Paul, S. and M. S. Islam. 2015. Ultra-poor char people's rights to development and accessibility to public services: a case of Bangladesh. *Habitat Int*, 48:113-21.

- Rahman, S. 2010. Six decades of agricultural land use change in Bangladesh: effects on crop diversity, productivity, food availability and the environment, 1948-2006. *M Singapore J. Trop. Eogroph*, 31: 245-269.
- Sarker, U.K.; S. Monira and M. R. Uddin, 2020. On-farm evaluation and system productivity of Wheat-Jute-T. aman rice cropping pattern in char area of Bangladesh. *Agricultural Science*, 2(1): 39-46.
- Soil Resource Development Institute (SRDI). 2001. Land and Soil Resource Utilization Guide (Upazila Nirdeshika in Bangla). Soil Resource Development Institute (SRDI), Dhaka pp.1-274.
- Sattar, S. A. and M. N. Islam. 2010. Charlands of Bangladesh: Their extent, management practices and future research needs. Paper presented at the workshop on ‘Soil fertility, fertilizer management and future research strategy’ held on 18-19 January, 2010 at Bangladesh Agricultural Research Council, Farm gate, Dhaka.

Signature of the Coordinator

Date

Seal

Counter signature of the Head of the
organization/authorized representative

Date

Seal



Ministry of Agriculture



THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP



Investing in rural people