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Sub-project Completion Report

on

**Development of profitable cropping pattern
through crop intensification in some selected
areas of Bangladesh**

**Sub-Project Duration
12 July 2018 to 15 May 2022**

**Coordinating Organization
Bangladesh Institute of Nuclear Agriculture (BINA)
Mymensingh-2202**



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



April 2022

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Implementing Organization

**Adaptive Research and Extension Division
Agricultural Economics Division
Bangladesh Institute of Nuclear Agriculture (BINA)
Mymensingh-2202**

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Abbreviation and acronyms

AED	Agricultural Economics Division
ARED	Adaptive Research and Extension Division
BARC	Bangladesh Agricultural Research Council
BINA	Bangladesh Institute of Nuclear Agriculture
BARI	Bangladesh Agricultural Research Institute
BCR	Benefit Cost Ratio
BDT	Bangladesh Taka
BRRRI	Bangladesh Rice Research Institute
CP	Cropping Pattern
CI	Cropping Intensity
DAE	Department of Agricultural Extension
DAS	Day after sowing
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
GM	Gross Margin
GoB	Government of Bangladesh
ha	Hectare
IFAD	International Fund for Agricultural Development
Kg	Kilogram
LoA	Letter of Agreement
MT	Metric Ton
NATP	National Agricultural Technology Program
NR	Net Return
PBRG	Program Based Research Grant
PCR	Project Completion Report
PIU	Project Implementation Unit
PP	Project Proposal
REY	Rice Equivalent Yield
SAAO	Sub-Assistant Agriculture Officer
TC	Total Cost
TFC	Total Fixed Cost
Tk.	Taka
TR	Total Return
TVC	Total Variable Cost
WB	World Bank

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Executive summary

Bangladesh is a small country with 8.56 million ha of cultivated land and nearly 160 million populations. The population is being increased by 1.37% annually while the cultivable land is being decreased by 0.74%. The present cropping intensity (CI) of Bangladesh is 194% (BBS 2017) which is the average of 2.36 million ha of one cropped, 3.85 million ha of two cropped and 1.71 million ha of three cropped area. The share of land area for pulse and oilseed crops in this CI is only 0.86 million ha and 0.9 million ha, respectively. The production of these two crops are 0.93 and 1.12 million tons, respectively, that meet 20% and 30% of country's demand. There is a little scope to increase land for growing pulses and oilseeds. Increase of CI is the only way to boost up pulse and oilseed productions. In this context, the Sub-Project PBRG-089 entitled "Development of profitable cropping pattern through crop intensification in some selected areas of Bangladesh" was executed by Adaptive Research and Extension Division in collaboration with four sub-stations and Agricultural Economics Division of Bangladesh Institute of Nuclear Agriculture (BINA), coordinated by Coordination Component, during 12 July 2018 to 15 May 2022. General objective of the project was increasing cropping intensity through introducing improved cropping patterns for improving the farmers' livelihood through achieving the specific objectives (a) to identify location specific suitable improved crop varieties, (b) to increase cropping intensity, system productivity and farm profitability through designing suitable three or four cropping patterns, (c) to improve knowledge and skill of farmers and extension personnel on improved techniques of cropping pattern, (d) to assess the profitability of improved cropping pattern over existing one and (e) to determine the increase level of farmers' income and their livelihood improvement. Project title was modified to "Development of profitable cropping pattern through crop intensification in some selected areas of Bangladesh" and some activities were also modified following the suggestions, comments and recommendations of the day long Inception Workshop arranged at BARC at the very beginning of the project in 2018 under Coordination Component with attendance from different stakeholders of Agriculture.

To fulfill the objectives, cropping patterns experiments were conducted at five locations viz. Mymensingh sadar upazila, Nalitabari upazila of Sherpur district, Rangpur sadar upazila, Sunamganj sadar and Bishwambarpur upazilas of Sunamganj and Kashiani upazila of Gopalganj district against existing cropping patterns with two crops. At each location, there were 24 farmers who altogether had 3.12 ha of adjacent land. The experiments were conducted during 2018-19, 2019-20 and 2020-21 along with base line survey and economic profitability analysis. In 2018-19, the best/better varieties were selected for all the patterns based on rice equivalent yield (REY), field duration (FD) and benefit cost ratio (BCR). During 2019-20 and 2020-21 block demonstrations were conducted to confirm the findings of 2018-19 based on higher BCR than the existing two crops based pattern, FD and REY.

At Char Ghagra, Mymensingh, the improved pattern T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the highest BCR (1.57) against the existing two crops based pattern (1.23). It also had lower FD (267 days) and medium REY (16.70).

Therefore, this pattern was recommended for Mymensingh sadar upazila. Similarly, the four crops based pattern T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) could be also recommended for Mymensingh sadar upazila; T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) for Nalitabari upazila, Sherpur district; T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14 and T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) for Rangpur sadar upazila; T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14), T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19) for Bishwambarpur and Sunamganj sadar upazila, respectively; T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524), T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) and T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) for Kashiani upazila of Gopalganj district as these had higher BCR than the existing cropping pattern, lower FD and comparatively higher REY.

It was also revealed the significant role of the late transplanting potential, short duration and heat tolerant Boro rice variety, Binadhan-14 and Aus rice variety Binadhan-19 to modify the two crops based patterns to three/four crops based patterns.

The project farmers attained required knowledge and skills for using the cropping patterns, particularly the production technologies of the modern varieties of component crops through Focus Group Discussion (FGD) and Field Days arranged each year before and during harvests, respectively.

Among the five locations, overall change in income was 17.09%. The highest income was found in Rangpur (20.22%) followed by Mymensingh (17.54%), Sunamganj (16.22%), Gopalganj (15.56%) and the lowest in Sherpur (14.56%).

The four crops based cropping pattern T. aman rice-Mustard-Patshak-Aus was successfully disseminated at all 13 upazilas of Mymensingh district. Average yield of Binasarisha-9 was 1.45 t/ha at 91 days after sowing (DAS) and that of Binapatshak-1, Binadhan-19 and Binadhan-11 were 3.40 t/ha at 36 DAS, 4.90 t/ha at 102 DAS and 4.18 t/ha at 113 DAS, respectively.

Seven improved cropping patterns with 3/4 crops (i) T. aman rice-Mustard-Boro rice, (ii) T. aman rice-Mustard-Patshak (Jute leaf)-Aus rice, (iii) T. aman rice-Potato-Boro rice, (iv) T. aman rice-Grass pea-Aus rice, (v) T. aman rice-Mustard-Jute, (vi) T. aman rice-Lentil-Jute and (vii) T. aman rice-Grass pea-Jute were developed at five locations.

Finally, it could be concluded that to attain double farm productivity target of sustainable development goal (SDG) of UNO together with enhanced supply of nutritious food to the common people of Bangladesh, these improved cropping patterns will play significant role.

Key words: Improved cropping pattern, Cropping intensity, Rice, Oilseed, Pulse, Jute, Profitability, Benefit Cost Ratio

PBRG Sub-project Completion Report (PCR)

A. Sub-project description

1. **Title of the PBRG sub-project:** Development of profitable cropping pattern through crop intensification in some selected areas of Bangladesh
2. **Implementing organization:** Bangladesh Institute of Nuclear Agriculture (BINA)
3. **Name and full address with phone, cell and e-mail of Coordinator, Associate Coordinator and PI/Co-PI (s)**
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4. Sub-project budget (Tk.):

A. COORDINATION COMPONENT:

4.1 Total:(in Tk. as approved): 18,00,000.00

4.2 Revised: 19,90,000.00

B. COMPONENT-1:

4.1 Total:(in Tk. as approved): 1,17,000,00.00

4.2 Revised: 1,14,30,000.00

C. COMPONENT-2:

4.1 Total:(in Tk. as approved): 25,00,000.00

4.2 Revised: 25,80,000.00

5. Duration of the sub-project:

a. COORDINATION COMPONENT:

5.1 Start date (based on LoA signed): 12 July 2018

5.2 End date: 15 May 2022

COMPONENT-1:

5.1 Start date (based on LoA signed): 12 July 2018

5.2 End date: 15 May 2022

COMPONENT-2:

5.1 Start date (based on LoA signed): 12 July 2018

5.2 End date: 15 December 2021

6. Background of the sub-project:

Bangladesh is a small country with 8.56 million ha of cultivated land and 160 million of population. The population is increasing by 1.37% annually while the cultivable land is decreasing by 0.74%. The present cropping intensity of Bangladesh is 194% (BBS 2017) which is the average of 23.55 lakh ha of one cropped 38.47 lakh ha of two cropped and 17.11 lakh ha of three cropped area. The share of land areas for pulses and oilseeds in this cropping intensity are 8.53 lakh ha and 8.86 lakh ha only; and the productions are 0.93 and 1.12 million tons which meet 20% and 30% of country's demand, respectively. There is a little scope to increase land for growing pulses and oilseeds. Increase of cropping intensity is the only way to boost up pulses and oilseed production. By incorporating short duration pulse and oilseed varieties in rice based cropping sequence, cropping intensity is possible to increase from 194 to 400% and productivity and farmers livelihood as well. Cultivation of traditional varieties, imbalance use of fertilizers, seed sowing inappropriate time, non adoption of modern production technologies, natural calamities, socio-economic barrier, large yield gap (20-60%), nutrient mining in existing cropping pattern, unavailability of seeds of suitable HYV varieties, drought, flash flood and other biotic and abiotic stresses are the main constraints of maximizing farm productivity. On the other hand, according to the 7th Five Year Plan and SDGs, poverty alleviation, end hunger, achieve food security and improved nutrition and promote sustainable agriculture are the new challenges for researchers, economists, extensionists and farmers. BINA and BRRI developed short duration T. aman and Aus rice varieties that mature within 90-120 days and produce grain yield of 5-6 t/ha, which created opportunity of crop intensification. BINA and BARI already developed pulses and oilseeds varieties with high yield and shorter duration that could be fitted in the cropping sequence of the area of underutilized and unfavourable ecosystems. Based on above facts, some areas like Sunamganj, Rangpur, Gopalganj, Nalitabari (Sherpur) and Mymensingh were considered for establishing alternative profitable cropping pattern(s). To address the constraints of above rice, oilseeds, pulses and other crops cultivation following appropriate technologies in proper time will maximize the farm productivity and profitability by reducing yield gap and improving cropping pattern in the above areas having unfavorable and underutilized ecosystem.

7. Sub-project general objective(s): Increasing cropping intensity through introducing improved cropping patterns for improving the farmers' livelihood

8. Sub-project specific objectives (component wise):

i. Adaptive Research and Extension Division (ARED)

- a. To identify location specific suitable improved crop varieties;
- b. To increase cropping intensity, system productivity and farm profitability through designing suitable three or four cropping pattern(s);
- c. To improve knowledge and skill of farmers and extension personnel on improved techniques of cropping pattern production technology.

ii. Agricultural Economics Division (AED)

- a. To assess the profitability of improved cropping pattern over existing one;
- b. To determine the increase level of farmers income and their livelihood improvement.

9. Implementing location(s): Mymensingh sadar upazila, Nalitabari upazila of Sherpur, Kashiani upazila of Gopalganj, Rangpur sadar upazila and sadar and Bishwambharpur upazila of Sunamganj district.

10. Methodology in brief

10.1 COMPONENT-1 (Adaptive Research and Extension Division)

In all five implementing locations, 24 farmers having 3.12 ha or more adjacent land were selected during 2018-19 at the initiation of the project activities. Thereafter, baseline survey was conducted from these 24 project farmers along with another 24 non-project farmers. The project activities of 2019-20 and 2020-21 were also conducted in the same locations keeping the farmers unchanged.

10.1.1 Mymensingh

Two proposed cropping patterns were:

10.1.1.1 T. aman rice → Mustard → Boro rice and

10.1.1.2 T. aman rice → Mustard → Patshak (Jute leaf) → Aus rice

10.1.1.1 The proposed cropping pattern T. aman rice → Mustard → Boro rice

This pattern was carried out at the village Char Ghagra, sadar Mymensingh. In 2018-19, T. aman season, the early T. aman rice varieties Binadhan-11, Binadhan-17 and BRRI dhan71 were tested (Fig. 10.1.1). In 2019-20 and 2020-21, block demonstrations were conducted with best/better performing early T. aman rice varieties Binadhan-11 and BRRI dhan71. Seedlings of 23-24 days old were transplanted at 15 cm distances within rows of 20 cm apart on 18 July-11 August. Fertilizers were applied at the rate of Urea 120 kg, TSP 100 kg, MoP 50 kg, Gypsum 50 kg and ZnSO₄ 10 kg ha⁻¹. The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP were applied during the final land preparation. Urea was applied at three equal installments; the 1st installment was applied after seedling establishment, the 2nd and 3rd doses after 20-25 days and 30-35 days of planting, respectively. The remaining amount of MoP was applied with the last dose of Urea. Moreover, necessary cultural and intercultural operations were followed as and when required. Data on maturity and grain yield were recorded at harvest. Maturity was assessed plot basis and grain yield was recorded from an area of 20 m² for each variety which was later converted to t/ha.

After harvest of T. aman rice, the land was prepared for sowing mustard. The mustard varieties Binasarisha-7, Binasarisha-9 and BARI Sarisha-14 were tested for three consecutive years in 2018-19, 2019-20 and 2020-21. Block demonstrations were conducted with best/better performing Binasarisha-9 and BARI Sharisa-14. The mustard varieties were broadcasted at the seed rate of 7.5 kg ha⁻¹ on 10 November to 28 November. Fertilizers were applied at the rate of Urea 150 kg, TSP 100 kg, MoP 80 kg, Gypsum 80 kg, ZnSO₄ 4 kg and Boric acid 3 kg ha⁻¹. The whole amount of TSP, Gypsum, Zn SO₄ and 1/2 of Urea were applied during the final land preparation. Rest of the Urea was applied after 20-25 days of seed sowing as top dress. A field day was organized on mustard in presence of DG, Director (Admin. & Support Service) the Coordinator of the project, Director (Training and Planning), BINA, Deputy Director, DAE, Mymensingh at Char Ghagra, Mymensingh (Fig. 10.1.2). The plot was visited by the former Director General, BINA and Additional Secretary, MoA at pre-flowering stage (Fig.10.1.3). Data on maturity and seed yields were recorded at harvest. Maturity was assessed plot basis and grain yield was recorded from an area of 20 m² for each variety which was later converted to t ha⁻¹.

The third crop of the pattern was late Boro rice. Boro rice varieties, Binadhan-14 and BRRI dhan28 were tested in 2018-19 and block demonstrations were conducted with the best performing Binadhan-14 in 2019-20 and 2020-21. In 2018-19, Boro rice could not be cultivated in the plots of Binasarisha-7 due to its long duration. But in the other plots, seedlings of 25-30 days old were transplanted at 15 cm distances within rows of 20 cm apart on 19 February in 2019 and 13 March in 2021. Fertilizers were applied at the rate of Urea 240 kg, TSP 110 kg, MoP 160 kg, Gypsum 70 kg and ZnSO₄ 03 kg ha⁻¹. Method of fertilizer application, cultural and intercultural operations and data recording were the same as in T. aman rice (10.1.1.1).



Fig. 10.1.1 Field views of T. aman rice varieties at Char Ghagra, Mymensingh in 2018



Fig. 10.1.2 Field day on mustard in presence of DG, Director (Training and Planning), Director (Admin. & Support Service), BINA the Coordinator of the project, Deputy Director, DAE, Mymensinghat Char Ghagra, Mymensingh

Fig. 10.1.3 Additional Secretary, Ministry of Agriculture visited the project area at Char Ghagra, Mymensingh

10.1.1.2 The proposed cropping pattern T. aman rice→Mustard→Patshak (Jute leaf) →Aus rice

This pattern was carried out at the village Char Ghagra, sadar, Mymensingh in 2019-20 and 2020-21. A Focus Group Discussion (FGD) was organized on T. aman rice cultivation at Char Ghagra, sadar, Mymensingh (Fig. 10.1.4). The early T. aman rice varieties Binadhan-11 and BRRI dhan71, mustard varieties Binasarisha-9 and BARI Sarisha-14, Patshak variety Binapatshak-1 (Fig. 10.1.5), Aus rice variety Binadhan-19 were used for block demonstrations. Cultivation procedure, method of fertilizer application and intercultural operations and data recording were the same as in T. aman rice and mustard (10.1.1.1).

Seeds of patshak (jute leaf) were broadcasted at the seed rate of 15 kg ha⁻¹ after harvest of mustard on 08 March-10 March. Fertilizers were applied at the rate of Urea 30 kg, TSP 25 kg and MoP 30 kg and 5 t ha⁻¹ of Farm Yard Manure (FYM). The whole amount of fertilizers and FYM were applied during the final land preparation. Necessary cultural and inter-cultural operations were followed as and when required. Twenty five to thirty nine days old plants were used for consumption and selling. Data was recorded from an area of 20 m² which was later converted to t ha⁻¹.

The fourth crop of the pattern was Aus rice. Binadhan-19 was used in the Aus season. Seedlings of Binadhan-19 of 25 days old were transplanted in the same land of patshak at 15 cm distance within rows of 20 cm apart on 28 April-09 March. Fertilizers were applied at the rate of Urea 135 kg, TSP 90 kg, MoP 112 kg, Gypsum 60 kg and ZnSO₄ 04 kg ha⁻¹. The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP were applied during the final land preparation. Urea was applied at three equal installments; the 1st installment was applied after seedling establishment, the 2nd and 3rd doses after 20-25 days and 30-35 days of planting, respectively. The remaining amount of MoP was applied with the last dose of urea. Data recording was same as in T. aman rice (10.1.1.1)



Fig. 10.1.4 FGD on T. aman rice cultivation at Char Ghagra, sadar, Mymensingh



Fig. 10.1.5 Patshak before harvest in the project area at Char Ghagra, sadar, Mymensingh

10.1.2 Sherpur

10.1.2.1 The proposed cropping pattern T. aman rice→Mustard→Boro rice

This pattern was carried out at the village Kadamtali, in Nalitabari upazila of Sherpur against the existing T. aman rice-Fallow-Boro rice pattern. In 2018-19, Aman season, the early T. aman rice varieties Binadhan-7, Binadhan-17 and BRRI dhan49 were tested. In 2019-20 and 2020-21, block demonstrations were conducted with best/better performing early T. aman rice varieties Binadhan-7 and Binadhan-17. Seedlings of 25-28 days old were transplanted at 15 cm distances within rows of 20 cm apart on 01 August to 08 August. Amount of fertilizers, method of fertilizer application, cultural and inter-cultural operations and data recording were the same as in T. aman rice (10.1.1.1). A FGD on mustard cultivation was arranged in presence of Executive Chairman, BARC and the project Coordinator (PBRG-089) and Director (Admin. and S.S.), BINA (Fig.10.1.7).

After harvest of T. aman rice, the land was prepared for sowing mustard. After harvest of T. aman rice, farmers could comfortably sow mustard varieties Binasharisha-7, Binasharisha-9 and BARI Sharisha-14 on 09 November 2018 except the blocks of BRRI

dhan49. The mustard varieties Binasarisha-7, Binasarisha-9 and BARI Sarisha-14 were tested in 2018-19 and block demonstrations were conducted with best/better performing Binasarisha-9 and BARI Sarisha-14 varieties in 2019-20 and 2020-21. Amount and method of fertilizer application, cultural and intercultural operations and data recording were the same as in mustard (10.1.1.1).

The project area was monitored by the monitoring team of BARC headed by Dr. M.A. Jalil, NATP-2, PIU-BARC Component (Fig.10.1.8). Coordinator of the project and Principal Investigator of Component-1 along with Officer in Charge of BINA Sub-station, Nalitabari, Sherpur were present. Executive Chairman, BARC and the project Coordinator visited the project site at Kadamtoli, Nalitabari (Fig. 10.1.9)

The third crop of the pattern was late Boro rice. Boro rice varieties, Binadhan-14 and BRRI dhan58 were cultivated. Amount of fertilizers, method of fertilizer application, cultural and intercultural operations and data recording were the same as in Boro rice (10.1.1.1). Urea was top dressed three times in the long duration BRRI dhan58; the first split was applied after establishment of the seedlings, second split at 20-25 days and the final at 30-35 days after transplanting (DAT).



Fig. 10.1.6 Short duration T. aman rice (var.: Binadhan-7 and Binadhan-17) at Kadamtali, Nalitabari



Fig. 10.1.7 FGD on mustard cultivation with the presence of Executive Chairman, BARC, Coordinator (PBRG-089) at Kadamtali, Nalitabari



Fig. 10.1.8 BARC monitoring team headed by Dr. M.A. Jalil, NATP-2, PIU-BARC Component, Coordinator of the project and Principal Investigator of Component-1 along with Officer in Charge of BINA Sub-station, Nalitabari, Sherpur at project site at Kadamtali, Nalitabari



Fig. 10.1.9 Executive Chairman, BARC, Coordinator (PBRG-089) and Director (Admin. and S.S.), BINA visited the project site at Kadamtali, Nalitabari

10.1.3 Rangpur:

Two proposed cropping patterns were:

10.1.3.1 T. aman rice→Mustard→Boro rice; and

10.1.3.2 T. aman rice→Potato→Boro rice

10.1.3.1 T. aman→Mustard→Boro rice

This pattern was carried out at the village Mominpur of Rangpur sadar against the existing T. aman rice-Fallow-Boro rice pattern. Early T. aman rice varieties Binadhan-7, Binadhan-17 and BRRI dhan33 (Fig. 10.1.10) were tested in 2018-19 and block demonstrations were conducted with best/better performing Binadhan-7 and Binadhan-17 in the next two seasons. Seedlings of 25-26 days old were transplanted on 20 July to 25 July at 15 cm distances within rows of 20 cm apart following non replicated design. Amount and method of fertilizer application and intercultural operations and data recording were the same as in T. aman rice (10.1.1.1)

After harvest of T. aman rice, the land was prepared for sowing mustard. In 2018-19, the mustard varieties Binasarisha-9, BARI Sarisha-14 and BARI Sarisha-16 (Fig. 10.1.11) were tested and block demonstrations were conducted with best/better performing Binasarisha-9 and BARI Sarisha-14 varieties in 2019-20 and 2020-21 at the seed rate of 7.5 kg ha⁻¹. Seeds of Binasarisha-9 and BARI Sarisha-14 were broadcasted on 01 November to 11 December. Amount of fertilizers, method of fertilizer application and intercultural operations and data recording were the same as in mustard (10.1.1.1).

After harvest of mustard, the Boro rice varieties Binadhan-14 and BRRI dhan28 were tested in 2018-19. In 2019-20 and 2020-21, block demonstrations were conducted with the best performing Boro rice variety Binadhan-14. Seedlings of 25-28 days old were transplanted on 19 February to 15 March following the same spacing, amount and method of application of fertilizers and intercultural operations and data collection of Boro rice (10.1.1.1).



Fig. 10.1.10 Short duration T. aman rice (var.: Binadhan-7 and Binadhan-17) at Muktarpara, Rangpur



Fig. 10.1.11 Pictorial views of Binasarisha-9 and BARI Sarisha-14 at Muktarpara, Rangpur

10.1.3.2 T. aman rice→Potato→Boro rice

This pattern was also carried out at the village Mominpur of Rangpur sadar against the existing T. aman rice→Fallow→Boro pattern. T. aman rice and Boro rice variety selection and cultivation procedure were same as the pattern T. aman rice→Mustard→Boro rice

(10.1.3.1). The seeds of potato variety Asterix (Fig. 10.1.12) were used at the seed rate of 2.0 tha^{-1} at 15 cm distances within rows of 60 cm apart for three years of project period. Seeds of potato were planted on 01 November to 25 November. Fertilizers were applied at the rate of Urea 115 kg, TSP 135 kg, MoP 125 kg, Gypsum 150 kg, ZnSO_4 10 kg, MgSO_4 38 kg and Boric acid 04 kg ha^{-1} . The whole amount of TSP, Gypsum, Borax, MgSO_4 , Zn SO_4 and $1/3^{\text{rd}}$ of urea and $1/2$ of MoP were applied during the final land preparation. Rest of urea and MoP was applied at two equal installments; the 1st installment after 25-30 days and 2nd doses after 50-55 days of planting. Necessary cultural and intercultural operations were followed as and when required. Data on maturity and yield were recorded at harvest. Maturity was assessed plot basis and yield was recorded from an area of 20 m^2 for which was later converted to t ha^{-1} . A field day (Fig. 10.1.13) was organized on mustard and potato fields at Mominpur, Rangpur in the presence of Coordinator (PBRG-089), PI of Component-1, BINA Scientists, Project and interested farmers from adjacent area, DAE personnel and representatives from electronic and print media.



Fig.10.1.12 Pictorial views of potato (Asterix) at Muktarpara, Rangpur **Fig. 10.1.13** Field day on mustard and potato at Muktarpara, Rangpur

10.1.4 Sunamganj:

Two proposed cropping patterns were:

10.1.4.1 T. aman rice→Mustard→Boro rice; and

10.1.4.2 T. aman rice→Grass pea→Aus rice

10.1.4.1 T. aman rice→Mustard→Boro rice

This pattern was carried out at the village Vadertek of Bishwambharpur upazila of Sunamganj against the existing T. aman rice-Fallow-Boro pattern. The most popular early maturing T. aman rice varieties Binadhan-11, Binadhan-17 and that of BRRI dhan49 were tested in 2018-19 and block demonstrations were conducted with the best/better performing Binadhan-17 and BRRI dhan49 varieties in 2019-20 and 2020-21 following the same spacing, amount and method of application of fertilizers and intercultural operations and data collection of T. aman rice (10.1.1.1). Seedlings of 23-26 days old Binadhan-17 and BRRI dhan49 were transplanted within 26 July to 24 August.

After harvest of T. aman rice, the land was prepared for sowing mustard. In 2018-19, the mustard varieties Binasarisha-4, Binasarisha-9 and BARI Sarisha-14 (Fig. 10.2.15) were

12 to 16 December. Fertilizers were applied at the rate of Urea 82 kg, TSP 105 kg, MoP 75 kg, ZnSO₄ 4 kg and Boric acid 4 kg ha⁻¹. The whole amount of fertilizers was applied during the final land preparation. Necessary intercultural operations were followed as and when required. Data on maturity and yield were recorded at harvest. Maturity was assessed plot basis and yield was recorded from an area of 20 m² for each variety which was later converted to t ha⁻¹. A field day (Fig. 10.1.17) was organized on Binakhesari-1 at Sunamganj sadar in the presence of the Associate Coordinator, Principal Investigators and Co-Principal Investigator of the project. Farmers, representative from electronic and print media were also present.

The third crop of the pattern was Aus rice at Sunamganj sadar. Binadhan-19 and BRRI dhan48 were cultivated in the Aus season of three years of project period following the same spacing. Amount and method of application of fertilizers and intercultural operations and data collection of Aus rice were same as Aus rice (10.1.2.1). Seedlings of 20-24 days old Binadhan-19 and BRRI dhan48 were transplanted on 13-15 May.

10.1.5 Gopalganj

In 2018-19, three patterns i. T. aman rice→Mustard→Aus rice ii. T. aman rice→Lentil→Aus rice and iii. T. aman rice→Grass pea→Aus rice were conducted at the village of Majhigati of Kashiani upazila of Gopalganj. T. aman rice varieties Binadhan-7, Binadhan-16 and Binadhan-17 were tested in 2018-19 and block demonstrations were conducted with the best/better performing Binadhan-16 and Binadhan-17 in 2019-20 and 2020-21; mustard varieties Binasarisha-9, BARI Sarisha-14; lentil varieties Binamasur-8, BARI Masur-8; grass pea varieties Binakhesari-1, BARI Kheshari-4; Aus rice varieties Binadhan-19, BRRI dhan-48. But due to farmers' negative attitude to Aus rice and positive response to traditional jute cultivation in the area, the third crop of the patterns Aus rice was replaced by jute.

10.1.5.1 T. aman rice→Mustard→Jute

T. aman rice (Fig. 10.1.18) varieties Binadhan-7, Binadhan-16 and Binadhan-17 were tested in 2018-19. Block demonstrations were conducted with the best/better performing Binadhan-16 and Binadhan-17 varieties in 2019-20 and 2020-21 following the same spacing, amount and method of application of fertilizers and intercultural operations and data collection of T. aman rice (10.1.1.1). Seedlings of 25-27 days old Binadhan-16 and Binadhan-17 were transplanted on 13 to 17 August.

After harvest of T. aman rice, the land was prepared for mustard (Fig. 10.1.19) cultivation. Binasarisha-9 and BARI Sarisha-14 were used for block demonstration for three years of project period. Seeds of mustard were broadcasted on 17 to 27 November. Amount and method of application of fertilizers, intercultural operations and data collection were same as mustard (10.1.1.1). A field day (Fig. 10.1.21) was organized on Binadhan-16 at Kashiani, Gopalganj in the presence of BINA Scientists, Project personnel and interested farmers from adjacent area, DAE personnel and representatives from electronic and print media.

tested and block demonstrations were conducted with Binasarisha-9, BARI Sarisha-14 in 2019-20 and 2020-21. Seeds of mustard were broadcasted on 14 November to 22 November at the seed rate of 7.5 kg ha⁻¹. Amount of fertilizers, method of fertilizer application and intercultural operations and data recording were the same as in mustard (10.1.1.1).

The third crop of the pattern was Boro rice at Bishwambharpur. Binadhan-14 and BRRI dhan28 were tested in the Boro season in 2018-19 and for the next two seasons, block demonstrations were conducted with the best performing Binadhan-14 (Fig. 10.2.14) considering the yield performance and crop duration following the same spacing, amount and method of application of fertilizers and intercultural operations and data collection of Boro rice (10.1.1.1). Seedlings of 25-26 days old Binadhan-14 were transplanted on 13 February to 15 March.



Fig. 10.1.14 Late boro rice variety Binadhan-14 at Bishwambharpur



Fig. 10.1.15 Mustard (Var. Binasarisha-9, BARI Sarisha-14 and BARI Sarisha-16) at Vadertek, Bishambharpur upazila of Sunamganj district



Fig. 10.1.16 Pictorial views of grass pea (Binakhesari-1) at Sunamganj sadar



Fig. 10.1.17 Field day on grass pea at Sunamganj sadar

10.1.4.2 T. aman rice→Grass pea→Aus rice

This pattern was carried out at the village Konagaw of Sunamganj sadar against the existing T. aman rice-Fallow-Aus rice pattern. T. aman rice variety selection, cultivation procedure and data collection is same as T. aman (10.1.4.1).

Grass pea varieties Binakhesari-1 and BARI Khesari-4 (Fig. 10.1.16) were used for block demonstrations at the seed rate of 40 kg ha⁻¹. Seeds of grass pea were broadcasted on



Fig. 10.1.22 Field day on Binamasur-8 at Kashiani, Gopalgaj

10.1.5.3 T. aman rice→Grass pea→Jute

The cultivation method of T. aman rice and jute were same as the pattern T. aman rice→Mustard→Jute (10.1.5.1). After harvest of T. aman, the land was prepared for grass pea cultivation. Seeds of grass pea variety Binakhesari-1 and BARI Khesari-4 were broadcasted on 23-28 November at the rate of 40 kg ha⁻¹. Amount and method of application of fertilizers, intercultural operations and data collection were same as of grass pea (10.1.4.2).



Fig. 10.1.23 Field views of jute variety (JRO 524) at Kashiani, Gopalgaj

Rice equivalent yield (REY) was calculated to compare system performance by converting the yield of non-rice crops into equivalent rice yield on a price basis, using the formula: $REY = Y_x (P_x/P_r)$, where Y_x is the yield of non-rice crops (kg ha⁻¹), P_x is the price of non-rice crops and P_r is the price of rice grain.

The third crop of the pattern was jute. Seeds of the jute variety JRO-524 (Fig. 10.1.23) were sown at the rate of 7.5 kg ha⁻¹ on 05-08 April. Fertilizers were applied at the rate of Urea 200 kg, TSP 90 kg, MoP 100 kg, Gypsum 65 kg ha⁻¹. The whole amount of fertilizers was applied during the final land preparation. Necessary cultural and intercultural operations were followed as and when required. Data on fibre yield was recorded from an area of 20 m² which was later converted to t ha⁻¹.



Fig. 10.1.18 T. aman rice (var. Binadhan-7/ Binadhan-16/Binadhan-17 at Kashiani



Fig. 10.1.19 Binasarisha-9 field at Kashiani, Gopalganj

10.1.5.2 T. aman rice→Lentil→Jute

The cultivation method of T. aman rice and jute were same as the pattern T. aman rice-Mustard-Jute (10.1.5.1). After harvest of T. aman rice, the lentil varieties Binamasur-8 (Fig. 10.20) and BARI Masur-8 were broadcasted at the rate of 16 kg ha⁻¹ on 27-28 November. Fertilizers were applied at the rate of Urea 38 kg, TSP 113 kg, MoP 60 kg, Gypsum 90 kg, ZnSO₄ 7.5 kg and Solubor Boron 7.5 kg ha⁻¹. The whole amount of fertilizers was applied during the final land preparation. Data on maturity and yield were recorded at harvest. Maturity was assessed plot basis and yield was recorded from an area of 20 m² for each variety. A field day (Fig. 10.1.22) was organized on Binamasur-8 in the presence of the Coordinator, Co-Principal Investigator of the project and other Scientists from BINA. Farmers, representatives from electronic and print media were also present.



Fig. 10.1.20 Field view of Binamasur-8 at Kashiani



Fig. 10.1.21 Field day on Binadhan-16 at Kashiani, Gopalgaj

10.2 Dissemination of four crops based technology

10.2.1 Dissemination of the technology of improved four crops pattern T. aman rice → Mustard → Patshak (jute leaf) → Aus rice at all 13 upazilas of Mymensingh district

Inspired by the successful trial of four crops based cropping pattern like T. aman rice-Mustard-Patshak (jute leaf)-Aus rice at Char Ghagra, Mymensingh sadar, an initiative was taken to disseminate the technology at all 13 upazillas of Mymensingh district. At the very beginning, a day long workshop entitled 'Dissemination of technology of four crops based cropping pattern' (Fig. 10.2.1) was arranged on 18 October 2020 at Dr. M A Wazed Miah Auditorium, BINA, Mymensingh in presence of related expert scientists from BINA, representatives from DAE (AD, DD and UAOs of all Upazillas of Mymensingh) to disseminate the technology at all 13 Upazillas of Mymensingh district. Honorable Executive Chairman, BARC, Dr. Shaikh Mohammad Bokhtiar was present as the Chief Guest; AD, DAE, Dr. Md. Rezaul Karim, Mymensingh Region, DD, DAE, Mymensingh, Krishibid Md. Motiuzzaman, Dr. Md. Harunur Rashid, Director, PIU-BARC, NATP-2, Dr. Md. Jahangir Alam, Director (Training and Planning), BINA, Dr. Md. Abul Kalam Azad, Director (Admin. & S.S.), BINA the Coordinator of the project were present as Special Guests. The Workshop was Chaired by the Director (Research), BINA, Dr. Hosneara Begum. In the workshop, valuable suggestions, comments and recommendations were recorded from guests and participants discussion about 'Dissemination of the technology of four crops based cropping pattern'. A training program (Fig. 10.2.2) was also conducted including three farmers and one Sub-Assistant Agriculture Officer (SAAO) from each of 13 Upazillas of Mymensingh district to successfully disseminate the technology. Four crops based cropping pattern block demonstrations were conducted at all 13 Upazillas of Mymensingh district against the existing T. aman rice-Fallow-Boro pattern in land of three farmers from each Upazilla who had individually one bigha of land in collaboration with DAE, Mymensingh.

After harvest of T. aman rice, the lands were prepared for sowing mustard. The mustard variety Binasarisha-9 (Fig. 10.2.3) was broadcasted on 10-15 November 2020 at the rate of 7.5 kg ha⁻¹. The amount and method of fertilizer application, cultural and intercultural operations and data recording were the same as in mustard (10.1.1.1)

Seeds of patshak (Jute leaf) were broadcasted on 08-14 March 2021 at the seed rate of 15 kg ha⁻¹ after harvest of mustard. The amount and method of fertilizer application, cultural and intercultural operations and data recording were the same as in Patshak (10.1.1.2)

The third crop of the pattern was Aus rice. Binadhan-19 (Fig. 10.2.4) was used in the Aus season. Seeds of Binadhan-19 were sown on 02-07 April 2021 and seedlings of 25 days old were transplanted in the same land of patshak on 22-28 April 2021 at 15 cm distances within rows of 20 cm apart. The amount and method of fertilizer application, cultural and intercultural operations and data recording were the same as in Aus (10.1.1.2)

After harvest of Aus rice, land was prepared for T. aman rice cultivation. Seeds of Binadhan-11 were sown on 01-06 July 2021 and seedlings of 24 days old were

transplanted on 22-25 July 2021 at 15 cm distances within rows of 20 cm apart. The amount and method of fertilizer application, cultural and intercultural operations and data recording were the same as in T. aman rice (10.1.1.1).



Fig.10.2.1 Address by Honorable Executive Chairman, BARC, Dr. Shaikh Mohammad Bokhtiar in a workshop on 'Dissemination of Technology of four crops based cropping pattern' at BINA, Mymensingh



Fig. 10.2.2 Farmers training at BINA, Mymensingh



Fig. 10.2.3 Field views of mustard variety Binasarisha-9 at Dhobaora, Mymensingh



Fig. 10.2.4 Pictorial views of Aus rice variety Binadhan-19 at Gouripur, Mymensingh



Fig.10.3.1 Economic data collection at sadar, Rangpur



Fig.10.3.2 Economic data collection at Kashiani, Gopalganj

10.3 COMPONENT-2 (Agricultural Economics Division)

The profitability analysis part of this sub-project was implemented by Agricultural Economics Division of BINA in collaboration with ARED and four substations following participatory approach at Mymensingh sadar upazila, Nalitabari upazila of Sherpur district, Mominpur village of Rangpur sadar upazila, Kashiani upazila of Gopalganj and Bishwambarpur and sadar upzilas of Sunamganj district. The following steps were considered to determine profitability of established cropping pattern at farmers' level.

10.3.1 Activity 1: Farmer selection

Farmers for data collection were selected in consultation with Component-1, ARED Division and Sub-station personnel. Forty eight (24 trials and 24 control) farmers were selected at each location to fulfill the objectives of the study. For five locations, total farmers were $48 \times 5 = 240$.

10.3.2 Activity 2: Baseline survey

Baseline survey was conducted during 2017-18 before validation/demonstration trials; all information were collected/recorded regarding existing cropping pattern, pattern based profitability, farmers' yearly farm income, their facilities and constraints through structured questionnaire.

10.3.3 Activity 3: Data collection related farm profitability

Data on cost, return and other related factors were collected from selected farmers at the end of each crop season such as Aman, Rabi, Boro/Kharif-1 to determine pattern based profitability in each location for each year. The total number of famers for collecting data of five locations in three year was 2160 (5 locations \times 9 season \times 48 HHs) (Table 10.3.1) (Fig. 10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5).

Table 10.3.1 Distribution of study locations, total sample size and year wise allocation of samples for data collection

Locations	Sample per location	No. of Season	Total samples	Year wise distribution		
				1 st Year	2 nd Year	3 rd Year
Mymensingh sadar upazila	48	09	432	144	144	144
Sunamganj sadar and Bishwambarpur upazila	48	09	432	144	144	144
Sherpur (Nalitabari)	48	09	432	144	144	144
Gopalganj (Kashiani)	48	09	432	144	144	144
Rangpur sadar	48	09	432	144	144	144
Total			2160	720	720	720

Almost all cropping patterns were considered for cost-benefit analysis. An in-depth literature review was conducted to supplement secondary information. A strong survey team had been formed with the scientists and trained enumerators of each location for collecting primary data with the help of substations and DAE personnel.



Fig. 10.3.5 Economic data collection at Sunamganj

10.3.4 Activity 4: Analytical technique

Collected data were edited and scrutinized for analysis. Most appropriate, available and necessary descriptive methods, tools and techniques were used for data analysis. Tabular and diagrammatic analyses were also being carried out.

10.3.5 Measurement of costs and returns

In this study, cost and return analyses were done on the basis of variable and total cost for each pattern separately. The following equation (II) was used to assess the profitability of selected cropping pattern.

$$II = \sum_{i=1}^n P_i Q_i - TC = \sum_{i=1}^n P_i Q_i - (VC + FC) \text{ -----(1)}$$

Where,

- II = Profit or value addition from cropping pattern
- Q_i = Quantity of crop production of i^{th} farmers (Kg ha^{-1})
- P_i = Average price of crop of i^{th} farmers (Tk. kg^{-1})
- TC = Total cost (Tk. ha^{-1})
- VC = Variable cost (Tk. ha^{-1})
- FC = Fixed cost (Tk. ha^{-1})
- $i = 1, 2, 3, \dots, n$

Per hectare profitability of cropping pattern from the view points of individual farmers was measured in terms of Rice equivalent yield (REY), Total return, Gross margin, Net return and Benefit cost ration (BCR).



Fig. 10.3.3 Economic data collection at Char Ghagra, Sadar, Mymensingh



Fig. 10.3.4 Economic data collection at Nalitabari, Sherpur

11. RESULTS

11.1 COMPONENT-1 (ARED)

Mymensingh sadar

2018-19: T. aman rice-Mustard-Boro rice cropping pattern

At Char Ghagra, Mymensingh sadar, in 2018-19, Binadhan-11 was harvested on 26 October 2018 at 113 days after sowing (DAS) (Table 11.1.1). The grain yield was 5.70 t ha⁻¹. On the other hand, Binadhan-17 was harvested on 28 October 2018 at 115 DAS, yield was 5.30 t ha⁻¹ while BRRIdhan71 on 02 November 2018 at 120 DAS and yield was 5.90 t ha⁻¹. After harvest of T. aman rice, farmers could comfortably sow mustard on 15 November 2018 (Table 11.1.1). Binasarisha-7, Binasarisha-9 and BARI Sarisha-14 were harvested on 02 March 2019 at 108 DAS, 07 February 2019 at 85 DAS and 02 February 2019 at 80 DAS, respectively. Yield of Binasarisha-7, Binasarisha-9 and BARI Sarisha-14 were 1.45 t ha⁻¹, 1.75 t ha⁻¹ and 1.79 t ha⁻¹, respectively. As per schedule, after harvest of mustard, farmers transplanted the Boro rice varieties Binadhan-14 and BRRIdhan28 on the plots of Binasarisha-9 and BARI Sarisha-14 on 19 February 2019 at seedling age of 25 days. Boro rice could not be transplanted on the plots of Binasarisha-7 due to long duration of Binasarisha-7 (108 days). Binadhan-14 was harvested on 25 May 2019 with duration of 121 days and BRRIdhan28 on 12 June 2019 with duration of 138 days. Yield of Binadhan-14 was 6.40 t ha⁻¹ and BRRIdhan28 was 5.80 t ha⁻¹ (Table 11.1.1).

Table 11.1.1 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Char Ghagra, Mymensingh sadar upazila during 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-11	06.07.18	28.07.18	23	26.10.18	113	5.70
		Binadhan-17	06.07.18	28.07.18	23	28.10.18	115	5.30
		BRRIdhan71	06.07.18	28.07.18	23	02.11.18	120	5.90
2	Mustard	Binasarisha-7	15.11.18	-	-	02.03.19	108	1.45
		Binasarisha-9	15.11.18	-	-	07.02.19	85	1.75
		BARI Sarisha-14	15.11.18	-	-	02.02.19	80	1.79
3	Boro rice	Binadhan-14	26.01.19	19.02.19	25	25.05.19	121	6.40
		BRRIdhan28	26.01.19	19.02.19	25	12.06.19	138	5.80

Field duration (excluding seedling age), crop yield and total rice equivalent yield (REY) of the crop wise variety combinations of the pattern T. aman rice-Mustard-Boro rice are shown in Table 11.1.1.1. The cost benefit ratios (BCR) of the combinations are shown in Table 11.3.1 while that of the existing pattern in Table 11.3.5. The crop wise variety combination T. aman rice (BRRIdhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) had the highest REY (17.07 t ha⁻¹) followed by T. aman rice (BRRIdhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (16.96 t ha⁻¹) (Table 11.1.1.1). But BCR was the highest (1.51) in the crop variety combination T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) of all the cropwise variety combinations and the existing cropping pattern (Table 11.1.1.1, Table 11.3.1, Table 11.3.4). Therefore, the component varieties BRRIdhan-71 and Binadhan-11 of T. aman rice, BARI Sarisha-14 and Binasarisha-9 of mustard and Binadhan-14 of Boro rice were selected for block demonstrations in the following two years.

10.3.5.1 Rice equivalent yield (REY):

For comparison between variety wise crop combinations/sequences, the yield of every crop was converted into rice equivalent yield on the basis of prevailing market price of individual crop (Lal *et. al*, 2017). Rice equivalent yield (REY) was computed as yield of individual crop multiplied by market price of that crop divided by market price of rice.

10.3.5.2 Total return: Gross return was calculated by simply multiplying the total volume of output with it's per unit of price in the harvesting period.

10.3.5.3 Gross margin: Gross margin calculation was done to have an estimate of the difference between total return and variable costs. The argument for using the gross margin analysis is that the farmers of Bangladesh are more interested to know their return over variable costs.

10.3.5.4 Net return: The analysis considered fixed cost (which included land rent and family labour). Net return was calculated by deducting all costs (Variable and Fixed) from the gross return.

10.3.5.5 Benefit cost ratio: The benefit cost ratio was calculated by benefit to cost of the farmers.

10.3.6 Activity 5: Farmers income analysis

At the end of the project, change of farmers' income was analyzed. Pre-intervention and post-intervention of the changes of the farmers were determined.

10.3.7 Activity 6: Farmers livelihood improvement

At the end of the project, change of farmers' livelihood was assessed.

Table 11.1.1.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Mymensingh sadar during 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-11)-Mustard (Binasarisha-7)-Boro rice (Binadhan-14)	90	5.70	108	1.45	3.86	96	6.40	294	15.96
T. aman rice (Binadhan-11)-Mustard (Binasarisha-7)-Boro rice (BRRI dhan28)	90	5.70	108	1.45	3.86	113	5.80	311	15.36
T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	90	5.70	85	1.75	4.66	96	6.40	271	16.76
T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan28)	90	5.70	85	1.75	4.66	113	5.80	288	16.16
T. aman rice (Binadhan-11)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	90	5.70	80	1.79	4.77	96	6.40	266	16.87
T. aman rice (Binadhan-11)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan28)	90	5.70	80	1.79	4.77	113	5.80	283	16.27
T. aman rice (Binadhan-17)-Mustard (Binasarisha-7)-Boro rice (Binadhan-14)	92	5.30	108	1.45	3.86	96	6.40	296	15.56
T. aman rice (Binadhan-17)-Mustard (Binasarisha-7)-Boro rice (BRRI dhan28)	92	5.30	108	1.45	3.86	113	5.80	313	14.96
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	92	5.30	85	1.75	4.66	96	6.40	273	16.36
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan28)	92	5.30	85	1.75	4.66	113	5.80	290	15.76
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	92	5.30	80	1.79	4.77	96	6.40	268	16.47
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan28)	92	5.30	80	1.79	4.77	113	5.80	285	15.87
T. aman rice (BRRI dhan71)-Mustard (Binasarisha-7)-Boro rice (Binadhan-14)	97	5.90	108	1.45	3.86	96	6.40	301	16.16

Table 11.1.1.1 Contd.

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (BRR1 dhan71)-Mustard (Binasarisha-7)-Boro rice (BRR1 dhan28)	97	5.90	108	1.45	3.86	113	5.80	318	15.56
T. aman rice (BRR1 dhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	97	5.90	85	1.75	4.66	96	6.40	278	16.96
T. aman rice (BRR1 dhan71)-Mustard (Binasarisha-9)-Boro rice (BRR1 dhan28)	97	5.90	85	1.75	4.66	113	5.80	295	16.36
T. aman rice (BRR1 dhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	97	5.90	80	1.79	4.77	96	6.40	273	17.07
T. aman rice (BRR1 dhan71)-Mustard (BARI Sarisha-14)-Boro rice (BRR1 dhan28)	97	5.90	80	1.79	4.77	113	5.80	290	16.47

Price: Rice-Tk. 17.50, MustInard-Tk. 46.63

Table 11.1.2.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Mymensingh sadar during 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	90	5.90	85	1.65	4.35	95	6.60	270	16.85
T. aman rice (Binadhan-11)-Mustard ((BARI Sarisha-14)-Boro rice (Binadhan-14)	90	5.90	81	1.70	4.48	95	6.60	266	16.98
T. aman rice (BRR1 dhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	95	6.10	85	1.65	4.35	95	6.60	275	17.05
T. aman rice (BRR1 dhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	95	6.10	81	1.70	4.48	95	6.60	271	17.18

Price: Rice-Tk. 18.18, Mustard-Tk. 47.88

2019-20: i. T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-11 was harvested on 09 November 2019 at 114 DAS while BRRIdhan71 on 14 November 2019 at 119 DAS (Table 11.1.2). Yield of Binadhan-11 was 5.90 t ha⁻¹ and BRRIdhan71 was 6.10 t ha⁻¹. Binasarisha-9 was harvested on 20 February 2020 at 85 DAS with yield of 1.65 t ha⁻¹ and BARI Sarisha-14 on 16 February 2020 at 81 DAS with yield of 1.70 t ha⁻¹ (Table 11.1.2). Binadhan-14 was harvested on 16 June 2020 with duration of 122 days and yield was 6.60 t ha⁻¹ (Table 11.1.2).

Table 11.1.2 Performance of T. aman rice-Mustard- Boro rice cropping pattern at Char Ghagra, Mymensingh sadar upazila during 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-11	19.07.2019	11.08.2019	24	09.11.2019	114	5.90
		BRRIdhan71	19.07.2019	11.08.2019	24	14.11.2019	119	6.10
2	Mustard	Binasarisha-9	28.11.2019	-	-	20.02.2020	85	1.65
		BARI Sarisha-14	28.11.2019	-	-	16.02.2020	81	1.70
3	Boro rice	Binadhan-14	16.02.2020	13.03.2020	27	16.06.2020	122	6.60

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern early T. aman rice- Mustard- late Boro rice are shown in Table 11.1.2.1. The cost benefit ratios of the combinations (BCR) are shown in Table 11.3.2 and that of the existing pattern in the Table 11.3.4. The cropwise variety combination T. aman rice (BRRIdhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) had the highest REY (17.18 t ha⁻¹) followed by T. aman rice (BRRIdhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (17.05 t ha⁻¹) (Table 11.1.2.1). But BCR was the highest (1.53) in the crop variety combination T. aman rice (BRRIdhan71)-Mustard (Binasarisha-9)-Boro (Binadhan-14) followed by T. aman (BRRIdhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) (1.51) (Table 11.1.2.1).

2019-20: ii. T. aman rice-Mustard-Patshak-Aus rice pattern

The results of T. aman rice and Mustard were the same as discussed above (Table 11.1.2). Patshak was harvested on 09 April 2020 with duration of 30 days and yield of 3.40 t ha⁻¹. Binadhan-19 was harvested on 15 July 2020 with duration of 103 days and yield of 4.40 t ha⁻¹ (Table 11.1.3).

Table 11.1.3 Performance of T. aman rice-Mustard-Patshak-Aus rice cropping pattern at Char Ghagra, Mymensingh sadar upazila during 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-11	19.07.2019	11.08.2019	24	09.11.2019	114	5.90
		BRRi dhan71	19.07.2019	11.08.2019	24	14.11.2019	119	6.10
2	Mustard	Binasarisha-9	28.11.2019	-	-	20.02.2020	85	1.65
		BARI Sarisha-14	28.11.2019	-	-	16.02.2020	81	1.70
3	Patshak	Binapatshak-1	10.03.2020	-	-	09.04.2020	30	3.4
4	Aus rice	Binadhan-19	04.04.2020	28.04.2020	25	15.07.2020	103	4.40

Field duration (excluding seedling age), crop yield and total REY of the crop wise variety combinations of the pattern T. aman rice-Mustard-Patshak-Aus rice are shown in Table 11.1.3.1. The BCR of the combinations are shown in Table 11.3.6 and that of the existing pattern in Table 11.3.4. The crop wise variety combination T. aman rice (BRRi dhan71)-Mustard (BARI Sharisha-14)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) had the highest REY (17.33 t ha⁻¹) followed by T. aman rice (BRRi dhan71)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) (17.21 t ha⁻¹) (Table 11.1.3.1). In contrast, BCR was highest (1.70) in the variety combination T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus (Binadhan-19) followed by T. aman rice (BRRi dhan71)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus (Binadhan-19) (1.63) (Table 11.3.6).

Table 11.1.3.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Patshak-Aus rice cropping pattern for Mymensingh sadar upazila during 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Patshak)			Field duration and yield of 4 th crop (Aus rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	90	5.90	85	1.65	4.08	30	3.4	2.63	81	4.40	286	17.01
T. aman rice (Binadhan-11)-Mustard (BARI Sarisha-14)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	90	5.90	81	1.70	4.20	30	3.4	2.63	81	4.40	282	17.13
T. aman rice (BRII dhan71)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	95	6.10	85	1.65	4.08	30	3.4	2.63	81	4.40	294	17.21
T. aman rice (BRII dhan71)-Mustard (BARI Sarisha-14)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	95	6.10	81	1.70	4.20	30	3.4	2.63	81	4.40	287	17.33

Price: Rice-Tk. 19.38, Mustard-Tk. 47.88, Patshak-Tk. 15.00

2020-21: i. T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-11 was harvested on 13 October 2020 at 111 DAS and BRRI dhan71 on 20 October 2020 at 122 DAS (Table 11.1.4). Yield of Binadhan-11 was 5.80 t ha and BRRI dhan71 was 6.00 t ha⁻¹. Binasarisha-9 was harvested on 13 February 2021 at 86 DAS with yield of 1.79 t ha⁻¹ and BARI Sarisha-14 on 31 January 2021 at 82 DAS with yield of 1.65 t ha⁻¹ (Table 11.1.4). Binadhan-14 was harvested on 02 June 2021 with duration of 121 days and yield 6.65 t ha⁻¹ (Table 11.1.4).

Table 11.1.4 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Char Ghagra, Mymensingh sadar upazila during 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-11	25.06.2020	18.07.2020	24	13.10.2020	111	5.80
		BRRI dhan71	25.06.2020	18.07.2020	24	24.10.2020	122	6.00
2	Mustard	Binasarisha-9	10.11.2020	-	-	03.02.2021	86	1.79
		BARI Sarisha-14	10.11.2020	-	-	30.01.2021	82	1.65
3	Boro rice	Binadhan-14	02.02.2021	03.03.2021	30	02.06.2021	121	6.65

Field duration (excluding seedling age), crop yield and total REY of the crop wise variety combinations of the pattern T. aman rice- Mustard-Boro rice are shown in Table 11.1.4.1 while BCR is shown in Table 11.3.3 and that of the existing pattern in Table 11.3.4. The crop wise variety combination T. aman rice (BRRI dhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) ranked the top (16.74 t ha⁻¹) in terms of total REY followed by T. aman rice (BRRI dhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (16.54 t ha⁻¹) (Table 11.1.4.1). But BCR was the highest (1.64) in the variety combination T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro (Binadhan-14) followed by T. aman rice (BRRI dhan71)-Mustard (Binasarisha-9)-Boro (Binadhan-14).

Table 11.1.4.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Mymensingh sadar during 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	87	5.80	86	1.79	4.09	91	6.65	264	16.54
T. aman rice (Binadhan-11)-Mustard ((BARI Sarisha-14)-Boro rice (Binadhan-14)	87	5.80	82	1.65	3.77	91	6.65	260	16.22
T. aman rice (BRR1 dhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	98	6.00	86	1.79	4.09	91	6.65	275	16.74
T. aman rice (BRR1 dhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	98	6.00	82	1.65	3.77	91	6.65	271	16.42

Price: Rice-Tk. 21.75, Mustard-Tk. 49.75

2020-21:ii. T. aman rice-Mustard-Patshak-Aus rice cropping pattern

The results of T. aman rice and mustard are same as in Table 11.1.4. Patshak was harvested on 13 April 2021 with duration of 37 days and yield 3.60 t ha⁻¹ (Table 11.1.5). Binadhan-19 was harvested on 25 July 2021 with duration of 102 days and yield 5.20 t ha⁻¹ (Table 11.1.5).

Table 11.1.5 Performance of T. aman rice-Mustard-Patshak-Aus rice cropping pattern at Char Ghagra, Mymensingh sadar upazila during 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-11	25.06.2020	18.07.2020	24	13.10.2020	111	5.80
		BRRI dhan71	25.06.2020	18.07.2020	24	24.10.2020	122	6.00
2	Mustard	Binasarisha-9	10.11.2020	-	-	03.02.2021	86	1.79
		BARI Sarisha-14	10.11.2020	-	-	30.01.2021	82	1.65
3	Patshak	Binapatshak-1	08.03.2021	-	-	13.04.2021	37	3.6
4	Aus rice	Binadhan-19	15.04.2021	09.05.2021	25	25.07.2021	102	5.20

Field duration (excluding seedling age), crop yield and total rice equivalent yield of the cropwise variety combinations of the pattern T. aman rice- Mustard-Patshak-Aus rice are shown in Table 11.1.5.1. BCR was shown in Table 11.3.7. The cropwise variety combination T. aman rice (BRRI dhan71)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) ranked the top (17.85 t ha⁻¹) in terms of total REY followed by T. aman rice (Binadhan-11)-Mustard (Binasharisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) (17.65 t ha⁻¹) (Table 11.1.5.1). But BCR was the highest (1.82) in the variety combination T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) followed by T. aman rice (BRRI dhan71)-Mustard (BARI Sarisha-14)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) (1.78) (Table 11.3.7).

Table 11.1.5.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Patshak-Aus rice cropping pattern for Mymensingh sadar upazila during 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Patshak)			Field duration and yield of 4 th crop (Aus rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	87	5.80	86	1.79	4.13	37	3.6	2.52	77	5.20	287	17.65
T. aman rice (Binadhan-11)-Mustard (BARI Sarisha-14)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	87	5.80	82	1.65	3.80	37	3.6	2.52	77	5.20	283	17.32
T. aman rice (BRR1 dhan71)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	98	6.00	86	1.79	4.13	37	3.6	2.52	77	5.20	298	17.85
T. aman rice (BRR1 dhan71)-Mustard (BARI Sarisha-14)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	98	6.00	82	1.65	3.80	37	3.6	2.52	77	5.20	294	17.52

Price: Rice-Tk. 21.58, Mustard-Tk. 49.75, Patshak-Tk. 15.10

The average FD, REY, NR and BCR over 2019-20 and 2020-21 is shown in Table 11.1.6. It was revealed that two patterns T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) and T. aman rice (BRRI dhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the highest BCR (1.57). But FD was shorter (267 days) in the pattern T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14). Therefore, T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) pattern was recommended for Mymensingh sadar.

Table 11.1.6 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Mustard-Boro rice cropping pattern at Mymensingh sadar averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20					2020-21					Average				
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR			
1	T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	270	16.85	98212.69	1.50	264	16.54	131610.44	1.64	267	16.70	114911.57	1.57			
2	T. aman rice (Binadhan-11)-Mustard ((BARI Sarisha-14)-Boro rice (Binadhan-14)	266	16.98	96521.71	1.48	260	16.22	119766.04	1.58	263	16.6	108143.88	1.53			
3	T. aman rice (BRRI dhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	275	17.05	100254.06	1.53	275	16.74	121155.59	1.60	275	16.90	110704.83	1.57			
4	T. aman rice (BRRI dhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	271	17.18	102823.20	1.51	271	16.42	124521.08	1.59	271	16.80	113672.14	1.55			

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.7. The crop wise variety combination T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) for the pattern T. aman rice-Mustard-Patshak-Aus rice showed the highest BCR (1.76) and NR (Tk. 144724.56) (Table (11.1.7). Therefore, this cropwise variety combination was also recommended for Mymensingh sadar upazila

Table 11.1.7 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Mustard-Patshak-Aus rice cropping pattern at Mymensingh sadar averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20					2020-21					Average				
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR			
1	T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	286	17.01	132918.54	1.70	287	17.65	156530.58	1.82	287	17.33	144724.56	1.76			
2	T. aman rice (Binadhan-11)- Mustard (BARI Sarisha-14)-Patshak (Binapatshak-1)--Aus rice (Binadhan-19)	282	17.13	120189.72	1.59	283	17.32	145734.03	1.72	283	17.23	132961.88	1.66			
3	T. aman rice (BRR1 dhan71)- Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19)	294	17.21	125109.66	1.63	298	17.85	144509.96	1.74	296	17.53	134809.81	1.69			
4	T. aman rice (BRR1 dhan71)- Mustard (BARI Sarisha-14)-Patshak (Binapatshak-1)--Aus rice (Binadhan-19)	287	17.33	119765.62	1.58	294	17.52	148903.42	1.78	291	17.43	134334.52	1.68			

Nalitabari, Sherpur

2018-19: T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-7 was harvested on 29 October 2018 at 114 DAS with yield of 5.50 t/ha, Binadhan-17 on 02 November 2018 at 117 DAS with yield of 5.80 t ha⁻¹ and BRRI dhan49 on 25 November 2018 at 141 DAS with yield of 6.00 t ha⁻¹ (Table 11.1.8). Binasarisha-7, Binasarisha-9 and BARI Sarisha-14 were harvested on 20 February 2019, 10 February 2019 and 01 February 2019, respectively. Binasarisha-7, Binasarisha-9 and BARI Sarisha-14 produced 1.60 t ha⁻¹ at 104 DAS, 1.79 t ha⁻¹ at 90 DAS and 1.65 t ha⁻¹ at 84 DAS, respectively. Binadhan-14 was harvested on 28 May 2019 with duration of 121 days and yield of 5.60 t ha⁻¹ and BRRI dhan58 on 18 June 2019 with duration of 142 days and yield of 6.00 t ha⁻¹ (Table 11.1.8).

Table 11.1.8 Performance of T. aman-Mustard-Boro rice cropping pattern at Kadamtali, Nalitabari, 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	06.07.18	01.08.18	25	29.10.18	114	5.50
		Binadhan-17	06.07.18	01.08.18	25	02.11.18	117	5.80
		BRRI dhan49	06.07.18	01.08.18	25	25.11.18	141	6.00
2	Mustard	Binasarisha-7	09.11.18	-	-	20.02.19	104	1.60
		Binasarisha-9	09.11.18	-	-	10.02.19	90	1.79
		BARI Sarisha-14	09.11.18	-	-	01.02.19	84	1.65
3	Boro rice	Binadhan-14	28.01.19	21.02.19	25	28.05.19	121	5.60
		BRRI dhan58	28.01.19	21.02.19	25	18.06.19	142	6.00

Field duration (excluding seedling age), crop yield and total rice equivalent yield of the crop wise variety combinations of the pattern early T. aman rice-Mustard-Boro rice are shown in Table 11.1.8.1. The BCR of the the crop wise variety combinations are shown in Table 11.3.9 and that of the existing cropping pattern in Table 11.3.12. The crop wise variety combination T. aman rice (BRRI dhan49)-Mustard (Binasarisha-9)-Boro rice BRRI dhan58) ranked the top (16.50 t ha⁻¹) in terms of total REY followed by T. aman rice (BRRI dhan49)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58) (16.15 t ha⁻¹) (Table 11.1.8.1). But BCR was the highest (1.52) in the crop wise variety combination of T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14). Therefore, the component varieties Binadhan-17 and Binadhan-7 of T. aman rice, Binasarisha-9 and BARI Sarisha-14 of mustard and Binadhan-14 and BRRI dhan58 of Boro rice were selected for block demonstrations in the following two years. Binadhan-7 was selected for T. aman rice season because many of the farmers of Sherpur district used to cultivate Binadhan-7 and even presently they grow it in their fields.

Table 11.1.8.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Kadamtali, Nalitabari in 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Mustard (Binasarisha-7)-Boro rice (Binadhan-14)	89	5.50	104	1.60	4.03	96	5.60	289	15.13
T. aman rice (Binadhan-7)-Mustard (Binasarisha-7)-Boro rice (BRR1 dhan58)	89	5.50	104	1.60	4.03	117	6.00	310	15.53
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	89	5.50	90	1.79	4.50	96	5.60	275	15.60
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (BRR1 dhan58)	89	5.50	90	1.79	4.50	117	6.00	296	16.00
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	89	5.50	84	1.65	4.15	96	5.60	269	15.25
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (BRR1 dhan58)	89	5.50	84	1.65	4.15	117	6.00	290	15.65
T. aman rice (Binadhan-17)- Mustard (Binasarisha-7)-Boro rice (Binadhan-14)	92	5.80	104	1.60	4.03	96	5.60	292	15.43
T. aman rice (Binadhan-17)- Mustard (Binasarisha-7)-Boro rice (BRR1 dhan58)	92	5.80	104	1.60	4.03	117	6.00	313	15.83
T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	92	5.80	90	1.79	4.50	96	5.60	278	15.90
T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)-Boro rice (BRR1 dhan58)	92	5.80	90	1.79	4.50	117	6.00	299	16.30
T. aman rice (Binadhan-17)- Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	92	5.80	84	1.65	4.15	96	5.60	272	15.55
T. aman rice (Binadhan-17)- Mustard (BARI Sarisha-14)-Boro rice (BRR1 dhan58)	92	5.80	84	1.65	4.15	117	6.00	293	15.95
T. aman rice (BRR1 dhan49)-Mustard (Binasarisha-7)-Boro rice (Binadhan-14)	116	6.00	104	1.60	4.03	96	5.60	316	15.63

Table 11.1.8.1 Contd.

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (BRRI dhan49)-Mustard (Binasarisha-7)-Boro rice (BRRI dhan58)	116	6.00	104	1.60	4.03	117	6.00	337	16.03
T. aman rice (BRRI dhan49)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	116	6.00	90	1.79	4.50	96	5.60	302	16.10
T. aman rice (BRRI dhan49)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58)	116	6.00	90	1.79	4.50	117	6.00	323	16.50
T. aman rice (BRRI dhan49)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	116	6.00	84	1.65	4.15	96	5.60	296	15.75
T. aman rice (BRRI dhan49)-Mustard (BARI Sarisha-14)-Boro rice BRRI dhan58)	116	6.00	84	1.65	4.15	117	6.00	317	16.15

Price: Rice-Tk. 17.21, Mustard-Tk. 43.30

2019-20: T. aman rice-Mustard-Boro rice pattern

In, 2019-20, Binadhan-7 was harvested on 01 November 2019 at 113 DAS with yield 5.60 t ha⁻¹ and Binadhan-17 on 05 November 2019 at 117 DAS with yield 6.00 t ha⁻¹ (Table 11.1.9). Binasarisha-9 was harvested on 16 February 2020 at 87 DAS with yield 1.78 t ha⁻¹ and BARI Sarisha-14 on 10 February 2020 at 83 DAS with yield 1.70 t ha⁻¹. Binadhan-14 was harvested on 16 June 2020 with duration of 122 days and yield 5.10 t ha⁻¹ and BRRI dhan58 on 29 June 2020 at 148 DAS with yield 5.50 t ha⁻¹ (Table 11.1.9).

Table 11.1.9 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Kadamtali, Nalitabari in 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	12.07.2019	08.08.2019	28	01.11.2019	113	5.60
		Binadhan-17	12.07.2019	08.08.2019	28	05.11.2019	117	6.00
2	Mustard	Binasarisha-9	22.11.2019	-	-	16.02.2020	87	1.78
		BARI Sarisha-14	22.11.2019	-	-	10.02.2020	83	1.70
3	Boro rice	Binadhan-14	30.01.2020	23.02.2020	25	30.05.2020	120	5.10
		BRRI dhan58	30.01.2020	04.03.2020	35	29.06.2020	148	5.50

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Boro rice are shown in Table 11.1.9.1. The BCR of the the cropwise variety combination is shown in Table 11.3.10 and that of the existing pattern in Table 11.3.12. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) ranked the top (15.77 t ha⁻¹) in terms of total REY followed by T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58) (15.58 t ha⁻¹) (Table 11.1.9.1). But the BCR was the highest for the variety wise combination, T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro (BRRI dhan58 (Table 11.3.10) of all the combinations and the existing pattern (Table 11.3.10, Table 11.3.12).

2020-21: T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-7 was harvested on 28 October 2020 at 110 DAS with yield of 5.50 t ha⁻¹ and Binadhan-17 on 05 November 2020 at 117 DAS with yield of 5.90 t ha⁻¹ (Table 11.1.10). Binasarisha-9 was harvested on 24 February 2021 at 89 DAS with yield of 1.65 t ha⁻¹ and BARI Sarisha-14 on 21 February 2021 at 86 DAS with yield of 1.60 t ha⁻¹. Binadhan-14 was harvested on 16 May 2021 with duration of 118 days and yield of 5.90 t ha⁻¹ while BRRI dhan58 on 12 June 2021 at 146 DAS with yield of 6.10 t ha⁻¹ (Table 11.1.10).

Table 11.1.10 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Kadamtali, Nalitabari, 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	14.07.2020	07.08.2020	25	28.10.2020	110	5.50
		Binadhan-17	14.07.2020	07.08.2020	25	05.11.2020	117	5.90
2	Mustard	Binasarisha-9	28.11.2020	-	-	24.02.21	89	1.65
		BARI Sarisha-14	28.11.2020	-	-	21.02.21	86	1.60
3	Boro rice	Binadhan-14	28.01.21	23.02.21	27	16.05.21	118	5.90
		BRRI dhan58	28.01.21	28.02.21	32	12.06.21	146	6.10

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Boro rice are shown in Table 11.1.10.1. The BCR of the the cropwise variety combination is shown in Table 11.3.11 and that of the existing pattern in Table 11.3.12. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) ranked the top (15.46 t ha⁻¹) in terms of total REY along with the highest BCR (1.62) followed by T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) with REY (15.26 t ha⁻¹) and BCR (1.60); and T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) with REY (15.06 t ha⁻¹) and BCR (1.60) (Table 11.1.10.1, Table 11.3.11, Table 11.3.12).

Table 11.1.9.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Kadamtali, Nalitabari in 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	85	5.60	87	1.78	4.27	95	5.10	267	14.97
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58)	85	5.60	87	1.78	4.27	113	5.50	285	15.37
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	85	5.60	83	1.70	4.08	95	5.10	263	14.78
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58)	85	5.60	83	1.70	4.08	113	5.50	281	15.18
T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	89	6.00	87	1.78	4.27	95	5.10	271	15.37
T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)-Boro rice (BRRI dhan58)	89	6.00	87	1.78	4.27	113	5.50	289	15.77
T. aman rice (Binadhan-17)- Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	89	6.00	83	1.70	4.08	95	5.10	267	15.18
T. aman rice (Binadhan-17)- Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58)	89	6.00	83	1.70	4.08	113	5.50	285	15.58

Price: Rice-Tk. 17.21, Mustard-Tk. 43.30

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.11. Three cropwise variety combinations T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14), ii. T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) and iii. T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58) had the highest BCR (1.55) (Table 11.1.11). Of that the combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)- Boro rice (BRRI dhan58) also had the highest net return (Tk. 108356.43) and the highest REY (15.62 t ha⁻¹) as well but took the longest FD (290 days). But the combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the lowest net return and REY but the shortest FD. Therefore, the cropwise variety combination, T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) was recommended for the improved pattern T. aman rice-Mustard-Boro rice for Nalitabari upazila of Sherpur district.

Table 11.1.10.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Kadamtali, Nalitabari in 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	84	5.50	89	1.65	3.46	91	5.90	264	14.86
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58)	84	5.50	89	1.65	3.46	111	6.10	284	15.06
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	84	5.50	86	1.60	3.35	91	5.90	261	14.75
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice BRRI dhan58)	84	5.50	86	1.60	3.35	111	6.10	281	14.95
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	91	5.90	89	1.65	3.46	91	5.90	271	15.26
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58)	91	5.90	89	1.65	3.46	111	6.10	291	15.46
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	91	5.90	86	1.60	3.35	91	5.90	268	15.15
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58)	91	5.90	86	1.60	3.35	111	6.10	288	15.35

Price: Rice-Tk. 21.27, Mustard-Tk. 44.58

Table 11.1.11 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Mustard-Boro rice cropping pattern at Kadamtali, Nalitabari averaged over 2019- 20 and 2020-21

Sl.	Pattern	2019-20				2020-21				Average			
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR
1	T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	267	14.97	82868.73	1.45	264	14.86	111305.69	1.58	266	14.92	97087.21	1.52
2	T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58)	285	15.37	82497.70	1.42	284	15.06	118464.85	1.60	285	15.22	100481.28	1.51
3	T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	263	14.78	78773.69	1.42	261	14.75	117127.16	1.59	262	14.77	97950.43	1.51
4	T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice BRRI dhan58)	281	15.18	84250.02	1.45	281	14.95	108297.01	1.56	281	15.07	96273.52	1.51
5	T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	271	15.37	91300.72	1.49	271	15.26	116027.22	1.60	271	15.32	103663.97	1.55
6	T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)-Boro rice (BRRI dhan58)	289	15.77	97631.68	1.52	291	15.46	119081.17	1.62	290	15.62	108356.43	1.55
7	T. aman rice (Binadhan-17)- Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	267	15.18	93111.93	1.47	268	15.15	117269.60	1.59	268	15.17	105190.77	1.53
8	T. aman rice (Binadhan-17)- Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58)	285	15.58	102453.37	1.54	288	15.35	109413.48	1.56	287	15.47	105933.43	1.55

Rangpur

2018-19: i. T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-7 was harvested on 23 October 2018 at 115 DAS with yield of 4.80 t ha⁻¹, Binadhan-17 on 25 October 2018 at 117 DAS with yield of 6.00 t ha⁻¹ and BRRRI dhan33 on 25 October 2018 at 117 DAS with yield of 4.10 t ha⁻¹ (Table 11.1.12). Binasarisha-9, BARI Sarisha-14 and BARI Sarisha-16 were harvested on 10 February 2019 at 86 DAS with yield of 1.70 t ha⁻¹, 04 February 2019 at 80 DAS with yield of 1.60 t ha⁻¹ and 15 February 2019 at 91 DAS with yield of 1.10 t ha⁻¹, respectively. Binadhan-14 was harvested on 30 May 2019 with duration of 121 days with yield of 5.80 t ha⁻¹ and BRRRI dhan28 on 16 June 2019 with duration of 138 days and yield of 5.60 t ha⁻¹ (Table 11.1.12).

Table 11.1.12 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Muktarpara, Rangpur, 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	01.07.18	25.07.18	25	23.10.18	115	4.80
		Binadhan-17	01.07.18	25.07.18	25	25.10.18	117	6.00
		BRRRI dhan33	01.07.18	25.07.18	25	25.10.18	117	4.10
2	Mustard	Binasarisha-9	17.11.18	-	-	10.02.19	86	1.70
		BARI Sarisha-14	17.11.18	-	-	04.02.19	80	1.60
		BARI Sarisha-16	17.11.18	-	-	15.02.19	91	1.10
3	Boro rice	Binadhan-14	29.01.19	25.02.19	28	30.05.19	121	5.80
		BRRRI dhan28	29.01.19	25.02.19	28	16.06.19	138	5.60

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Boro rice are shown in Table 11.1.12.1. The BCR of the cropwise variety combination of the improved pattern is shown in Table 11.3.14 and that of the existing cropping pattern in Table 11.3.17. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) ranked the top (16.26 t ha⁻¹) in terms of total REY than the other combinations followed by T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRRI dhan28) with REY (16.06 t ha⁻¹) (Table 11.1.12.1). Moreover, the cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the highest BCR (1.47) followed by T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRRI dhan28) (1.46) (Table 11.3.14). Therefore, the component varieties Binadhan-17 and Binadhan-7 of T. aman rice; Binasarisha-9 and BARI Sarisha-14 of mustard/rapeseed and Binadhan-14 of Boro rice were selected for block demonstrations in the following two years along with Binadhan-7 and BARI Sarisha-14 for more confirmation.

Table 11.1.12.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Muktarpara, Rangpur in 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	90	4.80	86	1.70	4.46	93	5.80	269	15.06
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (BRR1 dhan28)	90	4.80	86	1.70	4.46	110	5.60	286	14.86
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	90	4.80	80	1.60	4.19	93	5.80	263	14.79
T. aman rice (Binadhan-7)-Mustard BARI Sarisha-14)-Boro rice (BRR1 dhan28)	90	4.80	80	1.60	4.19	110	5.60	280	14.59
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-16)-Boro rice ((Binadhan-14)	90	4.80	91	1.10	2.88	93	5.80	274	13.48
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-16)-Boro rice (BRR1 dhan28)	90	4.80	91	1.10	2.88	110	5.60	291	13.28
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	92	6.00	86	1.70	4.46	93	5.80	271	16.26
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRR1 dhan28)	92	6.00	86	1.70	4.46	110	5.60	288	16.06
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	92	6.00	80	1.60	4.19	93	5.80	265	15.99
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRR1 dhan28)	92	6.00	80	1.60	4.19	110	5.60	282	15.79
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-16)-Boro rice (Binadhan-14)	92	6.00	91	1.10	2.88	93	5.80	276	14.68
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-16)-Boro rice (BRR1 dhan28)	92	6.00	91	1.10	2.88	110	5.60	293	14.48
T. aman rice (Binadhan-33)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	92	4.10	86	1.70	4.46	93	5.80	271	14.36

Table 11.1.1.12.1 Contd.

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (BRRI dhan33)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan28)	92	4.10	86	1.70	4.46	110	5.60	288	14.16
T. aman rice (BRRI dhan33)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	92	4.10	80	1.60	4.19	93	5.80	265	14.09
T. aman rice (BRRI dhan33)-Mustard-(BARI Sarisha-14)-Boro rice (BRRI dhan28)	92	4.10	80	1.60	4.19	110	5.60	282	13.89
T. aman rice (BRRI dhan33)-Mustard ((BARI Sarisha-16)-Boro rice (Binadhan-14)	92	4.10	91	1.10	2.88	93	5.80	276	12.78
T. aman rice (BRRI dhan33)-Mustard (BARI Sarisha-16)-Boro rice (BRRI dhan28)	92	4.10	91	1.10	2.88	110	5.60	293	12.58

Price: Rice-Tk. 17.08, Mustard-Tk. 44.76

2018-19: ii. T. aman rice-Potato-Boro rice cropping pattern

Results of T. aman rice and Boro rice are same as T. aman rice-Mustard-Boro rice cropping pattern described above (Table 11.1.12). Potato variety Asterix was harvested on 01 February 2019 at 97 DAS with yield of 26.61 t ha⁻¹ (Table 11.1.13).

Table 11.1.13 Performance of T. aman rice-Potato-Boro rice cropping pattern at Muktarpara, Rangpur, 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	01.07.18	25.07.18	25	23.10.18	115	4.80
		Binadhan-17	01.07.18	25.07.18	25	25.10.18	117	6.00
		BRRI dhan33	01.07.18	25.07.18	25	25.10.18	117	4.10
2	Potato	Asterix	01.11.18	-	-	05.02.19	97	26.61
3	Boro rice	Binadhan-14	29.01.19	25.02.19	28	30.05.19	121	5.80
		BRRI dhan28	29.01.19	25.02.19	28	16.06.19	138	5.60

Field duration (excluding seedling age), crop yield and total rice equivalent yield of the cropwise variety combinations of the pattern T. aman rice-Potato-Boro rice are shown in Table 11.1.13.1. The BCR of the cropwise variety combination of the improved pattern is shown in Table 11.3.19 and that of the existing cropping pattern in Table 11.3.17. The cropwise variety combination, T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) had the highest REY (29.56 t ha⁻¹) along with the highest BCR (1.52) of all the other combinations and the existing cropping pattern followed by T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (BRRI dhan28) with REY (29.36 t ha⁻¹) and BCR (1.49) (Table 11.1.13.1; Table 11.3.19). Therefore, the component varieties Binadhan-17 and Binadhan-7 of T.aman rice; Potato (Asterix) and Binadhan-14 of Boro rice were selected for block demonstrations in the following two years.

Table 11.1.13.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Potato-Boro rice cropping pattern for Muktarpara, Rangpur in 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Potato)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Potato (Asterix)-Boro rice (Binadhan-14)	90	4.80	97	26.61	17.76	93	5.80	280	28.36
T. aman rice (Binadhan-7)-Potato (Asterix)-Boro rice (BRR1 dhan28)	90	4.80	97	26.61	17.76	110	5.60	297	28.16
T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14)	92	6.00	97	26.61	17.76	93	5.80	282	29.56
T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (BRR1 dhan28)	92	6.00	97	26.61	17.76	110	5.60	299	29.36
T. aman rice (BRR1 dhan33)-Potato (Asterix)-Boro rice (Binadhan-14)	92	4.10	97	26.61	17.76	93	5.80	282	27.66
T. aman rice (BRR1 dhan33)-Potato (Asterix)-Boro rice (BRR1 dhan28)	92	4.10	97	26.61	17.76	110	5.60	299	27.46

Price: Rice-Tk. 17.08, Potato-Tk. 11.40

2019-20: i. T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-7 was harvested on 20 October 2019 at 117 DAS with yield of 5.20 t/ha and Binadhan-17 on 18 October 2019 at 115 DAS with yield of 6.20 t ha⁻¹ (Table 11.1.14). Binasarisha-9 and BARI Sarisha-14 were harvested on 05 March 2020 at 85 DAS and 02 March 2020 at 82 DAS, respectively. Yield of Binasarisha-9 and BARI Sarisha-14 were 1.50 t ha⁻¹ and 1.45 t ha⁻¹, respectively (Table 11.1.14). Binadhan-14 was harvested on 20 June 2020 with duration of 122 days with yield of 5.30 t ha⁻¹. BRRI dhan28 was avoided for its high susceptibility to diseases.

Table 11.1.14 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Muktarpara, Rangpur, 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	25.6.2019	20.07.2019	26	20.10.19	117	5.20
		Binadhan-17	25.6.2019	20.07.2019	26	18.10.19	115	6.20
2	Mustard	Binasarisha-9	11.12.2019	-	-	5.03.2020	85	1.50
		BARI Sarisha-14	11.12.2019	-	-	02.03.2020	82	1.45
3	Boro rice	Binadhan-14	20.02.2020	15.03.2020	25	20.06.2020	122	5.30

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Boro rice are shown in Table 11.1.14.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.15 and that of the existing cropping pattern in Table 11.3.17. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the highest REY (15.33 t ha⁻¹) and the highest BCR (1.50) of all the combinations and the existing cropping pattern followed by T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) with REY (15.20 t ha⁻¹) and BCR (1.48) (Table 11.1.14.1; Table 11.3.15, Table 11.3.17).

Table 11.1.14.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Muktarpara, Rangpur in 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	91	5.20	85	1.50	3.83	97	5.30	273	14.33
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	91	5.20	82	1.45	3.70	97	5.30	270	14.20
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	89	6.20	85	1.50	3.83	97	5.30	271	15.33
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	89	6.20	82	1.45	3.70	97	5.30	268	15.20

Price: Rice-Tk. 18.41, Mustard-Tk. 46.98

2019-20: ii. T. aman rice-Potato-Boro rice cropping pattern

Results of T. aman rice and Boro rice are the same as T. aman rice-Mustard-Boro rice pattern described above (Table 11.1.14, Table 11.1.14.1). Potato variety Asterix was harvested on 23 February 2020 at 91 days with yield of 23.10 t ha⁻¹ (Table 11.1.15).

Table 11.1.15 Performance of T. aman rice-Potato-Boro rice cropping pattern at Muktarpara, Rangpur, 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	25.6.2019	20.07.2019	26	23.10.2019	117	5.20
		Binadhan-17	25.6.2019	20.07.2019	26	21.10.2019	115	6.20
2	Potato	Asterix	25.11.19	-	-	23.02.2020	91	23.10
3	Boro rice	Binadhan-14	20.02.2020	15.03.2020	25	20.06.2020	122	5.30

Field duration (excluding seedling age), crop yield and total rice equivalent yield of the cropwise variety combinations of the pattern T. amanrice-Potato-Boro rice are shown in Table 11.1.15.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.20 and that of the existing cropping pattern in Table 11.3.17. The cropwise variety combination T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) had the highest REY (25.43 t ha⁻¹) and the highest BCR (1.49) of all the other combinations and the existing cropping pattern followed by T. aman rice (Binadhan-7)-Potato (Asterix)-Boro rice (Binadhan-14) with REY (24.43 t ha⁻¹) and BCR (1.47) (Table 11.1.15.1; Table 11.3.20).

Table 11.1.15.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Potato-Boro rice cropping pattern for Muktarpara, Rangpur in 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Potato)		Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)		
T. aman rice (Binadhan-7)-Potato (Asterix)-Boro rice (Binadhan-14)	91	5.20	91	23.10	13.93	97	279	24.43
T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14)	89	6.20	91	23.10	13.93	97	277	25.43

Price: Rice-Tk. 18.41, Potato-Tk. 11.10

2020-21: i. T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-7 was harvested on 15 October 2020 at 115 DAS with yield of 5.35 t ha⁻¹ and Binadhan-17 on 14 October 2020 at 114 DAS with yield of 5.36 t ha⁻¹ (Table 11.1.16). Binasarisha-9 and BARI Sarisha-14 were harvested on 15 February 2021 and 10 February 2021 at 88 DAS and 82 DAS, respectively. Yield of Binasarisha-9 and BARI Sarisha-14 were 1.82 t ha⁻¹ and 1.72 t ha⁻¹, respectively. Binadhan-14 was harvested on 25 May, 2021 with duration of 121 days and yield of 5.60 t ha⁻¹.

Table 11.1.16 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Muktarpara, Rangpur, 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	25.06.2020	20.07.2020	25	15.10.2020	115	5.35
		Binadhan-17	25.06.2020	20.07.2020	25	14.10.2020	114	5.36
2	Mustard	Binasarisha-9	20.11.2020	-	-	15.02.2021	88	1.82
		BARI Sarisha-14	20.11.2020	-	-	10.02.2021	82	1.72
3	Boro rice	Binadhan-14	25.01.2021	19.02.21	26	25.05.2021	121	5.60

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Boro rice are shown in Table 11.1.16.1. The BCR of the cropwise variety combination of the improved pattern is shown in Table 11.3.16 and that of the existing cropping pattern in Table 11.3.17. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the highest REY (15.06 t ha⁻¹) and the highest BCR (1.56) of all the the other combinations and the existing cropping pattern followed by T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) with REY (15.05 t ha⁻¹) and BCR (1.53) (Table 11.1.16.1; Table 11.3.16).

Table 11.1.16.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Muktarpara, Rangpur in 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	90	5.35	88	1.82	4.10	95	5.60	273	15.05
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	90	5.35	82	1.72	3.87	95	5.60	267	14.82
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	89	5.36	88	1.82	4.10	95	5.60	272	15.06
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	89	5.36	82	1.72	3.87	95	5.60	266	14.83

Price: Rice-7tk. 22.07, Mustard-7tk. 49.68

2020-21: ii. T. aman rice-Potato-Boro rice cropping pattern

Results of T. aman rice and Boro are the same as T. aman rice-Mustard-Boro rice pattern described above (Table 11.1.16, Table 11.1.16.1). Potato variety Asterix was harvested on 12 February 2021 at 88 DAS with yield of 26.63 t ha⁻¹ (Table 11.1.17).

Table 11.1.17 Performance of T. aman rice-Potato-Boro rice cropping pattern at Muktarpara, Rangpur, 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	25.06.2020	19.07.2020	25	15.10.2020	115	5.35
		Binadhan-17	25.06.2020	19.07.2020	25	14.10.2020	114	5.36
2	Potato	Asterix	14.11.2020	-	-	12.02.2021	88	26.63
3	Boro rice	Binadhan-14	25.01.2021	19.02.2021	26	25.05.2021	121	5.60

Field duration (excluding seedling age), crop yield and total rice equivalent yield of the cropwise variety combinations of the pattern T. aman rice-Potato-Boro rice are shown in Table 11.1.17.1. The BCR of the cropwise variety combination of the improved pattern is shown in Table 11.3.21 and that of the existing cropping pattern in Table 11.3.17. The cropwise variety combination, T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) had the highest REY (24.12 t ha⁻¹) and the highest BCR (1.60) of all the other combinations and the existing cropping pattern followed by T. aman rice (Binadhan-7)-Potato (Asterix)-Boro rice (Binadhan-14) with REY (24.11 t ha⁻¹) and BCR (1.55) (Table 11.1.17.1, Table 11.3.21).

Table 11.1.17.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Potato-Boro rice cropping pattern for Muktarpara, Rangpur in 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Potato)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Potato (Asterix)-Boro rice (Binadhan-14)	90	5.35	88	26.63	13.16	95	5.60	273	24.11
T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14)	89	5.36	88	26.63	13.16	95	5.60	272	24.12

Price: Rice-Tk. 22.07, Potato-Tk. 10.90

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.18. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) showed the highest BCR (1.53) along with the highest NR and REY as well. Therefore, this combination was recommended for Rangpur sadar upazila although it took some more days than other two combinations for the improved T. aman rice-Mustard-Boro rice pattern.

Table 11.1.18 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Mustard-Boro rice cropping pattern at Rangpur sadar averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20				2020-21				Average			
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR
1	T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	273	14.33	90369.14	1.48	273	15.05	102760.15	1.53	273	14.69	96564.65	1.50
2	T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	270	14.2	90141.71	1.45	267	14.82	112085.58	1.54	269	14.51	101113.65	1.50
3	T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	271	15.33	93896.85	1.50	272	15.06	110541.94	1.56	272	15.20	102219.40	1.53
4	T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	268	15.2	81838.37	1.44	266	14.83	101488.60	1.54	267	15.02	91663.49	1.49

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.19. The cropwise variety combination T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) had the highest BCR (1.55) along with NR and REY along with the lowest FD (275 days). Therefore, this combination was recommended for Rangpur sadar upazila for the improved T. aman rice-Potato-Boro rice pattern.

Table 11.1.19 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Potato-Boro rice cropping pattern at Rangpur sadar averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20				2020-21				Average			
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR
1	T. aman rice (Binadhan-7)-Potato (Asterix)-Boro rice (Binadhan-14)	279	24.43	153315.53	1.47	273	24.11	180039.29	1.55	276	24.27	166677.41	1.51
2	T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14)	277	25.43	169249.52	1.49	272	24.12	209883.62	1.60	275	24.78	189566.57	1.55

Sunamganj: Bishwambharpur upazila

2018-19: T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-11 was harvested on 21 October 2018 at 113 DAS with yield of 4.80 t ha⁻¹, Binadhan-17 on 25 October 2018 at 117 DAS with yield of 6.10 t ha⁻¹ and BRRI dhan49 on 09 November 2018 at 132 DAS with yield of 5.00 t ha⁻¹ (Table 11.1.20). Binasarisha-4 was harvested on 11 February 2019 at 90 DAS with yield of 1.60 t ha⁻¹, Binasarisha-9 on 08 February 2019 at 87 DAS with yield 1.70 t ha⁻¹ and BARI Sarisha-16 on 06 February 2019 at 85 DAS with yield of 1.65 t ha⁻¹. Binadhan-14 was harvested on 05 May 2019 with duration of 120 days and yield of 5.50 t ha⁻¹ and BRRI dhan28 on 21 May 2019 with duration of 136 days and yield of 5.20 t ha⁻¹.

Table 11.1.20 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Bishwambharpur upazila of Sunamganj district, 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-11	01.07.18	26.07.18	26	21.10.18	113	4.80
		Binadhan-17	01.07.18	26.07.18	26	25.10.18	117	6.10
		BRRI dhan49	01.07.18	26.07.18	26	09.11.18	132	5.00
2	Mustard	Binasarisha-4	14.11.18	-	-	11.02.19	90	1.60
		Binasarisha-9	14.11.18	-	-	08.02.19	87	1.70
		BARI Sarisha-14	14.11.18			06.02.19	85	1.65
3	Boro rice	Binadhan-14	20.01.19	13.02.19	25	05.05.19	120	5.50
		BRRI dhan28	20.01.19	13.02.19	25	21.05.19	136	5.20

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Boro rice are shown in Table 11.1.20.1. The BCR of the cropwise variety combination of the improved pattern is shown in Table 11.3.28 and that of the existing cropping pattern in Table 11.3.31. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the highest REY (16.02 t ha⁻¹) followed by T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) with REY (15.89 t ha⁻¹). But T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro (Binadhan-14) had the highest BCR (1.50) followed by T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)- Boro (BRRI dhan28); T. aman rice (BRRI dhan49)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) and T. aman rice (BRRI dhan49)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan28) with BCR (1.48) (Table 11.3.28). The cropwise variety combination with the highest BCR had the second highest REY (15.89 t ha⁻¹). Therefore, the component varieties Binadhan-17 and BRRI dhan49 of T. aman rice; Binasarisha-9 and BARI Sarisha-14 of mustard and Binadhan-14 of Boro rice were selected for block demonstrations in the following two years. BRRI dhan28 was suggested to discard for its disease susceptibility.

Table 11.1.20.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Bishwambharpur upazila of Sunamganj district, 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-11)-Mustard (Binasarisha-4)-Boro rice (Binadhan-14)	88	4.80	90	1.60	4.16	95	5.50	273	14.46
T. aman rice (Binadhan-11)-Mustard (Binasarisha-4)-Boro rice (BRR1 dhan28)	88	4.80	90	1.60	4.16	111	5.20	289	14.16
T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	88	4.80	87	1.70	4.42	95	5.50	270	14.72
T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (BRR1 dhan28)	88	4.80	87	1.70	4.42	111	5.20	286	14.42
T. aman rice (Binadhan-11)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	88	4.80	85	1.65	4.29	95	5.50	268	14.59
T. aman rice (Binadhan-11)-Mustard (BARI Sarisha-14)-Boro rice (BRR1 dhan28)	88	4.80	85	1.65	4.29	111	5.20	284	14.29
T. aman rice (Binadhan-17)-Mustard (Binasarisha-4)-Boro rice (Binadhan-14)	92	6.10	90	1.60	4.16	95	5.50	277	15.76
T. aman rice (Binadhan-17)-Mustard (Binasarisha-4)-Boro rice (BRR1 dhan28)	92	6.10	90	1.60	4.16	111	5.20	293	15.46
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	92	6.10	87	1.70	4.42	95	5.50	274	16.02
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRR1 dhan28)	92	6.10	87	1.70	4.42	111	5.20	290	15.72
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	92	6.10	85	1.65	4.29	95	5.50	272	15.89
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRR1 dhan28)	92	6.10	85	1.65	4.29	111	5.20	288	15.59
T. aman rice (BRR1 dhan-49)-Mustard (Binasarisha-4)-Boro rice (Binadhan-14)	107	5.00	90	1.60	4.16	95	5.50	292	14.66

Table 11.1.20.1 Contd.

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (BRRI dhan-49)-Mustard (Binasarisha-4)-Boro rice (BRRI dhan28)	107	5.00	90	1.60	4.16	111	5.20	308	14.36
T. aman rice (BRRI dhan-49)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	107	5.00	87	1.70	4.42	95	5.50	289	14.92
T. aman rice (BRRI dhan-49)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan28)	107	5.00	87	1.70	4.42	111	5.20	305	14.62
T. aman (BRRI dhan-49)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	107	5.00	85	1.65	4.29	95	5.50	287	14.79
T. aman (BRRI dhan-49)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan28)	107	5.00	85	1.65	4.29	111	5.20	303	14.49

Price: Rice-Tk. 18.93, Mustard-Tk. 49.21

Sunamganj: Sadar upazila

2018-19: T. aman rice-Grass pea-Aus rice cropping pattern

Binadhan-11 was harvested on 20 October 2018 at 112 DAS with yield of 4.70 t ha⁻¹, Binadhan-17 on 23 October 2018 at 115 DAS with yield of 6.00 t ha⁻¹ and BRRI dhan49 on 07 November 2018 at 130 DAS with yield of 5.20 t ha⁻¹ (Table 11.1.21). Binakhesari-1 was harvested on 31 March 2019 at 106 DAS with yield of 1.50 t ha⁻¹ and BARI Khesari-4 on 07 April 2019 at 113 DAS with yield of 1.30 t ha⁻¹. Binadhan-19 was harvested on 31 July 2019 with duration of 101 days and yield of 4.60 t ha⁻¹ and BRRI dhan48 on 09 August 2019 with duration of 110 days and yield of 4.12 t ha⁻¹.

Table 11.1.21 Performance of T. aman rice-Grass pea-Aus rice cropping pattern at sadar upazila of Sunamganj district, 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-11	01.07.18	26.07.18	26	20.10.18	112	4.70
		Binadhan-17	01.07.18	26.07.18	26	23.10.18	115	6.00
		BRRI dhan49	01.07.18	26.07.18	26	07.11.18	130	5.20
2	Grass pea	Binakhesari-1	16.12.18	-	-	31.03.19	106	1.50
		BARI Khesari-4	16.12.18	-	-	07.04.19	113	1.30
3	Aus rice	Binadhan-19	20.04.19	13.05.19	24	31.07.19	101	4.60
		BRRI dhan48	20.04.19	13.05.19	24	09.08.19	110	4.12

Field duration (excluding seedling age), crop yield and total rice equivalent yield of the cropwise variety combinations of the pattern T. aman rice-Grass pea-Aus rice are shown in Table 11.1.21.1. The BCR of the cropwise variety combination of the improved pattern is shown in Table 11.3.23 and that of the existing cropping pattern in Table 11.3.26. The cropwise variety combination T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19) had the highest REY (14.17 t ha⁻¹) and the highest BCR (1.48) of all the other combinations and the existing cropping pattern. The variety combinations T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (BRRI dhan48) and T. aman rice (BRRI dhan49)-Grass pea (Binakhesari-1)-Aus rice (BRRI dhan48) had the second highest BCR (1.46). Therefore, the component varieties Binadhan-17 and BRRI dhan49 of T. aman rice; Binakhesari-1 and BARI BARI Khesari-4 of Grass pea and Binadhan-19 and BRRI dhan48 of Aus rice were selected for block demonstrations in the following two years.

Table 11.1.21.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Grass pea-Aus rice cropping pattern for sadar upazila of Sunamganj district, 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Grass pea)			Field duration and yield of 3 rd crop (Aus rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-11)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	87	4.70	106	1.50	3.57	77	4.60	270	12.87
T. aman rice (Binadhan-11)-Grass pea (Binakhesari-1)-Aus rice (BRR1 dhan48)	87	4.70	106	1.50	3.57	86	4.12	279	12.39
T. aman rice (Binadhan-11)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	87	4.70	113	1.30	3.10	77	4.60	277	12.40
T. aman rice (Binadhan-11)-Grass pea (BARI Khesari-4)-Aus rice (BRR1 dhan48)	87	4.70	113	1.30	3.10	86	4.12	286	11.92
T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	90	6.00	106	1.50	3.57	77	4.60	273	14.17
T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (BRR1 dhan48)	90	6.00	106	1.50	3.57	86	4.12	282	13.69
T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	90	6.00	113	1.30	3.10	77	4.60	280	13.70
T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (BRR1 dhan48)	90	6.00	113	1.30	3.10	86	4.12	289	13.22
T. aman rice (BRR1 dhan-49)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	105	5.20	106	1.50	3.57	77	4.60	288	13.37
T. aman rice (BRR1 dhan-49)-Grass pea (Binakhesari-1)-Aus rice (BRR1 dhan48)	105	5.20	106	1.50	3.57	86	4.12	297	12.89
T. aman rice (BRR1 dhan-49)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	105	5.20	113	1.30	3.10	77	4.60	295	12.90
T. aman rice (BRR1 dhan-49)-Grass pea (BARI Khesari-4)-Aus rice (BRR1 dhan48)	105	5.20	113	1.30	3.10	86	4.12	304	12.42

Price: Rice-Tk. 19.68, Grass pea-Tk. 46.88

Sunamganj: Bishwambharpur upazila

2019-20: T. aman rice-Mustard-Boro rice cropping pattern

Binadhan-17 was harvested on 03 November 2019 at 116 DAS with yield of 6.20 t ha⁻¹ and BRRI dhan49 on 18 November 2019 at 131 DAS with yield of 5.20 t ha⁻¹ (Table 11.1.22). Binasarisha-9 was harvested on 18 February 2020 at 89 DAS with yield of 1.55 t ha⁻¹ and BARI Sarisha-14 on 15 February 2020 at 86 DAS with yield of 1.50 t ha⁻¹. Binadhan-14 was harvested on 14 June 2020 with duration of 116 days with yield of 5.80 t ha⁻¹ (Table 11.1.22).

Table 11.1.22 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Bishwambharpur upazila of Sunamganj district, 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-17	11.07.19	02.08.19	23	03.11.19	116	6.20
		BRRI dhan49	11.07.19	02.08.19	23	18.11.19	131	5.20
2	Mustard	Binasarisha-9	22.11.19	-	-	18.02.2020	89	1.55
		BARI Sarisha-14	22.11.19	-	-	15.02.2020	86	1.50
3	Boro rice	Binadhan-14	20.02.2020	15.03.2020	25	14.06.2020	116	5.80

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Boro rice are shown in Table 11.1.22.1. The BCR of the cropwise variety combination of the improved pattern are shown in Table 11.3.29 and that of the existing cropping pattern in Table 11.3.31. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the highest REY (16.18 t ha⁻¹) and the highest BCR (1.48) of all the other combinations and the existing cropping pattern (Table 11.1.22.1; Table 11.3.29).

Table 11.1.22.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Bishwambharpur upazila of Sunamganj district, 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	93	6.20	89	1.55	4.18	91	5.80	273	16.18
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	93	6.20	86	1.50	4.04	91	5.80	270	16.04
T. aman rice (BRRI dhan-49)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	108	5.20	89	1.55	4.18	91	5.80	288	15.18
T. aman rice (BRRI dhan-49)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	108	5.20	86	1.50	4.04	91	5.80	285	15.04

Price: Rice-Tk. 17.08, Mustard-Tk. 44.76

Sunamganj: Sadar upazila

2019-20: T. aman rice-Grass pea-Aus rice cropping pattern

Binadhan-17 was harvested on 25 November 2019 at 118 DAS with yield of 6.30 t ha⁻¹ and BRRI dhan49 on 08 December 2019 at 131 DAS with yield of 5.20 t ha⁻¹ (Table 11.1.23). Binakhesari-1 was harvested on 29 March 2020 at 107 DAS with yield of 1.55 t ha⁻¹ and BARI Khesari-4 on 03 April 2020 at 112 DAS with yield of 1.32 t ha⁻¹. Binadhan-19 was harvested on 31 July 2020 with duration of 98 days and yield of 4.65 t ha⁻¹ and BRRI dhan48 on 13 August 2020 at 111 DAS with yield of 4.30 t ha⁻¹ (Table 11.1.23).

Table 11.1.23 Performance of T. aman rice-Grass pea-Aus rice cropping pattern at sadar upazila of Sunamganj district, 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-17	31.07.2019	24.08.2019	25	25.11.2019	118	6.30
		BRRI dhan49	31.07.2019	24.08.2019	25	08.12.2019	131	5.20
2	Grass pea	Binakhesari-1	13.12.2019	-	-	29.03.2020	107	1.55
		BARI Khesari-4	13.12.2019	-	-	03.04.2020	112	1.32
3	Aus rice	Binadhan-19	25.04.2020	14.05.2020	20	31.07.2020	98	4.65
		BRRI dhan48	25.04.2020	14.05.2020	20	13.08.2020	111	4.30

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Grass pea-Aus rice are shown in Table 11.1.23.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.24 and that of the existing cropping pattern in Table 11.3.26. The cropwise variety combination T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus (Binadhan-19) had the highest REY (14.71 t ha⁻¹) and the highest BCR (1.50) of all the other combinations and the existing cropping pattern (Table 11.1.23.1; Table 11.3.24).

Table 11.1.23.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Grass pea-Aus rice cropping pattern for sadar upazila of Sunamganj district, 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Grass pea)			Field duration and yield of 3 rd crop (Aus rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	93	6.30	107	1.55	3.76	78	4.65	278	14.71
T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (BRR1 dhan48)	93	6.30	107	1.55	3.76	91	4.30	291	14.36
T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	93	6.30	112	1.32	3.21	78	4.65	283	14.16
T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (BRR1 dhan48)	93	6.30	112	1.32	3.21	91	4.30	296	13.81
T. aman rice (BRR1 dhan-49)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	106	5.20	107	1.55	3.76	78	4.65	291	13.61
T. aman rice (BRR1 dhan-49)-Grass pea (Binakhesari-1)-Aus rice (BRR1 dhan48)	106	5.20	107	1.55	3.76	91	4.30	304	13.26
T. aman rice (BRR1 dhan-49)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	106	5.20	112	1.32	3.21	78	4.65	296	13.06
T. aman rice (BRR1 dhan-49)-Grass pea (BARI Khesari-4)-Aus rice (BRR1 dhan48)	106	5.20	112	1.32	3.21	91	4.30	309	12.71

Price: Rice-Tk. 20.05, Grass pea-Tk. 48.70

Sunamganj: Bishwambharpur upazila

2020-21: T. aman rice-Mustard-Boro rice pattern

Binadhan-17 was harvested on 28 October 2020 at 116 DAS with yield of 5.80 t ha⁻¹ and BRRI dhan49 on 13 November 2020 at 132 DAS with yield of 5.10 t ha⁻¹ (Table 11.1.24). Binasarisha-9 was harvested on 13 February 2021 at 88 DAS with yield of 1.65 t ha⁻¹ and BARI Sarisha-14 on 04 February 2021 at 79 DAS with yield of 1.70 t ha⁻¹. Binadhan-14 was harvested on 03 June 2021 with duration of 119 DAS with yield of 5.50 t ha⁻¹ (Table 11.1.24).

Table 11.1.24 Performance of T. aman rice-Mustard-Boro rice cropping pattern at Bishwambharpur upazila of Sunamganj district, 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-17	05.07.2020	29.07.2020	25	28.10.2020	116	5.80
		BRRI dhan49	05.07.2020	29.07.2020	25	13.11.2020	132	5.10
2	Mustard	Binasarisha-9	18.11.2020	-	-	13.02.2021	88	1.65
		BARI Sarisha-14	18.11.2020	-	-	04.02.2021	79	1.70
3	Boro rice	Binadhan-14	20.01.2021	13.02.2021	26	03.06.2020	119	5.50

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Boro are shown in Table 11.1.24.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.30 and that of the existing cropping pattern in Table 11.3.31. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) had the highest REY (15.40 t ha⁻¹) and the highest BCR (1.55) of all other combinations and the existing pattern (Table 11.1.24.1, 11.3.30, Table 11.3.31).

Table 11.1.24.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Boro rice cropping pattern for Bishwambharpur upazila of Sunamganj district, 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Boro rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	91	5.80	88	1.65	3.97	93	5.50	272	15.27
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	91	5.80	79	1.70	4.10	93	5.50	263	15.40
T. aman rice (BRR1 dhan-49)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	107	5.10	88	1.65	3.97	93	5.50	288	14.57
T. aman rice (BRR1 dhan-49)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	107	5.10	79	1.70	4.10	93	5.50	279	14.70

Price: Rice-Tk. 21.25, Mustard-Tk. 51.18

Sunamganj: Sadar upazila

2020-21: T. aman rice-Grass pea-Aus rice cropping pattern

Binadhan-17 was harvested on 24 November 2020 at 117 DAS with yield of 5.50 t ha⁻¹ and BRRI dhan49 on 08 December 2020 at 129 DAS with yield of 5.30 t ha⁻¹ (Table 11.1.25). Binakhesari-1 was harvested on 29 March 2021 at 106 DAS with yield of 1.50 t ha⁻¹ and BARI Khesari-4 on 02 April 2021 at 111 DAS with yield of 1.45 t ha⁻¹. Binadhan-19 was harvested on 05 August 2021 with duration of 103 days with yield of 4.70 t ha⁻¹ and BRRI dhan48 on 14 August 2021 with duration of 112 days and yield of 4.55 t ha⁻¹ (Table 11.1.25)

Table 11.1.25 Performance of T. aman rice-Grass pea- Aus rice cropping pattern at sadar upazila of Sunamganj district, 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-17	31.07.2020	23.08.2020	24	24.11.2020	117	5.50
		BRRI dhan49	31.07.2020	23.08.2020	24	08.12.2020	129	5.30
2	Grass pea	Binakhesari-1	15.12.2020	-	-	29.03.2021	106	1.50
		BARI Khesari-4	15.12.2020	-	-	02.04.2021	111	1.45
3	Aus rice	Binadhan-19	24.04.2020	15.05.2020	22	05.08.2021	103	4.70
		BRRI dhan48	24.04.2020	15.05.2020	22	14.08.2021	112	4.55

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Grass pea-Aus rice are shown in Table 11.1.25.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.25 and that of the existing cropping pattern in Table 11.3.26. The cropwise variety combination T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19) had the highest REY (13.49 t ha⁻¹) along with the highest BCR (1.58) of all other combinations and the existing cropping pattern followed by T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19) with REY (13.38 t/ha) and BCR (1.56) (Table 11.1.25.1, Table 11.3.25, Table 11.3.26).

Table 11.1.25.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Grass pea-Aus rice cropping pattern for sadar upazila of Sunamganj district, 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Grass pea)			Field duration and yield of 3 rd crop (Aus rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	93	5.50	106	1.50	3.29	81	4.70	280	13.49
T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (BRR1 dhan48)	93	5.50	106	1.50	3.29	90	4.55	289	13.34
T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	93	5.50	111	1.45	3.18	81	4.70	285	13.38
T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (BRR1 dhan48)	93	5.50	111	1.45	3.18	90	4.55	294	13.23
T. aman rice (BRR1 dhan-49)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	105	5.30	106	1.50	3.29	81	4.70	292	13.29
T. aman rice (BRR1 dhan-49)-Grass pea (Binakhesari-1)-Aus rice (BRR1 dhan48)	105	5.30	106	1.50	3.29	90	4.55	301	13.14
T. aman rice (BRR1 dhan-49)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	105	5.30	111	1.45	3.18	81	4.70	297	13.18
T. aman rice (BRR1 dhan-49)-Grass pea (BARI Khesari-4)-Aus rice (BRR1 dhan48)	105	5.30	111	1.45	3.18	90	4.55	306	13.03

Price: Rice-Tk. 22.50, Grass pea-Tk. 49.40

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.26. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) showed the highest BCR (1.51), REY (15.73 t ha⁻¹) but lower net return (Tk. 101005.81) and took the second longest FD (273 days). Therefore, the cropwise variety combination was recommended for the pattern T. aman rice-Mustard-Boro rice for Bishwambharpur upazila of Sunamganj district.

Table 11.1.1.26 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Mustard-Boro rice cropping pattern at Bishwambharpur, Sunamganj averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20					2020-21					Average		
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	
1	T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	273	16.18	94614.97	1.48	272	15.27	107396.65	1.53	273	15.73	101005.81	1.51	
2	T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	270	16.04	88233.69	1.44	263	15.40	118881.16	1.55	267	15.72	103557.43	1.50	
3	T. aman rice (BRR1 dhan-49)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14)	288	15.18	85493.81	1.46	288	14.57	93584.10	1.49	288	14.88	89538.96	1.48	
4	T. aman rice (BRR1 dhan-49)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14)	285	15.04	86829.61	1.45	279	14.70	101412.90	1.51	285	14.87	94121.26	1.48	

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.27. The cropwise variety combination T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus (Binadhan-19) showed the highest BCR (1.54) along with the highest net return (Tk. 104803.20) and REY (14.10 t ha⁻¹). Therefore, this cropwise variety combination was recommended for the improved pattern T. aman rice-Grass pea-Aus rice for sadar upazila of Sunamganj district.

Table 11.1.27 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Grass pea-Aus rice cropping pattern at Sunamganj sadar upazila averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20					2020-21					Average				
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR			
1	T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	278	14.71	96753.74	1.50	280	13.49	112852.65	1.58	279	14.10	104803.20	1.54			
2	T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (BRRI dhan48)	291	14.36	88861.82	1.48	289	13.34	103713.23	1.54	290	13.85	96287.53	1.51			
3	T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	283	14.16	90992.38	1.47	285	13.38	108353.74	1.56	284	13.77	99673.06	1.52			
4	T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (BRRI dhan48)	296	13.81	86036.14	1.44	294	13.23	103896.98	1.52	295	13.52	94966.56	1.48			
5	T. aman rice (BRRI dhan-49)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	291	13.61	87814.26	1.46	292	13.29	106116.96	1.55	292	13.45	96965.61	1.51			
6	T. aman rice (BRRI dhan-49)-Grass pea (Binakhesari-1)-Aus rice (BRRI dhan48)	304	13.26	81501.22	1.43	301	13.14	108483.22	1.54	303	13.20	94992.22	1.49			
7	T. aman rice (BRRI dhan-49)-Grass pea (BARI Khesari-1)-Aus rice (Binadhan-19)	296	13.06	85285.81	1.44	297	13.18	109895.24	1.55	297	13.12	97590.53	1.50			
8	T. aman rice (BRRI dhan-49)-Grass pea (BARI Khesari-4)-Aus rice (BRRI dhan48)	309	12.71	79807.07	1.42	306	13.03	110094.76	1.56	308	12.87	94950.92	1.49			

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2018-19: i. T. aman rice-Mustard-Aus rice cropping pattern

Binadhan-7 was harvested on 11 November 2018 at 115 DAS with yield of 5.63 t ha⁻¹, Binadhan-16 on 08 November 2018 at 112 DAS with yield of 6.34 t ha⁻¹ and Binadhan-17 on 13 November 2018 at 117 DAS with yield of 6.20 t ha⁻¹ (Table 11.1.28). Binasarisha-9 was harvested on 02 February 2019 at 85 DAS with yield of 1.65 t ha⁻¹ and BARI Sarisha-14 on 06 February 2019 at 82 DAS with yield of 1.70 t ha⁻¹ (Table 11.1.21), respectively. Aus rice varieties Binadhan-19 was harvested on 24 July 2019 at 106 DAS with yield of 4.90 t ha⁻¹ and BRRI dhan48 on 28 July 2019 at 110 DAS with yield of 4.34 t ha⁻¹ (Table 11.1.28).

Table 11.1.28 Performance of T. aman rice-Mustard-Aus rice cropping pattern at Kashiani, Gopalganj, 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	20.07.18	13.08.18	25	11.11.18	115	5.63
		Binadhan-16	20.07.18	13.08.18	25	08.11.18	112	6.34
		Binadhan-17	20.07.18	13.08.18	25	13.11.18	117	6.20
2	Mustard	Binasarisha-9	17.11.18	-	-	09.02.19	85	1.65
		BARI Sarisha-14	17.11.18	-	-	06.02.19	82	1.70
3	Aus rice	Binadhan-19	10.04.19	01.05.19	22	24.7.19	106	4.90
		BRRI dhan48	10.04.19	01.05.19	22	28.7.19	110	4.34

Field duration (excluding seedling age), crop yield and total rice equivalent yield of the cropwise variety combinations of the pattern T. aman rice-Mustard-Aus rice are shown in Table 11.1.28.1. The BCR of the cropwise variety combination of the improved pattern is shown in Table 11.3.33 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19) had the highest REY (15.53 t ha⁻¹). In contrast, T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Aus (Binadhan-19) had the highest BCR (1.51) of all other combinations and the existing pattern (Table 11.3.33, Table 11.3.36). Therefore, the component varieties Binadhan-16 and Binadhan-17 of T. aman rice; Binasarisha-9 and BARI Sarisha-14 of mustard were selected for block demonstrations in the following two years. But farmers preferred Jute instead of Aus rice. Therefore, jute was added in the pattern in the block demonstrations during 2019-20 and 2020-2021.

Table 11.1.28.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Aus rice cropping pattern for Kashiani, Gopalganj, 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Aus rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Aus rice (Binadhan-19)	90	5.63	85	1.65	4.16	84	4.90	259	14.69
T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Aus rice (BRRI dhan48)	90	5.63	85	1.65	4.16	88	4.34	263	14.13
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19)	90	5.63	82	1.70	4.29	84	4.90	256	14.82
T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Aus rice (BRRI dhan48)	90	5.63	82	1.70	4.29	88	4.34	260	14.26
T. aman rice (Binadhan-16)-Mustard (Binasarisha-9)-Aus rice (Binadhan-19)	87	6.34	85	1.65	4.16	84	4.90	256	15.40
T. aman rice (Binadhan-16)-Mustard (Binasarisha-9)-Aus rice (BRRI dhan48)	87	6.34	85	1.65	4.16	88	4.34	260	14.84
T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19)	87	6.34	82	1.70	4.29	84	4.90	253	15.53
T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Aus rice (BRRI dhan48)	87	6.34	82	1.70	4.29	88	4.34	257	14.97
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Aus rice (Binadhan-19)	92	6.20	85	1.65	4.16	84	4.90	261	15.26
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Aus rice (BRRI dhan48)	92	6.20	85	1.65	4.16	88	4.34	265	14.70
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19)	92	6.20	82	1.70	4.29	84	4.90	258	15.39
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Aus rice (BRRI dhan48)	92	6.20	82	1.70	4.29	88	4.34	262	14.83

Price: Rice-Tk. 18.53, Mustard-Tk. 46.72

2018-19: ii. T. aman rice-Lentil-Aus rice cropping pattern

The results of T. aman rice and Aus rice are same as T. aman rice-Mustard-Aus rice pattern of Kashiani upazila of Gopalganj, 2018-19 (Table 11.1.28). Lentil variety, Binamasur-8 was harvested on 14 March 2019 at 98 DAS with yield of 2.05 t ha⁻¹ and BARI Masur-8 on 02 April 2019 at 116 DAS with yield of 2.00 t ha⁻¹ (Table 11.1.29)

Table 11.1.29 Performance of T. aman rice-Lentil-Aus rice cropping pattern at Kashiani, Gopalganj, 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	20.07.18	13.08.18	25	11.11.18	115	5.63
		Binadhan-16	20.07.18	13.08.18	25	08.11.18	112	6.34
		Binadhan-17	20.07.18	13.08.18	25	13.11.18	117	6.20
2	Lentil	Binamasur-8	08.12.18	-	-	14.03.19	98	2.05
		BARI Masur-8	08.12.18	-	-	02.04.19	116	2.00
3	Aus rice	Binadhan-19	10.04.19	01.05.19	22	22.07.19	106	4.90
		BRRRI dhan48	10.04.19	01.05.19	22	28.07.19	110	4.34

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Aus rice are shown in Table 11.1.29.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.42 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-16)-Lentil (Binamasur-8)-Aus rice (Binadhan-19) had the highest REY (17.11 t ha⁻¹). In contrast, T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Aus (Binadhan-19) had the highest BCR (1.53) of all the other combinations and the existing pattern (Table 11.3.42, Table 11.3.36). Therefore, the component varieties Binadhan-16 and Binadhan-17 of T. aman rice; Binamasur-8 and BARI Masur-8 of lentil were selected for block demonstrations in the following two years. But farmers preferred Jute instead of Aus rice. Therefore, jute was added in the pattern in the block demonstrations during 2019-20 and 2020-21.

Table 11.1.29.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Lentil-Aus rice cropping pattern for Kashiani, Gopalganj, 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Lentil)			Field duration and yield of 3 rd crop (Aus rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Lentil (Binamasur-8)-Aus rice (Binadhan-19)	90	5.63	98	2.05	5.87	84	4.90	272	16.40
T. aman rice (Binadhan-7)-Lentil (Binamasur-8)-Aus rice (BRRI dhan48)	90	5.63	98	2.05	5.87	88	4.34	276	15.84
T. aman rice (Binadhan-7)-Lentil (BARI Masur-8)-Aus rice (Binadhan-19)	90	5.63	116	2.00	5.72	84	4.90	290	16.25
T. aman rice (Binadhan-7)-Lentil (BARI Masur-8)-Aus rice (BRRI dhan48)	90	5.63	116	2.00	5.72	88	4.34	294	15.69
T. aman rice (Binadhan-16)-Lentil (Binamasur-8)-Aus rice (Binadhan-19)	87	6.34	98	2.05	5.87	84	4.90	269	17.11
T. aman rice (Binadhan-16)-Lentil (Binamasur-8)-Aus rice (BRRI dhan48)	87	6.34	98	2.05	5.87	88	4.34	273	16.55
T. aman rice (Binadhan-16)-Lentil (BARI Masur-8)-Aus rice (Binadhan-19)	87	6.34	116	2.00	5.72	84	4.90	287	16.96
T. aman rice (Binadhan-16)-Lentil (BARI Masur-8)-Aus rice (BRRI dhan48)	87	6.34	116	2.00	5.72	88	4.34	291	16.40
T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Aus rice (Binadhan-19)	92	6.20	98	2.05	5.87	84	4.90	274	16.97
T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Aus rice (BRRI dhan48)	92	6.20	98	2.05	5.87	88	4.34	278	16.41
T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Aus rice (Binadhan-19)	92	6.20	116	2.00	5.72	84	4.90	292	16.82
T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Aus rice (BRRI dhan48)	92	6.20	116	2.00	5.72	88	4.34	296	16.26

Price: Rice-Tk. 18.53, Lentil-Tk. 53.02

2018-19: iii. T. aman rice-Grass pea-Aus rice cropping pattern

The results of T. aman rice and Aus rice are same as T. aman rice-Mustard-Aus pattern of Kashiani upazila of Gopalganj, 2018-19 (Table 11.1.28). Binakhesari-1 was harvested on 10 April 2019 at 114 DAS with yield of 1.48 t ha⁻¹ and BARI Khesari-4 on 04 April 2019 at 108 DAS with yield of 1.50 t ha⁻¹ (Table 11.1.30).

Table 11.1.30 Performance of T. aman rice-Grass pea-Aus rice cropping pattern at Kashiani, Gopalganj, 2018-19

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-7	20.07.18	13.08.18	25	11.11.18	115	5.63
		Binadhan-16	20.07.18	13.08.18	25	08.11.18	112	6.34
		Binadhan-17	20.07.18	13.08.18	25	13.11.18	117	6.20
2	Grass pea	Binakhesari-1	18.12.18	-	-	10.04.19	114	1.48
		BARI Khesari-4	18.12.18	-	-	04.04.19	108	1.50
3	Aus rice	Binadhan-19	10.04.19	01.05.19	22	22.07.19	106	4.90
		BRRI dhan48	10.04.19	01.05.19	22	28.07.19	110	4.34

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Grass pea-Aus rice are shown in Table 11.1.30.1. The BCR of the cropwise variety combination of the improved pattern is shown in Table 11.3.38 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-16)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19) had the highest REY (15.00 t ha⁻¹). In contrast, T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus (Binadhan-19) had the highest BCR (1.49) of all the combinations and the existing pattern (Table 11.3.38, Table 11.3.36). Therefore, the component varieties Binadhan-16 and Binadhan-17 of T. aman rice; Binakhesari-1 and BARI Khesari-4 of grass pea were selected for block demonstrations in the following two years. But farmers preferred Jute instead of Aus rice. Therefore, jute was added in the pattern in the block demonstrations during 2019-20 and 2020-21.

Table 11.1.30.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Grass pea-Aus rice cropping pattern for Kashiani, Gopalganj, 2018-19

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Grass pea)			Field duration and yield of 3 rd crop (Aus rice)		Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)		
T. aman rice (Binadhan-7)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	90	5.63	114	1.48	3.71	84	4.90	288	14.24
T. aman rice (Binadhan-7)-Grass pea (Binakhesari-1)-Aus rice (BRRI dhan48)	90	5.63	114	1.48	3.71	88	4.34	292	13.68
T. aman rice (Binadhan-7)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	90	5.63	108	1.50	3.76	84	4.90	282	14.29
T. aman rice (Binadhan-7)-Grass pea (BARI Khesari-4)-Aus rice (BRRI dhan48)	90	5.63	108	1.50	3.76	88	4.34	286	13.73
T. aman rice (Binadhan-16)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	87	6.34	114	1.48	3.71	84	4.90	285	14.95
T. aman rice (Binadhan-16)-Grass pea (Binakhesari-1)-Aus rice (BRRI dhan48)	87	6.34	114	1.48	3.71	88	4.34	289	14.39
T. aman rice (Binadhan-16)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	87	6.34	108	1.50	3.76	84	4.90	279	15.00
T. aman rice (Binadhan-16)-Grass pea (BARI Khesari-4)-Aus rice (BRRI dhan48)	87	6.34	108	1.50	3.76	88	4.34	283	14.44
T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19)	92	6.20	114	1.48	3.71	84	4.90	290	14.81
T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (BRRI dhan48)	92	6.20	114	1.48	3.71	88	4.34	294	14.25
T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19)	92	6.20	108	1.50	3.76	84	4.90	284	14.86
T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Aus rice (BRRI dhan48)	92	6.20	108	1.50	3.76	88	4.34	288	14.30

Price: Rice-Tk. 18.53, Grass pea-Tk. 46.48

2019-20: i. T. aman rice-Mustard-Jute cropping pattern

Binadhan-16 was harvested on 04 November 2019 at 103 DAS with yield of 5.90 t ha⁻¹ and Binadhan-17 on 16 November 2019 at 115 DAS with yield of 6.00 t ha⁻¹ (Table 11.1.31). Binasarisha-9 was harvested on 23 February 2020 at 88 DAS with yield of 1.69 t ha⁻¹ and BARI Sarisha-14 on 17 February 2020 at 83 DAS with yield of 1.65 t ha⁻¹ (Table 11.1.24). Jute variety JRO-524 was harvested on 12 August 2020 at 130 DAS with yield of 2.70 t ha⁻¹ (Table 11.1.31).

Table 11.1.31 Performance of T. aman rice-Mustard-Jute cropping pattern at Kashiani, Gopalganj, 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-16	23.07.2019	17.08.2019	26	04.11.2019	103	5.90
		Binadhan-17	23.07.2019	17.08.2019	26	16.11.2019	115	6.00
2	Mustard	Binasarisha-9	27.11.2019	-	-	23.02.2020	88	1.69
		BARI Sarisha-14	27.11.2019	-	-	17.02.2020	83	1.65
3	Jute	JRO-524	05.04.2020	-	-	12.08.2020	130	2.70

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Jute are shown in Table 11.1.31.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.34 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524) had the highest REY (17.92 t ha⁻¹) along with the highest BCR (1.49) of all the other combinations and the existing cropping pattern (Table 11.1.31.1, Table 11.3.34).

Table 11.1.31.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Jute cropping pattern for Kashiani, Gopalganj, 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Jute)			Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)		
T. aman rice (Binadhan-16)-Mustard (Binasarisha-9)-Jute (JRO-524)	77	5.90	88	1.69	4.48	130	2.70	7.44	295	17.82
T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Jute (JRO-524)	77	5.90	83	1.65	4.37	130	2.70	7.44	290	17.71
T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524)	89	6.00	88	1.69	4.48	130	2.70	7.44	307	17.92
T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Jute (JRO-524)	89	6.00	83	1.65	4.37	130	2.70	7.44	302	17.81

Price: Rice-Tk. 16.90, Mustard-Tk. 44.80, Jute-Tk. 46.60

2019-20: ii. T. aman rice-Lentil-Jute cropping pattern

The results of T. aman rice and Jute are the same as T. aman rice-Mustard-Jute pattern of Gopalganj in 2019-20 (Table 11.1.31). Lentil varieties Binamasur-8 and BARI Masur-8 were harvested on 28 February 2020 at 102 DAS with yield of 2.18 t ha⁻¹ and BARI Masur-8 on 08 March 2020 at 110 DAS with yield of 2.20 t ha⁻¹ (Table 11.1.32).

Table 11.1.32 Performance of T. aman rice-Lentil-Jute cropping pattern at Kashiani, Gopalganj, 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-16	23.07.2019	17.08.2019	26	04.11.2019	103	5.90
		Binadhan-17	23.07.2019	17.08.2019	26	16.11.2019	115	6.00
2	Lentil	Binamasur-8	21.11.2019	-	-	28.02.2020	102	2.18
		BARI Masur-8	21.11.2019	-	-	08.03.2020	110	2.20
3	Jute	JRO-524	05.04.2020	-	-	12.08.2020	130	2.70

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Lentil-Aus rice are shown in Table 11.1.32.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.43 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Jute (JRO-524) had the highest REY (20.04 t ha⁻¹). In contrast, T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) had the highest BCR (1.57) of all the other combinations and the existing cropping pattern (Table 11.3.25, Table 11.3.43).

Table 11.1.32.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Lentil-Jut cropping pattern for Kashiani, Gopalganj, 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Lentil)			Field duration and yield of 3 rd crop (Jute)			Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)		
T. aman rice (Binadhan-16)-Lentil (Binamasur-8)-Jute (JRO-524)	77	5.90	102	2.18	6.54	130	2.70	7.44	309	19.88
T. aman rice (Binadhan-16)-Lentil (BARI Masur-8)-Jute (JRO-524)	77	5.90	110	2.20	6.60	130	2.70	7.44	317	19.94
T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524)	89	6.00	102	2.18	6.54	130	2.70	7.44	321	19.98
T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Jute (JRO-524)	89	6.00	110	2.20	6.60	130	2.70	7.44	329	20.04

Price: Rice-Tk. 16.90, Lentil-Tk.50.69, Jute-Tk. 46.60

2019-20: iii. T. aman rice-Grass pea-Jute cropping pattern

The results of T. aman rice and Jute are the same as T. aman rice-Mustard-Jute pattern of Gopalganj in 2019-20 (Table 11.1.31). Grass pea varieties Binakhesari-1 and BARI Khesari-4 were harvested on 16 March 2020 at 109 DAS with yield of 1.95 t ha⁻¹ and BARI Khesari-4 on 11 March 2020 at 104 DAS with yield of 1.55 t ha⁻¹ (Table 11.1.33).

Table 11.1.33 Performance of T. aman rice-Grass pea-Jute cropping pattern at Kashiani, Gopalganj, 2019-20

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-16	23.07.2019	17.08.2019	26	04.11.2019	103	5.90
		Binadhan-17	23.07.2019	17.08.2019	26	16.11.2019	115	6.00
2	Grass pea	Binakhesari-1	28.11.2019	-	-	16.03.2020	109	1.95
		BARI Khesari-4	28.11.2019	-	-	11.03.2020	104	1.55
3	Jute	JRO-524	05.04.2020	-	-	12.08.2020	130	2.70

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Grass pea-Aus rice are shown in Table 11.1.33.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.39 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) ranked the top (19.04 t ha⁻¹) in terms of total REY along with the highest BCR (1.52) of all the other combinations and the existing cropping pattern (Table 11.1.33.1, Table 11.3.39, Table 11.3.36).

Table 11.1.33.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Grass pea-Jute cropping pattern for Kashiani, Gopalganj, 2019-20

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Grass pea)			Field duration and yield of 3 rd crop (Jute)			Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)		
T. aman rice (Binadhan-16)- Grass pea (Binakhesari-1)- Jute (JRO-524)	77	5.90	109	1.95	5.60	130	2.70	7.44	316	18.94
T. aman rice (Binadhan-16)- Grass pea (BARI Khesari-4)- Jute (JRO-524)	77	5.90	104	1.55	4.45	130	2.70	7.44	311	17.79
T. aman rice (Binadhan-17)- Grass pea (Binakhesari-1)- Jute (JRO-524)	89	6.00	109	1.95	5.60	130	2.70	7.44	328	19.04
T. aman rice (Binadhan-17)- Grass pea (BARI Khesari-4)- Jute (JRO-524)	89	6.00	104	1.55	4.45	130	2.70	7.44	323	17.89

Price: Rice-Tk. 16.90, Grass pea-Tk. 48.48, Jute-Tk. 46.60

2020-21: i. T. aman rice-Mustard-Jute cropping pattern

Binadhan-16 was harvested on 01 November 2020 at 104 DAS with yield of 5.90 t ha⁻¹ and Binadhan-17 on 10 November 2020 at 113 DAS with yield of 6.15 t ha⁻¹ (Table 11.1.34). Binasarisha-9 was harvested on 17 February 2021 at 87 DAS with yield of 1.65 t ha⁻¹ and BARI Sarisha-14 on 15 February 2021 at 85 DAS with yield of 1.70 t ha⁻¹ (Table 11.1.34). Jute variety JRO-524 was harvested on 09 August 2021 at 123 DAS with yield of 2.79 t ha⁻¹ (Table 11.1.34).

Table 11.1.34 Performance of T. aman rice-Mustard-Jute cropping pattern at Kashiani, Gopalganj, 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-16	20.07.2020	15.8.2020	27	01.11.2020	104	6.29
		Binadhan-17	20.07.2020	15.8.2020	27	10.11.2020	113	6.15
2	Mustard	Binasarisha-9	23.11.2020	-	-	17.02.2021	87	1.65
		BARI Sarisha-14	23.11.2020	-	-	15.02.2021	85	1.70
3	Jute	JRO-524	08.04.2021	-	-	09.08.2021	123	2.79

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Mustard-Jute are shown in Table 11.1.34.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.35 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Jute (JRO-524) had the highest REY (16.89 t ha⁻¹). In contrast, T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524) had the highest BCR (1.55) of all the other combinations and the existing pattern (Table 11.1.34.1, Table 11.3.35, Table 11.3.36).

Table 11.1.34.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Mustard-Jute cropping pattern for Kashiani, Gopalganj, 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Mustard)			Field duration and yield of 3 rd crop (Jute)			Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)		
T. aman rice (Binadhan-16)- Mustard (Binasarisha-9)- Jute (JRO-524)	79	6.29	87	1.65	3.58	123	2.79	6.91	289	16.78
T. aman rice (Binadhan-16)- Mustard (BARI Sarisha-14)- Jute (JRO-524)	79	6.29	85	1.70	3.69	123	2.79	6.91	287	16.89
T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)- Jute (JRO-524)	88	6.15	87	1.65	3.58	123	2.79	6.91	298	16.64
T. amanrice (Binadhan-17)- Mustard (BARI Sarisha-14)- Jute (JRO-524)	88	6.15	85	1.70	3.69	123	2.79	6.91	296	16.75

Price: Rice-Tk. 21.60, Mustard-Tk. 46.93, Jute-Tk. 53.50

2020-21: ii. T. aman rice-Lentil-Jute cropping pattern

The results of T. aman rice and Jute are same as T. aman rice-Mustard-Jute pattern of Gopalganj in 2020-21 (Table 11.1.34). Binamasur-8 was harvested on 08 March 2021 at 100 DAS with yield of 2.12 t ha⁻¹ and BARI Masur-8 on 18 March 2021 at 111 DAS with yield of 2.15 t ha⁻¹ (Table 11.1.35).

Table 11.1.35 Performance of T. aman rice-Lentil-Jute cropping pattern at Kashiani, Gopalganj, 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-16	20.7.2020	13.8.2020	25	01.11.2020	104	6.29
		Binadhan-17	20.7.2020	13.8.2020	25	10.11.2020	113	6.15
2	Lentil	Binamasur-8	28.11.2020	-	-	08.03.2021	100	2.12
		BARI Masur-8	28.11.2020	-	-	18.03.2021	111	2.15
3	Jute	JRO-524	08.04.2021	-	-	09.08.2021	123	2.79

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Lentil-Jute are shown in Table 11.1.35.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.44 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-16)-Lentil (BARI Masur-8)-Jute (JRO-524) had the highest REY (19.07 t ha⁻¹). In contrast, T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) had the highest BCR (1.57) of all the other combinations and the existing pattern (Table 11.1.35.1, Table 11.3.44, Table 11.3.36).

Table 11.1.35.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Lentil-Jute cropping pattern for Kashiani, Gopalganj, 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Lentil)			Field duration and yield of 3 rd crop (Jute)			Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)		
T. aman rice (Binadhan-16)-Lentil (Binamasur-8)-Jute (JRO-524)	79	6.29	100	2.12	5.79	123	2.79	6.91	302	18.99
T. aman rice (Binadhan-16)-Lentil (BARI Masur-8)-Jute (JRO-524)	79	6.29	111	2.15	5.87	123	2.79	6.91	313	19.07
T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524)	88	6.15	100	2.12	5.79	123	2.79	6.91	311	18.85
T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Jute (JRO-524)	88	6.15	111	2.15	5.87	123	2.79	6.91	322	18.93

Price: Rice-Tk. 21.60, Lentil-Tk. 58.97, Jute-Tk. 53.50

2020-21: iii. T. aman rice-Grass pea-Jute cropping pattern

The results of T. aman rice and Jute are same as T. aman rice-Mustard-Jute pattern of Gopalganj in 2020-21 (Table 11.1.34). Binakhesari-1 was harvested on 19 March 2021 at 109 DAS with yield of 1.77 t ha⁻¹ and BARI Khesari-4 on 20 March 2021 at 110 DAS with yield of 1.75 t ha⁻¹ (Table 11.1.36).

Table 11.1.36 Performance of T. aman rice-Grass pea-Jute cropping pattern at Kashiani, Gopalganj, 2020-21

Sl.	Component Crops	Variety	Date of sowing	Date of transplanting	Age of seedling (days)	Date of harvest	Crop duration (days)	Yield (t ha ⁻¹)
1	T. aman rice	Binadhan-16	13.8.2020	13.8.2020	25	01.11.2020	104	6.29
		Binadhan-17	13.8.2020	13.8.20	25	10.11.2020	113	6.15
2	Grass pea	Binakhesari-1	-		-	19.03.2021	109	1.77
		BARI Khesari-4	-		-	20.03.2021	110	1.75
3	Jute	JRO-524	-		-	09.08.2021	123	2.79

Field duration (excluding seedling age), crop yield and total REY of the cropwise variety combinations of the pattern T. aman rice-Grass pea-Jute are shown in Table 11.1.36.1. The BCR of the cropwise variety combinations of the improved pattern are shown in Table 11.3.40 and that of the existing cropping pattern in Table 11.3.36. The cropwise variety combination T. aman rice (Binadhan-16)-Grass pea (Binakhesari-1)-Jute (JRO-524) had the highest REY (17.19 t ha⁻¹). Incontrast, T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) had the highest BCR (1.61) of all the other combinations and the existing cropping pattern (Table 11.1.36.1, Table 11.3.40, Table 11.3.36).

Table 11.1.36.1 Field duration, crop yield and rice equivalent yield of different variety combinations of the T. aman rice-Grass pea-Jute cropping pattern for Kashiani, Gopalganj, 2020-21

Crop variety combinations	Field duration and yield of 1 st crop (T. aman rice)		Field duration and yield of 2 nd crop (Grass pea)			Field duration and yield of 3 rd crop (Jute)			Total field duration in the pattern (days)	Total rice equivalent yield (t ha ⁻¹) in the pattern
	Field duration (days)	Yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)	Field duration (days)	Yield (t ha ⁻¹)	Rice equivalent yield (t ha ⁻¹)		
T. aman rice (Binadhan-16)- Grass pea (Binakhesari-1)- Jute (JRO-524)	79	6.29	109	1.77	3.99	123	2.79	6.91	311	17.19
T. aman rice (Binadhan-16)- Grass pea (BARI Khesari-4)- Jute (JRO-524)	79	6.29	104	1.75	3.95	123	2.79	6.91	306	17.15
T. aman rice (Binadhan-17)- Grass pea (Binakhesari-1)- Jute (JRO-524)	88	6.15	109	1.77	3.99	123	2.79	6.91	320	17.05
T. aman rice (Binadhan-17)- Grass pea (BARI Khesari-4)- Jute (JRO-524)	88	6.15	104	1.75	3.95	123	2.79	6.91	315	17.01

Price: Rice-Tk.21.60, Grass pea-Tk. 48.74, Jute-Tk. 53.50

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.37. The cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524) showed the highest BCR (1.52) and net return (Tk. 102352.90) (Table 11.1.37). Therefore, this combination was recommended for the improved pattern T. aman rice-Mustard-Jute for Kashiani upazila of Gopalganj district.

Table 11.1.37 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Mustard-Jute cropping pattern at Kashiani, Gopalganj averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20					2020-21					Average				
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR			
1	T. aman rice (Binadhan-16)-Mustard (Binasarisha-9)-Jute (JRO-524)	295	17.82	91775.53	1.46	289	16.78	108613.36	1.52	292	17.30	100194.45	1.49			
2	T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Jute (JRO-524)	290	17.71	91072.34	1.44	287	16.89	108915.06	1.51	289	17.30	99993.70	1.48			
3	T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524)	307	17.92	93129.79	1.49	298	16.64	111576.00	1.55	303	17.28	102352.90	1.52			
4	T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Jute (JRO-524)	302	17.81	91946.56	1.47	296	16.75	107756.91	1.51	299	17.28	99851.74	1.49			

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.38. The cropwise variety combination T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) showed the highest BCR (1.54), the highest net return (Tk. 118349.40). Therefore, this combination was recommended for the improved pattern T. aman rice-Lentil-Jute for Kashiani upazila of Gopalganj district.

Table 11.1.38 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Lentil-Jute cropping pattern at Kashiani, Gopalanj averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20					2020-21					Average				
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR			
1	T. aman rice (Binadhan-16)-Lentil (Binamasur-8)-Jute (JRO-524)	309	19.88	97242.83	1.47	302	18.99	123423.82	1.55	306	19.44	110333.33	1.51			
2	T. aman rice (Binadhan-16)-Lentil (BARI Masur-8)-Jute (JRO-524)	317	19.94	100783.24	1.49	313	19.07	120872.86	1.55	315	19.51	110828.05	1.52			
3	T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524)	321	19.98	104384.04	1.51	311	18.85	132314.76	1.57	316	19.42	118349.40	1.54			
4	T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Jute (JRO-524)	329	20.04	100362.83	1.47	322	18.93	125387.88	1.54	326	19.49	112875.36	1.51			

The average FD, REY, NR and BCR over 2019-20 and 2020-21 are shown in Table 11.1.39. The cropwise variety combination T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) showed the highest net return (Tk. 115747.20) and the second highest REY (18.05 t ha⁻¹). Therefore, this combination was recommended for the improved pattern T. aman rice-Grass pea-Jute for Kashiani upazila of Gopalganj district.

Table 11.1.39 Field duration, Rice Equivalent Yield, Net Return and BCR for T. aman rice-Grass pea-Jute cropping pattern at Kashiani, Gopalanj averaged over 2019-20 and 2020-21

Sl.	Pattern	2019-20				2020-21				Average			
		FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR	FD (days)	REY (t ha ⁻¹)	NR (Tk.)	BCR
1	T. aman rice (Binadhan-16)-Grass pea (Binakhesari-1)-Jute (JRO-524)	316	18.94	96515.01	1.50	311	17.19	120163.37	1.58	314	18.07	108339.19	1.54
2	T. aman rice (Binadhan-16)-Grass pea (BARI Khesari-4)-Jute (JRO-524)	311	17.79	94185.77	1.48	306	17.15	113695.10	1.55	309	17.47	103940.44	1.52
3	T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524)	328	19.04	102635.56	1.52	320	17.05	128858.84	1.61	324	18.05	115747.20	1.57
4	T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Jute (JRO-524)	323	17.89	93610.77	1.47	315	17.01	120269.53	1.58	319	17.45	106940.15	1.53

11.2 Dissemination of four crops based cropping pattern

Average yield of Binasarisha-9 was 1.45 t ha⁻¹ at 91 DAS, Binapatshak-1 3.40 t ha⁻¹ at 36 DAS, Binadhan-19 was 4.90 t ha⁻¹ at 102 DAS and Binadhan-11 was 4.18 t ha⁻¹ at 113 DAS (Table 11.2.1).

Table 11.2.1 Performance of early T. Aman rice-Mustard-Patshak-Aus rice cropping pattern at 13 upazilas of Mymensingh during 2021-22

Sl.	Upazilla	1 st crop (Mustard var. Binasarisha-9)		2 nd crop (Patshak var. Binapakshak-1)		3 rd crop (Aus rice var. Binadhan-19)		4 th crop (T. aman rice var. Binadhan-11)	
		Duration (days)	Yield (t ha ⁻¹)	Duration (days)	Yield (t ha ⁻¹)	Duration (days)	Yield (t ha ⁻¹)	Duration (days)	Yield (t ha ⁻¹)
1	Mymensingh Sadar	96	1.50	36	3.20	99	5.10	111	5.50
2	Ishwarganj	88	1.35	37	3.60	101	4.70	115	5.20
3	Gouripur	87	1.40	33	3.00	102	4.80	112	5.40
4	Nandail	89	1.48	38	3.50	104	5.00	110	5.30
5	Tarakanda	86	1.50	34	3.70	105	4.90	113	4.80
6	Phulpur	97	1.35	36	2.80	103	4.20	114	5.00
7	Haluaghat	90	1.45	39	3.50	98	5.10	115	5.10
8	Dhobaora	93	1.42	35	3.60	100	4.10	114	5.20
9	Trishal	89	1.55	34	3.80	106	5.40	115	5.00
10	Bhaluka	91	1.30	33	3.30	105	5.20	112	5.20
11	Gafargaon	95	1.40	38	3.20	103	5.10	113	5.50
12	Fulbaria	88	1.60	37	3.60	101	5.10	112	5.20
13	Muktagacha	92	1.55	33	3.40	103	5.00	113	5.00
	Average	91	1.45	36	3.40	102	4.90	113	5.18

Duration of Binasarisha-9 ranged between 86-95 days with an average of 91 days (Table 11.2.1) and yield ranged between 1.30 to 1.60 t ha⁻¹ with an average of 1.45 t ha⁻¹. Duration of Binapatshak-1 ranged between 33-39 days having average of 36 days while yield ranged between 2.80-3.80 t ha⁻¹ with an average of 3.40 t ha⁻¹. Similarly, Binadhan-19 had durations between 98-106 days having an average of 102 days. Yield of Binadhan-19 ranged between 4.10 to 5.40 t ha⁻¹ with an average of 4.90 t ha⁻¹. Finally, duration of Binadhan-11 ranged from 110 to 115 days with an average of 113 days and yield ranged from 4.80 to 5.50 t ha⁻¹ with an average of 5.18 t ha⁻¹ (Table 11.2.1).

11.3 Component-2 (Agricultural Economics Division)

11.3.1 Profitability of improved three crops based (T. aman rice-Mustard-Boro rice) cropping pattern and existing two crops based (T. aman rice-Fallow-Boro rice) cropping pattern for sadar, Mymensingh

Profitability is one of the major criteria for determination of acceptance of a crop variety by the farmers. Most of the farmers in the study areas sold their grain just after harvest. The total return from crop production consists of the values of crop yield and straw. It was revealed that at Char Ghagra, Mymensingh sadar upazila rice equivalent yield (REY), total return, total variable cost, total cost, gross margin, net return and benefit cost ratio (BCR) were different for different combinations of the varieties of the component crops and from year to year during 2018-19, 2019-20, 2020-21 and base year 2017-18 (Table 11.3.1, Table 11.3.2, Table 11.3.3, Table 11.3.4).

The highest total return (Tk. 336002.33 ha⁻¹) was obtained from T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) variety combinations in 2020-21 and was Tk. 298314.25 ha⁻¹ in 2018-19 (Table 11.3.3, Table 11.3.1). In 2019-20, the highest total return (Tk. 303586.61 ha⁻¹) was found in T. aman rice (BRRI dhan71)-Mustard (BARI Sarisha14)-Boro rice (Binadhan-14) variety combinations (Table 11.3.2). In the existing pattern, the highest total return (Tk. 181266.33 ha⁻¹) was observed in T. aman rice (Haridhan)-Fallow-Boro rice (BRRI dhan28) variety combinations in base year 2017-18. The lowest total return (Tk. 167187.18 ha⁻¹) was also recorded from existing pattern T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combinations in base year 2017-18 (Table 11.3.4).

The maximum total cost (Tk. 211176.89 ha⁻¹) was observed in T. aman rice (BRRI dhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combinations in 2020-21 (Table 11.3.3). In 2018-19, it was Tk. 201582.48 ha⁻¹ in T. aman rice (Binadhan-17)-Mustard (Binasarisha-7)-Boro rice (BRRI dhan28) (Table 11.3.1). The maximum total cost (Tk. 200763.41 ha⁻¹) was found in T. aman rice (BRRI dhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combinations in 2019-20 (Table 11.3.2). In the existing pattern, the highest total cost (Tk. 151638.62 ha⁻¹) was observed in T. aman rice (Haridhan)-Fallow-Boro rice (BRRI dhan28) and the lowest total cost (Tk. 139044.11 ha⁻¹) was recorded in T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combinations in base year 2017-18.

Gross margin was the highest (Tk. 194067.65 ha⁻¹) in T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) variety combinations in 2020-21 and was Tk. 160015.41 ha⁻¹ in 2018-19 (Table 11.3.3 and Table 11.3.1). In 2019-20, the highest gross margin (Tk. 161550.63 ha⁻¹) was found in T. aman rice (BRRI dhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combinations (Table 11.3.2). In the existing pattern, the highest gross margin (Tk. 76591.93 ha⁻¹) was observed in T. aman rice (Haridhan)-Fallow-Boro rice (Hybrid-99) and the lowest gross margin (Tk. 69598.49 ha⁻¹) was recorded in T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combinations in base year 2017-18 (Table 11.3.4).

The highest net return (Tk. 131610.44 ha⁻¹) was obtained from T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) variety combinations in 2020-21 and was Tk. 101711.86 ha⁻¹ in 2018-19 (Table 11.3.3, Table 11.3.1). In 2019-20, the highest net return (Tk. 102823.20 ha⁻¹) was found in T. aman rice (BRRI dhan71)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combinations (Table 11.3.2). In the existing pattern, the highest net return (Tk. 33326.74 ha⁻¹) was observed in T. aman rice (Haridhan)-Fallow-Boro rice (Hybrid-99) and the lowest net return (Tk. 28143.07 ha⁻¹) was recorded in T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combinations in base year 2017-18 (Table 11.3.4).

The highest benefit cost ratio (BCR) was obtained from variety combinations of T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (1.64) in 2020-21 and 1.51 in 2018-19 (Table 11.3.3 and Table 11.3.1). In 2019-20, the highest BCR was 1.53 in T. aman rice (BRRI dhan71)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) variety combinations (Table 11.3.2). In the existing pattern, the highest BCR was 1.23 observed in T. aman rice (Haridhan)-Fallow-Boro rice (Hybrid-99) and the lowest BCR was obtained from T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combinations (1.19) in base year 2017-18 (Table 11.3.4).

Table 11.3.1 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Mymensingh sadar during 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-11	Binasarisha-7	Binadhan-14	15.78	276116.68	129930.11	187228.87	146186.57	88887.82	1.47
Binadhan-11	Binasarisha-9	Binadhan-14	17.05	298314.25	138298.84	196602.39	160015.41	101711.86	1.51
Binadhan-11	BARI Sarisha-14	Binadhan-14	16.59	290410.78	139800.24	199080.82	150610.54	90380.73	1.46
Binadhan-11	Binasarisha-7	BRRRI dhan28	15.72	275183.57	130024.80	188624.42	145158.78	86559.15	1.46
Binadhan-11	Binasarisha-9	BRRRI dhan28	16.30	285291.86	138374.59	196225.14	146917.27	89066.72	1.45
Binadhan-11	BARI Sarisha-14	BRRRI dhan28	16.64	291227.78	140065.35	199940.54	151162.42	91287.23	1.46
Binadhan-17	Binasarisha-7	Binadhan-14	16.34	285890.22	141694.07	199002.93	144196.15	86887.29	1.44
Binadhan-17	Binasarisha-9	Binadhan-14	16.32	285569.94	140003.43	195999.33	145566.52	89570.62	1.46
Binadhan-17	BARI Sarisha-14	Binadhan-14	16.69	292138.13	139087.95	196771.57	153050.19	95366.57	1.48
Binadhan-17	Binasarisha-7	BRRRI dhan28	16.48	293711.84	141731.94	201582.48	151979.90	92129.35	1.46
Binadhan-17	Binasarisha-9	BRRRI dhan28	16.21	283588.95	140095.40	196249.82	143493.55	87339.13	1.45
Binadhan-17	BARI Sarisha-14	BRRRI dhan28	16.34	291259.57	139087.95	197094.57	152171.63	94165.01	1.48
BRRRI dhan71	Binasarisha-7	Binadhan-14	16.31	285429.08	138340.44	196198.79	147088.64	88229.90	1.45
BRRRI dhan71	Binasarisha-9	Binadhan-14	16.05	280848.04	135508.46	190716.31	145339.58	90131.73	1.47
BRRRI dhan71	BARI Sarisha-14	Binadhan-14	16.95	296670.61	142035.97	200463.41	154634.63	95506.48	1.48
BRRRI dhan71	Binasarisha-7	BRRRI dhan28	16.31	285429.08	138340.44	196198.79	147088.64	88229.90	1.45
BRRRI dhan71	Binasarisha-9	BRRRI dhan28	16.06	280848.04	135508.46	190716.31	145339.58	90131.73	1.47
BRRRI dhan71	BARI Sarisha-14	BRRRI dhan28	16.95	296670.61	142035.97	200963.41	154634.63	95506.48	1.48

Source: Field survey, 2018-19

Selling price (Tk. kg⁻¹): Aman rice -16.75, Boro rice-18.25, Mustard-46.63, REY including by-product

Table 11.3.2 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Mymensingh sadar during 2019-20

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-11	Binasarisha-9	Binadhan-14	16.22	294815.08	138298.84	196602.39	156516.24	98212.69	1.50
Binadhan-11	BARI Sarisha-14	Binadhan-14	16.26	295602.53	139800.24	199080.82	155802.29	96521.71	1.48
BRRI dhan71	Binasarisha-9	Binadhan-14	16.05	290970.37	135508.46	190716.31	155461.90	100254.06	1.53
BRRI dhan71	BARI Sarisha-14	Binadhan-14	16.70	303586.61	142035.97	200763.41	161550.63	102823.20	1.51

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-17.25, Boro rice-19.10, Mustard- 47.88, REY including by-product

Table 11.3.3 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Mymensingh sadar during 2020-21

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-11	Binasarisha-9	Binadhan-14	15.92	336002.33	141934.68	204391.89	194067.65	131610.44	1.64
Binadhan-11	BARI Sarisha-14	Binadhan-14	15.41	325055.69	142413.50	205289.66	182642.19	119766.04	1.58
BRRI dhan71	Binasarisha-9	Binadhan-14	15.33	323430.59	140503.85	202275.00	182926.74	121155.59	1.60
BRRI dhan71	BARI Sarisha-14	Binadhan-14	15.91	335697.97	146951.65	211176.89	188746.33	124521.08	1.59

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.15, Boro rice-21.05, Mustard- 48, REY including by-product

Table 11.3.4 Profitability analysis of farmers existing cropping pattern (T. aman rice-Fallow-Boro rice) at Mymensingh sadar during base year 2017-18

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Fallow	Boro rice							
Haridhan	Fallow	BRR1 dhan28	9.76	181266.33	109888.79	151638.62	71377.55	29627.71	1.20
Haridhan	Fallow	Hybrid-99	9.74	181052.27	104460.34	147725.53	76591.93	33326.74	1.23
Kironmala	Fallow	BRR1 dhan28	9.33	173416.18	101457.47	141719.79	71958.71	31696.39	1.22
Kironmala	Fallow	Hybrid-99	9.01	167187.18	97588.69	139044.11	69598.49	28143.07	1.19

Source: Field survey, 2017-18

Selling price (Tk. kg⁻¹): Aman rice-17.50, Boro rice-19.66, REY including by-product

11.3.2 Comparative profitability of improved three crops cropping pattern with existing two crops based cropping pattern for sadar, Mymensingh

Based on three years observation (2018-19, 2019-20 and 2020-21), comparative profitability of the patterns are presented in Table 11.3.5. Improved cropping pattern attributed a remarkable change on total return, total cost, gross margin, net return and benefit cost ratio (BCR) than the existing cropping pattern (Base year 2017-18).

The improved cropping pattern showed its superiority over farmers' existing pattern during three consecutive years of cropping. In three years of cropping, according to BCR, the best profitable improved cropping pattern was T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (1.64) than the existing pattern T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) (1.23) (Table 11.3.5, Fig. 11.3.2) in sadar, Mymensingh.

Total return of the best improved pattern was Tk. 336002.33 ha⁻¹ which was 85% higher than farmers' existing pattern of Tk. 181052.27 ha⁻¹. The total cost of the improved pattern (Tk. 204391.89 ha⁻¹) was higher than farmers' existing pattern (Tk. 147725.53 ha⁻¹) due to introduction of mustard in fallow land and cost of fertilizer and other inputs. The gross margin was higher in the improved pattern (Tk. 194067.65 ha⁻¹) than farmers' existing pattern (Tk. 76591.93 ha⁻¹).

The net return was substantially higher in the improved pattern (Tk. 131610.44 ha⁻¹) than farmers' existing pattern (Tk. 33326.74 ha⁻¹) (Table 11.3.5) (Fig. 11.3.1). Due to inclusion of mustard as an extra crop in between T. aman rice and Boro rice, net return increased by 295% over farmers' existing pattern.

Table 11.3.5 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at sadar, Mymensingh

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Mustard	Boro rice					
2018-19	Improved pattern	Binadhan-11	Binasarisha-9	Binadhan-14	298314.25	196602.39	160015.41	101711.86	1.51
2019-20		BRRIdhan71	Binasarisha-9	Binadhan-14	290970.37	190716.31	155461.90	100254.06	1.53
2020-21		Binadhan-11	Binasarisha-9	Binadhan-14	336002.33	204391.89	194067.65	131610.44	1.64
Base year (2017-18)	Existing pattern	Haridhan	Fallow	Hybrid-99	181052.27	147725.53	76591.93	33326.74	1.23

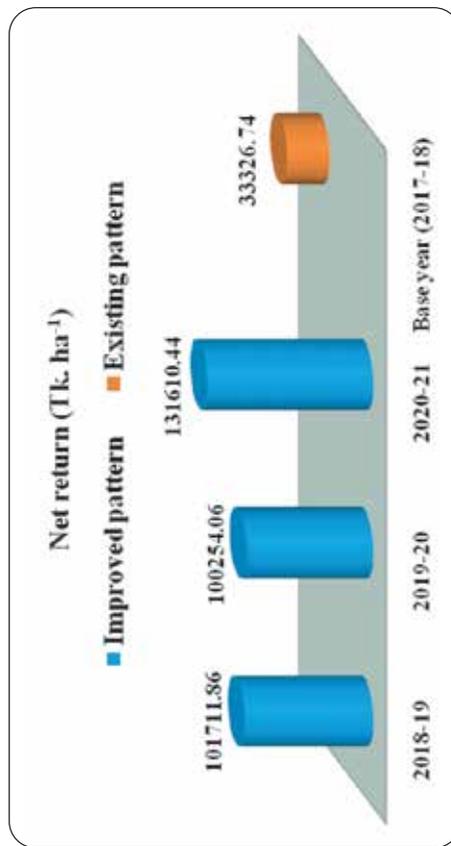


Fig: 11.3.1 Net return of improved and existing cropping patterns in different years at Mymensingh

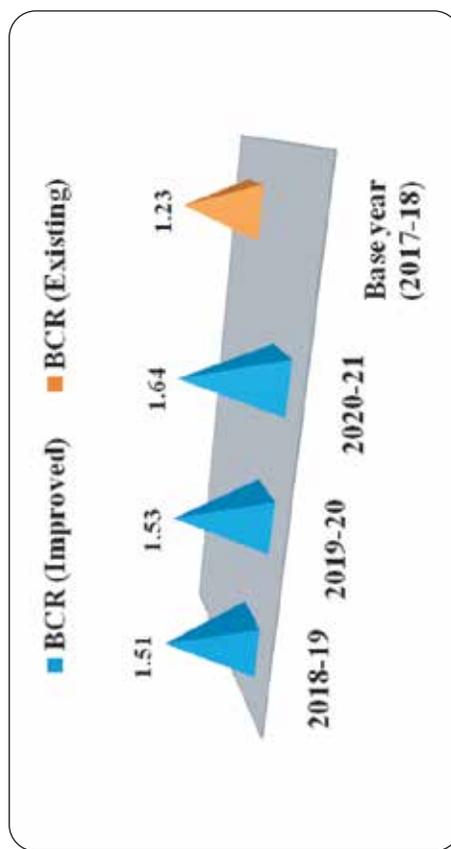


Fig: 11.3.2 BCR of improved and existing cropping patterns in different years at Mymensingh

11.3.3 Profitability of improved four crops based (T. aman rice-Mustard-Patshak-Aus rice) cropping pattern and existing two crops based (T. aman rice-Fallow-Boro rice) cropping pattern for sadar, Mymensingh

Profitability of four crops based T. aman rice-Mustard-Patshak-Aus rice and existing two crops based T. aman rice-Fallow-Boro rice variety combinations at Char Ghagra, Sadar, Mymensingh during 2019-20, 2020-21 and base year 2017-18 are shown in Table 11.3.6, Table 11.3.7, Table 11.3.4.

The farmers had the highest total return (Tk. 383344.37 ha⁻¹) from the variety combination T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) in 2020-21 and Tk. 346781.74 ha⁻¹ in 2019-20 (Table 11.3.7, Table 11.3.6). In the existing pattern, the highest total return (Tk. 181266.33 ha⁻¹) was observed in T. aman rice (Haridhan)-Fallow-Boro rice (BRRRI dhan28) variety combination in the base year 2017-18. The lowest total return (Tk. 167187.18 ha⁻¹) was also recorded from existing pattern T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combination in the base year 2017-18 (Table 11.3.4).

In 2020-21 and 2019-20, the highest total cost was Tk. 213460.51 ha⁻¹ and Tk. 210303.20 ha⁻¹ respectively, were found in T. aman rice (Binadhan-11)-Mustard (BARI Sarisha-14)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) (Table 11.3.7, Table 11.3.6). In the existing pattern, the highest total cost (Tk. 151638.62 ha⁻¹) was observed in T. aman rice (Haridhan)-Fallow-Boro rice (BRRRI dhan28) and the lowest total cost (Tk. 139044.11 ha⁻¹) was recorded in T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combination in the base year 2017-18 (Table 11.3.4).

Gross margin were the highest (Tk. 217233.19 ha⁻¹) in T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) in 2020-21 and Tk.191866.70 ha⁻¹ in 2019-20 (Table 11.3.7, Table 11.3.6). In the existing pattern, the highest gross margin (Tk. 76591.93 ha⁻¹) was observed in T. aman rice (Haridhan)-Fallow-Boro rice (Hybrid-99) and the lowest gross margin (Tk. 69598.49 ha⁻¹) was recorded in T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combination in the base year 2017-18 (Table 11.3.4).

The highest net return were obtained from variety combination T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) (Tk. 156530.58 ha⁻¹) in 2020-21 and Tk. 132918.54 ha⁻¹ in 2019-20 (Table 11.3.7, Table 11.3.6). In the existing pattern, the highest net return (Tk. 33326.74 ha⁻¹) was observed in T. aman rice (Haridhan)-Fallow-Boro rice (Hybrid-99) and the lowest net return (Tk. 28143.07 ha⁻¹) was recorded in T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combination in the base year 2017-18 (Table 11.3.4).

The benefit cost ratio (BCR) was the highest in the variety combinations T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) 1.82 and 1.70 in 2020-21 and 2019-20, respectively (Table 11.3.7 and Table 11.3.6). In the existing pattern, the highest BCR was 1.23 observed in T. aman rice (Haridhan)-Fallow-Boro rice (Hybrid-99) and the lowest BCR obtained was in T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) variety combination (1.19) in the base year 2017-18 (Table 11.3.4).

Table 11.3.6 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Patshak-Aus rice cropping pattern for Mymensingh sadar during 2019-20

T. aman rice	Cropwise variety combinations			REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Patshak	Aus rice							
Binadhan-11	Binasarisha-9	Binapatshak-1	Binadhan-19	17.90	346781.74	145484.37	203446.54	191866.70	132918.54	1.70
Binadhan-11	BARI Sarisha-14	Binapatshak-1	Binadhan-19	17.25	334073.42	147994.80	210303.20	181306.62	120189.72	1.59
BRRJ dhan71	Binasarisha-9	Binapatshak-1	Binadhan-19	17.13	331814.85	146997.07	203974.69	181767.78	125109.66	1.63
BRRJ dhan71	BARI Sarisha-14	Binapatshak-1	Binadhan-19	17.01	329482.89	151020.07	208360.78	178129.82	119765.62	1.58

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-18.25, Aus rice-20.50, Mustard- 47.88, Patshak-15, REY including by-product

Table 11.3.7 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Patshak-Aus rice cropping pattern for Mymensingh sadar during 2020-21

T. aman rice	Cropwise variety combinations			REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Patshak	Aus rice							
Binadhan-11	Binasarisha-9	Binapatshak-1	Binadhan-19	17.76	383344.37	149641.52	210227.46	217233.19	156530.58	1.82
Binadhan-11	BARI Sarisha-14	Binapatshak-1	Binadhan-19	16.98	366517.04	148648.11	213460.51	208655.44	145734.03	1.72
BRRJ dhan71	Binasarisha-9	Binapatshak-1	Binadhan-19	16.85	363679.83	148643.54	208478.88	203544.29	144509.96	1.74
BRRJ dhan71	BARI Sarisha-14	Binapatshak-1	Binadhan-19	17.35	374376.20	151335.31	210365.78	208957.38	148903.42	1.78

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.50, Aus rice-21.66, Mustard-49.75, Patshak-15.10, REY including by-product

11.3.4 Comparative profitability of improved four crops cropping patterns with existing two crops based cropping patterns for sadar, Mymensingh

Four crops based improved cropping pattern showed its superiority over farmers' existing cropping pattern during two consecutive years of cropping. In two years, according to BCR, the best profitable improved cropping pattern was T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) (1.82) than the existing pattern T. aman rice (Kironmala)-Fallow-Boro rice (Hybrid-99) (1.23) (Table 11.3.8, Fig. 11.3.4).

Total return of the best improved pattern was Tk. 383344.37 ha⁻¹ which was 112% higher than the farmers' existing cropping pattern of Tk. 181052.27 ha⁻¹. The total cost of the improved cropping pattern (Tk. 210227.46 ha⁻¹) was higher than farmers' existing cropping pattern (Tk. 147725.53 ha⁻¹) due to introduction of mustard and patshak in fallow land and cost of fertilizer and other inputs. The gross margin was higher in the improved pattern (Tk. 217233.19 ha⁻¹) than farmers' existing cropping pattern (Tk. 76591.93 ha⁻¹).

The net return was much higher in the improved cropping pattern (Tk. 156530.58 ha⁻¹) than farmers' existing cropping pattern (Tk. 33326.74 ha⁻¹) (Table 11.3.8, Fig. 11.3.3). Due to inclusion of mustard and patshak as extra crops in between T. aman rice and Aus rice, net return increased by 369% over farmers' existing cropping pattern.

Table 11.3.8 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at sadar, Mymensingh

Year	Parameters						Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Mustard	Patshak	Aus rice						
2019-20	Improved pattern	Binadhan-11	Binasarisha-9	Binapakshak-1	Binadhan-19		346781.74	203946.54	191866.70	132918.54	1.70
2020-21		Binadhan-11	Binasarisha-9	Binapakshak-1	Binadhan-19		383344.37	210227.46	217233.19	156530.58	1.82
Base year (2017-18)	Existing pattern	Haridhan	Fallow		Hybrid-99		181052.27	147725.53	76591.93	33326.74	1.23

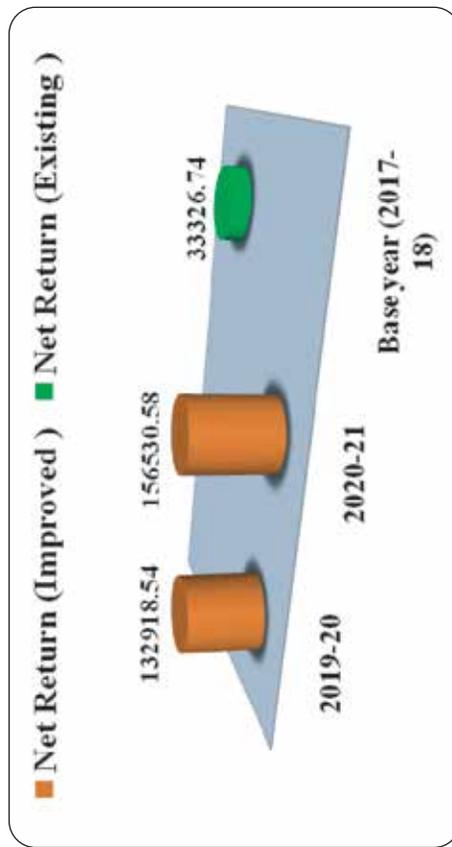


Fig: 11.3.3 Net return (Tk. ha⁻¹) of improved and existing cropping patterns in different years at Mymensingh

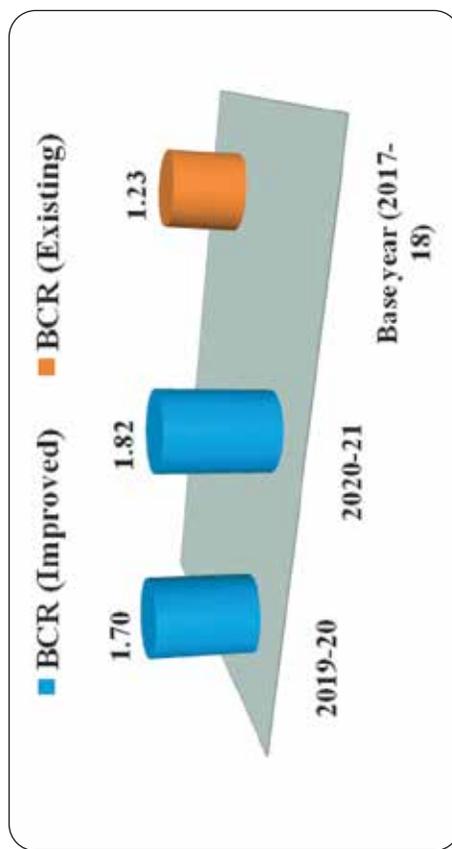


Fig: 11.3.4 BCR of improved and existing cropping patterns in different years at Mymensingh

11.3.5 Profitability of improved three crops based (T. aman rice-Mustard-Boro rice) cropping pattern and existing two crops based (T. aman rice-Fallow-Boro rice) cropping pattern for Nalitabari, Sherpur

Profitability of three crops based improved cropping pattern T. aman rice-Mustard-Boro rice over two crops based existing cropping pattern T. aman rice-Fallow-Boro rice at Nalitabari, Sherpur during 2018-19, 2019-20, 2020-21 and base year 2017-18 are shown in Table 11.3.9, Table 11.3.10, Table 11.3.11, Table 11.3.12. Most of the farmers in the study area sold their grain just after harvest.

The variety combination T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) had the highest total return (Tk. 316958.63 ha⁻¹) in 2020-21 followed by Tk. 293320.73 ha⁻¹ and Tk. 292011.63 ha⁻¹ in 2018-19 and 2019-20, respectively (Table 11.3.11, Table 11.3.9, Table 11.3.10). The highest total return (Tk. 187308.33 ha⁻¹) was observed in T. aman rice (Tulsimala)-Fallow-Boro rice (Tejgold) variety combinations in the base year 2017-18 for existing pattern. The lowest total return (Tk. 166910.25 ha⁻¹) was also recorded from the existing cropping pattern T. aman rice (Pajam)-Fallow-Boro rice (Hybrid-777) variety combination in the base year 2017-18 (Table 11.3.12).

The highest total cost (Tk. 199689.04 ha⁻¹) was observed in T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combination in 2020-21 and Tk. 198899.71 ha⁻¹ in 2019-20 (Table 11.3.11, Table 11.3.10). In 2018-19, it was Tk. 198415.70 ha⁻¹ in T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58) variety combination (Table 11.3.9). In the existing cropping pattern, the highest total cost (Tk. 150725.75 ha⁻¹) was observed in T. aman rice (Tulsimala)-Fallow-Boro rice (Hybrid-777) and the lowest total cost (Tk. 141850.95 ha⁻¹) was recorded in T. aman rice (Pajam)-Fallow-Boro rice (Dhanigold) variety combination in the base year 2017-18 (Table 11.3.12).

The highest gross margin was Tk. 173676.67 ha⁻¹ in T. aman rice (Binadhan-7)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) variety combination in 2020-21 and Tk. 149867.50 ha⁻¹ in 2018-19 for T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) (Table 11.3.11, Table 11.3.9). In 2019-20, it was Tk. 147995.22 ha⁻¹ in T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) (Table 11.3.10).

In the existing cropping pattern, the highest gross margin (Tk. 78112.60 ha⁻¹) was observed in T. aman rice (Tulsimala)-Fallow-Boro rice (Tejgold) and the lowest gross margin (Tk. 63405.55 ha⁻¹) was recorded in T. aman rice (Chinisail)-Fallow-Boro rice (Dhanigold) variety combination in the base year 2017-18 (Table 11.3.12).

The highest net return was Tk. 119081.17 ha⁻¹ from T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) variety combination in 2020-21 (Table 11.3.11). In 2019-20, the highest net return (Tk. 102453.37 ha⁻¹) was found in T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58) (Table 11.3.10) and in 2018-19, it was (Tk. 97096.63 ha⁻¹) found in T. aman rice (Binadhan-17)-Mustard

(Binasarisha-9)-Boro rice (Binadhan-14) (Table 11.3.9). In the existing cropping pattern, the highest net return (Tk. 47669.78 ha⁻¹) was observed in T. aman rice (Pajam)-Fallow-Boro rice (Dhanigold) and the lowest net return (Tk. 22622.35 ha⁻¹) was recorded in T. aman rice (Chinisail)-Fallow-Boro rice (Dhanigold) variety combination in the base year 2017-18 (Table 11.3.112).

The highest benefit cost ratio (BCR) was obtained from variety combination of T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) (1.62) in 2020-21 (Table 11.3.11). In 2019-20, the highest BCR (1.54) was found in T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan58) variety combination (Table 11.3.10). The highest BCR was 1.52 in T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) variety combination in 2018-19 (Table 11.3.9). In the existing cropping pattern, the highest BCR was 1.25 observed in T. aman rice (Tulsimala)-Fallow-Boro rice (Tejgold) and the lowest BCR obtained was from in T. aman rice (Chinisail)-Fallow-Boro rice (Dhanigold) variety combination (1.15) in the base year 2017-18 (Table 11.3.12).

Table 11.3.9 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Nalitabari, Sherpur in 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-7	Binasarisha-7	Binadhan-14	15.97	274635.18	133626.98	188265.05	141008.20	86370.14	1.46
Binadhan-7	Binasarisha-9	Binadhan-14	15.41	265022.49	130495.36	183356.75	134527.12	81665.73	1.45
Binadhan-7	BARI Sarisha-14	Binadhan-14	15.93	273997.10	139502.07	194136.61	134495.03	79860.49	1.41
Binadhan-7	Binasarisha-7	BRR1 dhan58	16.02	275524.38	138789.07	194279.48	136735.31	80969.18	1.42
Binadhan-7	Binasarisha-9	BRR1 dhan58	16.08	276568.15	138985.39	194132.92	137582.75	82435.23	1.42
Binadhan-7	BARI Sarisha-14	BRR1 dhan58	16.50	283761.83	140966.56	194686.60	142795.27	88874.99	1.46
Binadhan-17	Binasarisha-7	Binadhan-14	15.08	259360.35	131755.22	183787.26	127605.14	75573.09	1.41
Binadhan-17	Binasarisha-9	Binadhan-14	16.58	285223.25	135355.75	188126.62	149867.50	97096.63	1.52
Binadhan-17	BARI Sarisha-14	Binadhan-14	17.05	293320.73	143848.13	198147.11	149472.61	95173.63	1.48
Binadhan-17	Binasarisha-7	BRR1 dhan58	16.26	279752.82	141161.81	195669.56	138591.01	84083.27	1.43
Binadhan-17	Binasarisha-9	BRR1 dhan58	15.83	272337.62	137049.08	189407.61	135288.54	82930.01	1.44
Binadhan-17	BARI Sarisha-14	BRR1 dhan58	16.65	286465.11	144843.46	198415.70	141621.65	88049.41	1.44
BRR1 dhan49	Binasarisha-7	Binadhan-14	14.40	247699.83	125159.66	177426.69	122540.17	70273.15	1.40
BRR1 dhan49	Binasarisha-9	Binadhan-14	15.09	259491.61	122243.63	172636.86	137247.99	86854.75	1.50
BRR1 dhan49	BARI Sarisha-14	Binadhan-14	15.86	272729.17	130479.30	182327.99	142249.87	90401.18	1.50
BRR1 dhan49	Binasarisha-7	BRR1 dhan58	14.98	257588.07	127683.82	179936.21	129904.25	77651.86	1.43
BRR1 dhan49	Binasarisha-9	BRR1 dhan58	15.18	261066.18	131810.33	184507.06	129255.85	76559.12	1.41
BRR1 dhan49	BARI Sarisha-14	BRR1 dhan58	15.60	268247.61	130734.57	181620.10	137513.05	86627.52	1.48

Source: Field survey, 2018-19
Selling price (Tk. kg⁻¹): Aman rice-16.25, Boro rice-18.16, Mustard- 43.30, REY including by-product

Table 11.3.10 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Nalitabari, Sherpur in 2019-20

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-7	Binasarisha-9	Binadhan-14	14.42	265036.53	130572.77	183221.23	135759.57	82868.73	1.45
Binadhan-7	BARI Sarisha-14	Binadhan-14	14.96	274951.97	139502.07	193261.58	133408.23	78773.69	1.42
Binadhan-7	Binasarisha-9	BRRI dhan58	15.17	278804.24	140181.10	196306.54	138623.15	82497.70	1.42
Binadhan-7	BARI Sarisha-14	BRRI dhan58	14.78	271609.43	140966.56	187359.42	130642.87	84250.02	1.45
Binadhan-17	Binasarisha-9	Binadhan-14	15.17	278847.56	134698.63	187546.84	144148.93	91300.72	1.49
Binadhan-17	BARI Sarisha-14	Binadhan-14	15.89	292011.63	144016.42	198899.71	147995.22	93111.93	1.47
Binadhan-17	Binasarisha-9	BRRI dhan58	15.51	285135.40	136941.02	187503.72	148194.38	97631.68	1.52
Binadhan-17	BARI Sarisha-14	BRRI dhan58	15.91	292453.99	144843.46	190000.62	147610.53	102453.37	1.54

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-17.83, Boro rice-18.93, Mustard-44.13, REY including by-product

Table 11.3.11 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Nalitabari, Sherpur in 2020-21

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-7	Binasarisha-9	Binadhan-14	14.32	304637.17	134541.52	193331.48	170095.65	111305.69	1.58
Binadhan-7	BARI Sarisha-14	Binadhan-14	14.69	312377.41	139502.07	195857.07	172875.34	117127.16	1.59
Binadhan-7	Binasarisha-9	BRRI dhan58	14.79	314617.93	140941.27	196153.09	173676.67	118464.85	1.60
Binadhan-7	BARI Sarisha-14	BRRI dhan58	14.18	301784.60	140966.56	193487.59	160818.04	108297.01	1.56
Binadhan-17	Binasarisha-9	Binadhan-14	14.55	309415.36	136364.81	193388.14	173050.55	116027.22	1.60
Binadhan-17	BARI Sarisha-14	Binadhan-14	14.90	316958.63	144076.52	199689.04	172882.11	117269.60	1.59
Binadhan-17	Binasarisha-9	BRRI dhan58	14.57	309816.22	138010.83	190735.04	171805.38	119081.17	1.62
Binadhan-17	BARI Sarisha-14	BRRI dhan58	14.36	305511.56	144843.46	196098.08	160668.10	109413.48	1.56

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.37, Boro rice-21.17, Mustard-44.58, REY including by-product

Table 11.3.12 Profitability analysis of farmers existing pattern (T. aman rice-Fallow-Boro rice) at Nalitabari, Sherpur during base year, 2017-18

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Fallow	Boro rice							
Tulisimala	Fallow	Tejgold	8.12	187308.33	109195.74	149583.20	78112.60	37725.13	1.25
Tulisimala	Fallow	Dhanigold	8.03	185241.77	108853.58	150150.18	76388.18	35091.59	1.23
Tulisimala	Fallow	Hybrid-777	7.66	176709.50	109894.75	150725.75	66164.75	25364.25	1.17
Chinisail	Fallow	Tejgold	7.53	173734.31	103732.53	142099.35	70001.79	31634.96	1.22
Chinisail	Fallow	Dhanigold	7.36	169760.80	106460.25	147405.45	63405.55	22622.35	1.15
Chinisail	Fallow	Hybrid-777	7.44	171603.25	107098.13	146709.77	64505.12	24893.48	1.17
Pajam	Fallow	Tejgold	7.88	181705.55	106669.17	147002.05	75036.38	34703.50	1.24
Pajam	Fallow	Dhanigold	7.52	167807.68	102152.85	141850.95	65654.84	47669.78	1.18
Pajam	Fallow	Hybrid-777	7.48	166910.25	103261.31	142286.45	63648.94	24576.50	1.17

Source: Field survey, 2017-18

Selling price (Tk. kg⁻¹): Aman rice-26.50, Boro rice-19.62, REY including by-product

11.3.6 Comparative profitability of improved cropping pattern with existing cropping pattern for Nalitabari, Sherpur

Three crops based improved cropping pattern showed its dominance over farmers' existing cropping pattern during three years of cropping (Table 11.3.13). In three years of cropping, based on benefit cost ratio (BCR), the best profitable improved cropping pattern is T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) (1.62) than the existing cropping pattern T. aman rice (Tulsimala)-Fallow-Boro rice (Tejgold) (1.25) (Table 11.3.13, Fig. 11.3.6).

In Table 11.3.13, it was observed that the total return was different for different cropping patterns. Higher total return (Tk. 309816.22 ha⁻¹), total cost (Tk. 190735.04 ha⁻¹), gross margin (Tk. 171805.38 ha⁻¹) and net return (Tk. 119081.17 ha⁻¹) were obtained from improved cropping pattern T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) as compared to farmers' existing cropping pattern. Due to inclusion of mustard as an extra crop in between T. aman rice and Boro rice, net return increased by 216% over farmers' existing cropping pattern) (Fig. 11.3.5).

Table 11.3.13 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at Nalitabari, Sherpur

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Mustard	Aus rice					
2018-19	Improved pattern	Binadhan-17	Binasarisha-9	Binadhan-14	285223.25	188126.62	149867.50	97096.63	1.52
2019-20		Binadhan-17	BARI Sarisha-14	BRRi dhan58	292453.99	190000.62	147610.53	102453.37	1.54
2020-21		Binadhan-17	Binasarisha-9	BRRi dhan58	309816.22	190735.04	171805.38	119081.17	1.62
Base year (2017-18)	Existing pattern	Tulsimala	Fallow	Tejgold	187308.33	149583.20	78112.60	37725.13	1.25

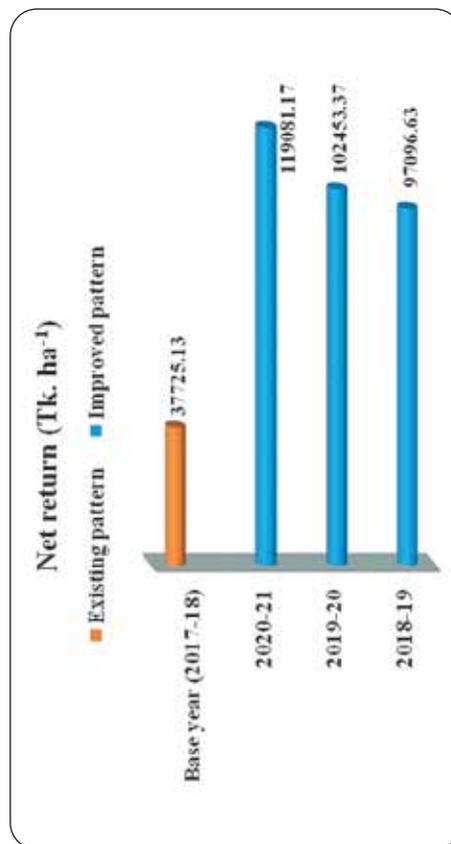


Fig: 11.3.5 Net return of improved and existing cropping patterns in different years at Nalitabari, Sherpur

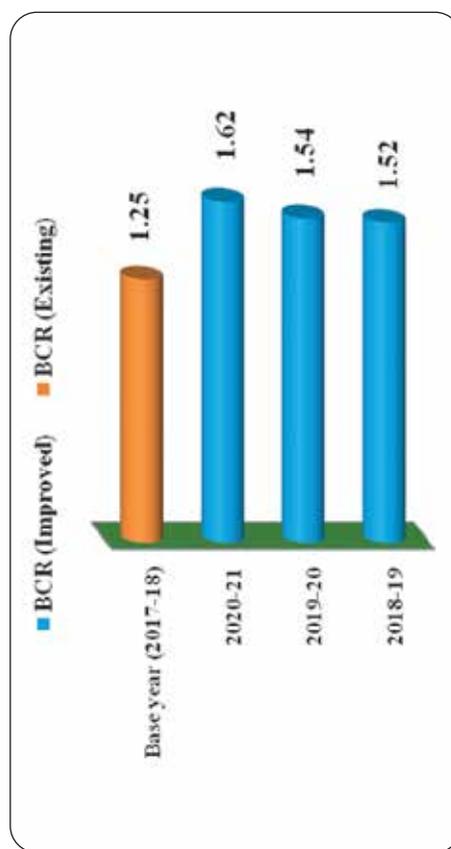


Fig: 11.3.6 BCR of improved and existing cropping patterns in different years at Nalitabari, Sherpur

11.3.7 Profitability of improved three crops based (T. aman rice-Mustard-Boro rice) cropping pattern and existing two crops based (T. aman rice-Fallow-Boro rice) cropping pattern for sadar, Rangpur

T. aman rice-Mustard-Boro rice and T. aman rice-Fallow-Boro rice variety combinations at Rangpur sadar during 2018-19, 2019-20, 2020-21 and base year 2017-18 are shown in Table 11.3.14, Table 11.3.15, Table 11.3.16 and Table 11.3.17, respectively.

The highest total return (Tk. 318674.67 ha⁻¹) was obtained from T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) in 2020-21 and Tk. 291633.98 ha⁻¹ in 2019-20 (Table 11.3.16 and Table 11.3.15). In 2018-19, the highest total return (Tk. 292807.36 ha⁻¹) was found in T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-16)-Boro rice (Binadhan-14) variety combination (Table 11.3.14). In case of existing cropping pattern, the highest total return (Tk. 185227.36 ha⁻¹) was observed in T. aman rice (Binadhan-7)-Fallow-Boro rice (BRRI dhan16) variety combination in the base year 2017-18. The lowest total return (Tk. 166910.25 ha⁻¹) was also recorded from the existing cropping pattern T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan16) variety combinations in the base year 2017-18 (Table 11.3.17).

The highest total cost Tk. 206589.09 ha⁻¹ was observed in T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combination in 2020-21 and Tk. 201492.27 ha⁻¹ in 2019-20 (Table 11.3.16 and Table 11.3.15). In 2018-19, it was Tk. 206580.33 ha⁻¹ in T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-16)-Boro rice (Binadhan-14) (Table 11.3.14). In case of existing cropping pattern, the highest total cost (Tk. 154901.93 ha⁻¹) was observed in T. aman rice (Binadhan-7)-Fallow-Boro rice (Hira) and the lowest total cost (Tk. 128278.25 ha⁻¹) was recorded in T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan28) variety combination in the base year 2017-18 (Table 11.3.17).

The highest Gross margin was Tk. 169061.28 ha⁻¹ in T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combination in 2020-21 and Tk. 145701.28 ha⁻¹ in 2019-20 (Table 11.3.16 and Table 11.3.15). In 2018-19, it was Tk. 143950.59 ha⁻¹ in T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-16)-Boro rice (Binadhan-14) (Table 11.3.14). In the existing cropping pattern, the highest gross margin (Tk. 74643.09 ha⁻¹) was observed in T. aman (Guti Shorna)-Fallow-Boro rice (Hira) and the lowest gross margin (Tk. 60102.65 ha⁻¹) was recorded in T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan28) variety combination in the base year 2017-18 (Table 11.3.17).

The net return was highest Tk. 112085.58 ha⁻¹ in T. aman rice (Binadhan-7)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combination in 2020-21 (Table 11.3.16). In 2019-20, the highest net return (Tk. 93896.85 ha⁻¹) was in T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) variety combination and it was Tk. 86682.92 ha⁻¹ in 2018-19 (Table 11.3.15 and Table 11.3.14). In the existing cropping pattern, the highest net return (Tk. 33043.66 ha⁻¹) was observed in T. aman rice (Guti Shorna)-Fallow-Boro rice (Hira) and the lowest net return (Tk. 24843.04 ha⁻¹) was

recorded in T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan28) variety combination in the base year 2017-18 (Table 11.3.17).

The highest benefit cost ratio (BCR), was obtained from variety combinations of T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) for 2020-21, 2019-20 and 2018-19, 1.64, 1.50 and 1.47, respectively. In the existing cropping pattern, the highest BCR was 1.22 observed in T. aman rice (Guti Shorna)-Fallow-Boro rice (Hira) and the lowest BCR obtained from T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan28) variety combination (1.18) in the base year 2017-18 (Table 11.3.17).

Table 11.3.14 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for sadar, Rangpur in 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-7	Binasarisha-9	Binadhan-14	15.62	266840.49	134593.12	185870.23	132247.38	80970.26	1.44
Binadhan-7	BARI Sarisha-14	Binadhan-14	16.86	288035.55	145672.74	201111.04	142362.81	86124.51	1.43
Binadhan-7	BARI Sarisha-16	Binadhan-14	17.14	292807.36	148856.76	206580.33	143950.59	86227.03	1.42
Binadhan-7	Binasarisha-9	BRR1 dhan28	15.87	271064.98	138420.53	191130.52	132644.44	79934.46	1.42
Binadhan-7	BARI Sarisha-14	BRR1 dhan28	16.22	277019.77	141820.65	195897.37	135199.11	81122.39	1.41
Binadhan-7	BARI Sarisha-16	BRR1 dhan28	16.30	278423.68	143132.64	197651.84	135291.04	80771.84	1.41
Binadhan-17	Binasarisha-9	Binadhan-14	15.84	270470.96	133065.46	183788.04	137405.50	86682.92	1.47
Binadhan-17	BARI Sarisha-14	Binadhan-14	15.43	263607.03	132696.65	183340.83	130910.37	80266.20	1.44
Binadhan-17	BARI Sarisha-16	Binadhan-14	16.31	278617.37	139474.63	192605.11	139142.75	86012.26	1.45
Binadhan-17	Binasarisha-9	BRR1 dhan28	15.35	262124.52	134242.78	185382.37	127881.74	76742.15	1.41
Binadhan-17	BARI Sarisha-14	BRR1 dhan28	16.25	277540.96	137399.42	189743.52	140141.54	87797.44	1.46
Binadhan-17	BARI Sarisha-16	BRR1 dhan28	16.08	274624.40	138655.98	191509.71	135968.42	83114.70	1.43
BRR1 dhan33	Binasarisha-9	Binadhan-14	14.55	248552.68	129879.74	178910.40	118672.94	69642.28	1.39
BRR1 dhan33	BARI Sarisha-14	Binadhan-14	15.73	268631.56	137048.11	188692.37	131583.45	79939.19	1.42
BRR1 dhan33	BARI Sarisha-16	Binadhan-14	15.93	272108.67	139093.09	191531.05	133015.59	80577.62	1.42
BRR1 dhan33	Binasarisha-9	BRR1 dhan28	14.82	253047.68	128714.08	177263.37	124333.60	75784.30	1.43
BRR1 dhan33	BARI Sarisha-14	BRR1 dhan28	15.23	260058.44	133305.66	183579.26	126752.78	76479.18	1.42
BRR1 dhan33	BARI Sarisha-16	BRR1 dhan28	14.79	252730.25	128221.97	176631.35	124508.28	76098.91	1.43

Source: Field survey, 2018-19

Selling price (Tk. kg⁻¹): Aman rice-16.33, Boro rice-17.83, Mustard-44.76, REY including by-product

Table 11.3.15 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for sadar, Rangpur in 2019-20

T. aman	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-7	Binasarisha-9	Binadhan-14	15.12	278441.71	136193.69	188072.57	142248.02	90369.14	1.48
Binadhan-7	BARI Sarisha-14	Binadhan-14	15.84	291633.98	145932.70	201492.27	145701.28	90141.71	1.45
Binadhan-17	Binasarisha-9	Binadhan-14	15.24	280555.85	135146.19	186659.01	145409.67	93896.85	1.50
Binadhan-17	BARI Sarisha-14	Binadhan-14	14.51	267218.32	134172.07	185379.95	133046.26	81838.37	1.44

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-17.66, Boro rice-19.16, Mustard-46.98, REY including by-product

Table 11.3.16 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for sadar, Rangpur in 2020-21

T. aman	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-7	Binasarisha-9	Binadhan-14	14.05	295729.44	139723.08	192969.29	156006.37	102760.15	1.53
Binadhan-7	BARI Sarisha-14	Binadhan-14	15.14	318674.67	149613.39	206589.09	169061.28	112085.58	1.54
Binadhan-17	Binasarisha-9	Binadhan-14	14.07	306312.89	141725.14	195770.95	164587.76	110541.94	1.56
Binadhan-17	BARI Sarisha-14	Binadhan-14	13.79	290250.09	136618.54	188761.50	153631.55	101488.60	1.54

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.10, Boro rice-21, Mustard-46.68, REY including by-product

Table 11.3.17 Profitability analysis of farmers existing cropping pattern (T. aman rice-Fallow-Boro rice) at sadar, Rangpur during base year, 2017-18

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Fallow	Boro rice							
Binadhan-7	Fallow	Hira	10.63	182516.53	112281.51	154901.93	70235.03	27614.60	1.19
Binadhan-7	Fallow	BRR1 dhan16	10.79	185227.36	110641.37	152648.06	74585.99	32579.30	1.21
Binadhan-7	Fallow	BRR1 dhan28	10.52	180598.47	110666.30	152528.49	69932.17	28069.98	1.19
Guti Shorna	Fallow	Hira	10.74	184334.45	109691.37	151290.79	74643.09	33043.66	1.22
Guti Shorna	Fallow	BRR1 dhan16	9.72	166910.25	100235.69	138174.27	66674.56	28735.98	1.21
Guti Shorna	Fallow	BRR1 dhan28	8.92	153121.29	93018.63	128278.25	60102.65	24843.04	1.18

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.10, Boro rice-21, Mustard-46.68, REY including by-product

11.3.8 Comparative profitability of improved cropping pattern with existing cropping pattern for sadar, Rangpur

Based on three years' observations, comparative profitability of the patterns are presented in Table 11.3.18. The improved cropping pattern showed its superiority over farmers' existing cropping pattern during three consecutive years of cropping. In three years of cropping, according to BCR the best profitable improved cropping pattern was T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (1.56) as compared to farmers' existing cropping pattern BCR (1.22) (Table 11.3.18, Fig. 11.3.8).

Total return of the best improved cropping pattern was Tk. 306312.89 ha⁻¹ which was 66% higher than farmers' existing cropping pattern of Tk. 184334.45 ha⁻¹. The total cost of the improved cropping pattern (Tk. 195770.95 ha⁻¹) was higher than farmers' existing cropping pattern (Tk. 151290.79 ha⁻¹) due to introduction of mustard in fallow land and cost of fertilizers and other inputs. The gross margin was higher in the improved cropping pattern (Tk. 164587.76 ha⁻¹) than farmers' existing cropping pattern (Tk. 74643.09 ha⁻¹).

The net return was higher in the improved cropping pattern (Tk. 110541.94 ha⁻¹) than farmers' existing cropping pattern (Tk. 33043.66 ha⁻¹). Due to inclusion of mustard as an extra crop in between T. aman rice and Boro rice, net return increased by 235% over farmers' existing pattern (Table 11.3.18, Fig. 11.3.7).

Table 11.3.18 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at sadar, Rangpur

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Mustard	Aus rice					
2018-19	Improved pattern	Binadhan-17	Binasarisha-9	Binadhan-14	270470.96	183788.04	137405.50	86682.92	1.47
2019-20		Binadhan-17	Binasarisha-9	Binadhan-14	280555.85	186659.01	145409.67	93896.85	1.50
2020-21		Binadhan-17	Binasarisha-9	Binadhan-14	306312.89	195770.95	164587.76	110541.94	1.56
Base year (2017-18)	Existing pattern	GutiShorna	Fallow	Hira	184334.45	151290.79	74643.09	33043.66	1.22

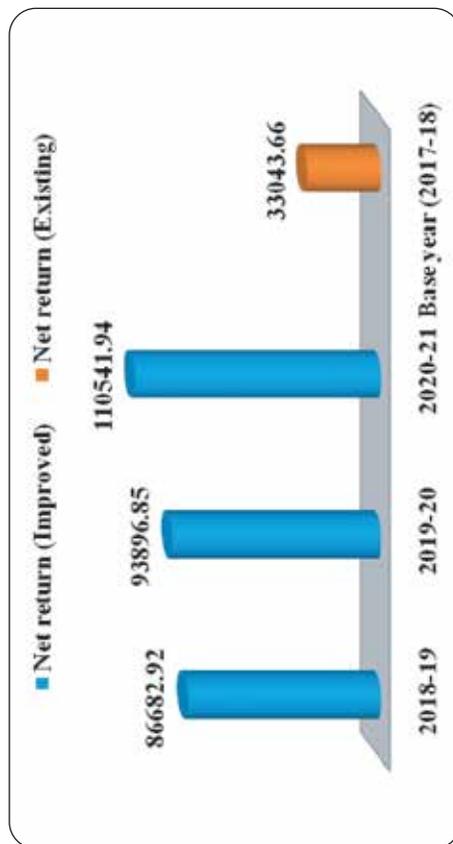


Fig: 11.3.7 Net return (Tk. ha⁻¹) of improved and existing cropping patterns in different years at Rangpur

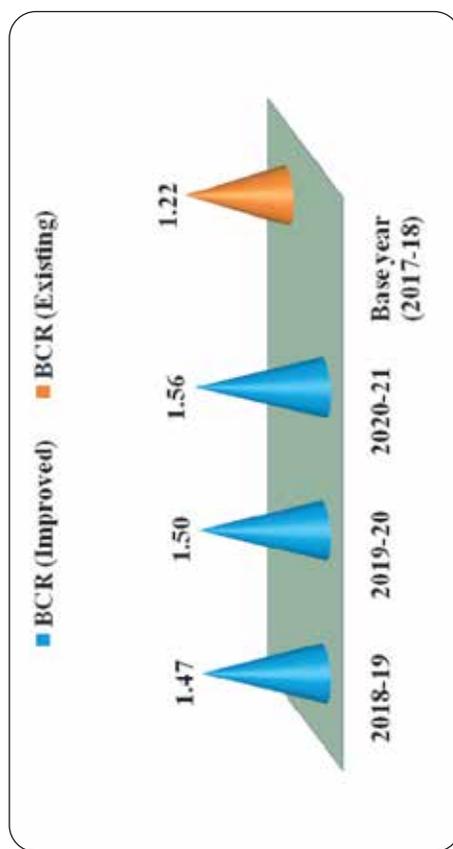


Fig: 11.3.8 BCR of improved and existing cropping patterns in different years at Rangpur

11.3.9 Profitability of improved three crops based (T. aman rice-Potato-Boro rice) cropping pattern and existing two crops based (T. aman rice-Fallow-Boro rice) cropping pattern for sadar, Rangpur

Profitability of improved three crops based cropping pattern (T. aman rice-Potato-Boro rice) over existing two crops based (T. aman rice-Fallow-Boro rice) cropping pattern at Sadar, Rangpur during 2018-19, 2019-20, 2020-21 and the base year 2017-18 are shown in Table 11.3.19, Table 11.3.20, Table 11.3.21, Table 11.3.17).

The variety combination, T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) had the highest total return (Tk. 562464.0 ha⁻¹) in 2020-21, followed by Tk. 520740.12 ha⁻¹ and 516310.59 ha⁻¹ in 2018-19 and 2019-20, respectively (Table 11.3.21, Table 11.3.19, Table 11.3.20). In the existing cropping pattern, the highest total return (Tk. 185227.36 ha⁻¹) was observed in T. aman rice (Binadhan-7)-Fallow-Boro rice (BRRI dhan16) variety combinations in the base year 2017-18. The lowest total return (Tk. 166910.25 ha⁻¹) was also recorded from the existing cropping pattern T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan16) variety combination in the base year 2017-18 (Table 11.3.17).

The variety combination T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) showed the maximum total cost was Tk. 352580.39 ha⁻¹ followed by Tk. 347061.06 ha⁻¹ and 343684.30 ha⁻¹ in 2020-21, 2019-20 and 2018-19, respectively (Table 11.3.21, Table 11.3.20, Table 11.3.19). In the existing cropping pattern, the highest total cost (Tk. 154901.93 ha⁻¹) was observed in T. aman rice (Binadhan-7)-Fallow-Boro rice (Hira) and the lowest total cost (Tk. 128278.25 ha⁻¹) was recorded in T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan28) variety combination in the base year 2017-18 (Table 11.3.17).

The combinations, T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) gross margin was highest Tk. 307760.68 ha⁻¹ found in 2020-21, followed by Tk. 272460.89 ha⁻¹ and 265592.40 ha⁻¹ in 2018-19 and 2019-20, respectively (Table 11.3.21, Table 11.3.19, Table 11.3.20). In the existing cropping pattern, the highest gross margin (Tk. 74643.09 ha⁻¹) was observed in T. aman rice (Guti Shorna)-Fallow-Boro rice (Hira) and the lowest gross margin (Tk. 60102.65 ha⁻¹) was recorded in T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan28) variety combination in the base year 2017-18 (Table 11.3.17).

The highest net return was Tk. 209883.62 ha⁻¹ obtained from T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) variety combination in 2020-21, followed by Tk. 177055.82 ha⁻¹ and 169249.52 ha⁻¹ in 2018-19 and 2019-20, respectively (Table 11.3.21, Table 11.3.19, Table 11.3.20). In the existing cropping pattern, the highest net return (Tk. 33043.66 ha⁻¹) was observed in T. aman rice (Guti Shorna)-Fallow-Boro rice (Hira) and the lowest net return (Tk. 24843.04 ha⁻¹) was recorded in T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan28) variety combination in the base year 2017-18 (Table 11.3.17).

The highest benefit cost ratios (BCR) were obtained from variety combination of T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) for 2020-21, 2018-19 and 2019-20, 1.60, 1.52 and 1.49, respectively. In case of existing cropping pattern, the highest BCR was 1.22 observed in T. aman rice (Guti Shorna)-Fallow-Boro rice (Hira) and the lowest BCR obtained was from T. aman rice (Guti Shorna)-Fallow-Boro rice (BRRI dhan28) variety combination (1.18) from the base year 2017-18 (Table 11.3.17).

Table 11.3.19 Profitability analysis of different variety combinations of the proposed T. aman rice-Potato-Boro rice cropping pattern at sadar, Rangpur during 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Potato	Boro rice							
Binadhan-7	Asterix	Binadhan-14	27.17	464045.16	232044.39	321219.22	232000.77	142825.94	1.44
Binadhan-7	Asterix	BRR1 dhan28	28.86	492858.10	241859.86	334793.02	250998.24	158065.09	1.47
Binadhan-17	Asterix	Binadhan-14	30.49	520740.12	248279.23	343684.30	272460.89	177055.82	1.52
Binadhan-17	Asterix	BRR1 dhan28	29.50	503912.73	243671.55	337314.97	260241.19	166597.76	1.49
BRR1 dhan33	Asterix	Binadhan-14	26.71	456261.55	223597.22	309073.57	232664.33	147187.98	1.48
BRR1 dhan33	Asterix	BRR1 dhan28	28.49	486667.33	243316.19	336444.02	243351.14	150223.31	1.45

Source: Field survey, 2018-19

Selling price (Tk. kg⁻¹): Aman rice-16.33, Boro rice-17.83, Potato-11.40, REY including by-product

Table 11.3.20 Profitability analysis of different variety combinations of the proposed T. aman rice-Potato-Boro rice cropping pattern at sadar, Rangpur during 2019-20

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Potato	Boro rice							
Binadhan-7	Asterix	Binadhan-14	26.03	479367.72	235539.60	326052.19	243828.12	153315.53	1.47
Binadhan-17	Asterix	Binadhan-14	28.05	516310.59	250718.19	347061.06	265592.40	169249.52	1.49

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-17.66, Boro rice-19.16, Potato-11.10, REY including by-product

Table 11.3.21 Profitability analysis of different variety combinations of the proposed T. aman rice-Potato-Boro rice cropping pattern at sadar, Rangpur during 2020-21

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Potato	Boro rice							
Binadhan-7	Asterix	Binadhan-14	24.13	509055.47	237683.56	329016.19	271371.91	180039.29	1.55
Binadhan-17	Asterix	Binadhan-14	26.66	562464.01	254703.33	352580.39	307760.68	209883.62	1.60

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.10, Boro rice-21, Potato-10.90, REY including by-product

11.3.10 Comparative profitability of improved cropping pattern with existing cropping pattern for sadar, Rangpur

Comparative profitability of improved versus existing cropping pattern for sadar, Rangpur are shown in Table 11.3.22. According to BCR, the best profitable improved cropping pattern was T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) (1.60) as compared to farmers' existing cropping pattern BCR (1.22) (Table 11.3.22, Fig. 11.3.10).

In Table 11.3.22, the highest total return (Tk. 562464.01 ha⁻¹), total cost (Tk. 352580.39 ha⁻¹), gross margin (Tk. 307760.68 ha⁻¹) and net return (Tk. 209883.62 ha⁻¹) were obtained from improved cropping pattern T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) as compared to farmers' existing cropping pattern. Due to inclusion of potato as an extra crop in between T. aman rice and Boro rice, net return increased by 535% over farmers' existing cropping pattern (Table 11.3.22, Fig. 11.3.9).

Table 11.3.22 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at sadar, Rangpur

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Potato	Boro rice					
2018-19	Improved pattern	Binadhan-17	Asterix	Binadhan-14	520740.12	343684.30	272460.89	177055.82	1.52
2019-20		Binadhan-17	Asterix	Binadhan-14	516310.59	347061.06	265592.40	169249.52	
2020-21		Binadhan-17	Asterix	Binadhan-14	562464.01	352580.39	307760.68	209883.62	
Base year (2017-18)	Existing pattern	Guti Shorna	Fallow	Hira	184334.45	151290.79	74643.09	33043.66	1.22

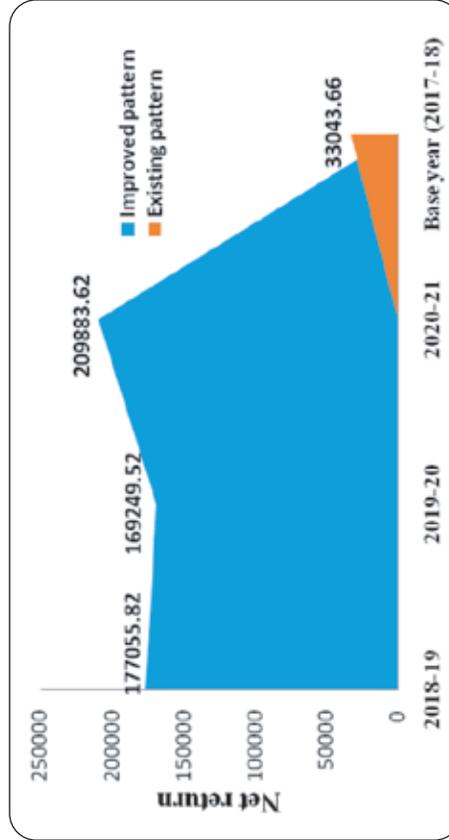


Fig: 11.3.9 Net return (Tk. ha⁻¹) of improved and existing cropping patterns in different years at Rangpur

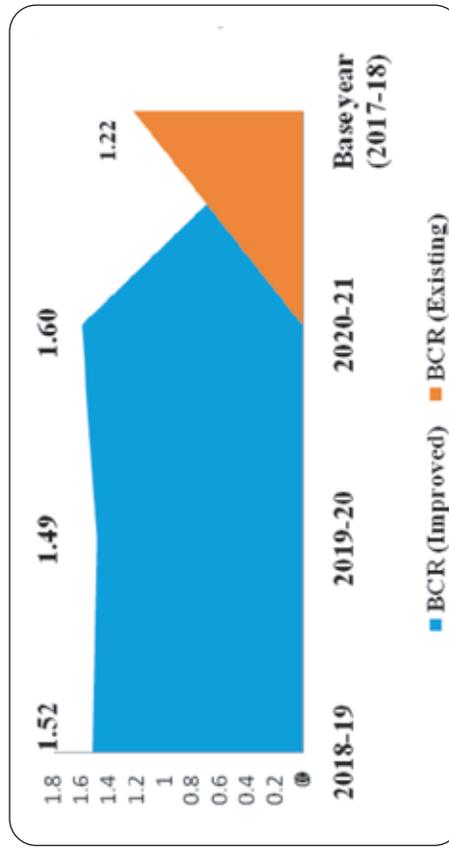


Fig: 11.3.10 BCR of improved and existing cropping patterns in different years at Rangpur

11.3.11 Profitability of improved three crops based (T. aman rice-Grass pea-Aus rice) cropping pattern and existing two crops based (T. aman rice-Fallow-Aus rice) cropping pattern for sadar, Sunamganj

Profitability of improved three crops based cropping pattern (T. aman rice-Grass pea-Aus rice) and two crops based cropping pattern (T. aman rice-Fallow-Aus rice) variety combinations at sadar, Sunamganj during 2018-19, 2019-20, 2020-21 and base year 2017-18 revealed that rice equivalent yield (REY), total return, total variable cost, total cost, gross margin, net return and benefit cost ratio (BCR) were different for different cropwise variety combination (Table 11.3.23, Table 11.3.24, Table 11.3.25, Table 11.3.26).

The variety combination T. aman rice (Binadhan-17)-Grass pea (Binakeshari-1)-Aus rice (Binadhan-19) showed the highest total return Tk. 308162.69 ha⁻¹, Tk. 290911.11 ha⁻¹ and 287186.90 ha⁻¹ in 2020-21, 2019-20 and 2018-19, respectively (Table 11.3.25, Table 11.3.24, Table 11.3.23). In the existing cropping pattern, the highest total return (Tk. 171010.45 ha⁻¹) was observed in T. aman rice (BRRI dhan22)-Fallow-Aus rice (BRRI dhan48) variety combination in the base year 2017-18. The lowest total return (Tk. 163653.97 ha⁻¹) was also recorded from the existing cropping pattern T. aman rice (BRRI dhan22)-Fallow-Aus rice (Binadhan-19) variety combination in the base year 2017-18 (Table 11.3.26).

The variety combination T. aman rice (BRRI dhan48)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19) showed the maximum total cost Tk. 200262.66 ha⁻¹ in 2020-21 and Tk. 195569.66 ha⁻¹ in 2019-20 (Table 11.3.25, Table 11.3.24). In 2018-19, it was Tk. 196774.06 ha⁻¹ from T. aman rice (Binadhan-11)-Grass pea (BARI Khesari-4)-Aus rice (BRRI dhan48) (Table 11.3.23). In the existing cropping pattern, the highest total cost (Tk. 142758.14 ha⁻¹) was observed in T. aman rice (Binadhan-11)-Fallow-Aus rice (Binadhan-19) and the lowest total cost (Tk. 138918.79 ha⁻¹) was recorded in T. aman rice (Binadhan-11)-Fallow-Aus rice (BRRI dhan48) variety combination in the base year 2017-18 (Table 11.3.26).

Gross margin was the highest (Tk. 168278.19 ha⁻¹) in T. aman rice (Binadhan-17)-Grass pea (Binakeshari-1)-Aus rice (Binadhan-19) variety combination in 2020-21, followed by Tk. 151857.85 ha⁻¹ and Tk. 148141.21 ha⁻¹ in 2019-20 and 2018-19, respectively (Table 11.3.25, Table 11.3.24, Table 11.3.23). In the existing cropping pattern, the highest gross margin (Tk. 69125.83 ha⁻¹) was observed in T. aman rice (Binadhan-11)-Fallow-Aus rice (Binadhan-19) and the lowest gross margin (Tk. 46186.01 ha⁻¹) was recorded in T. aman rice (Binadhan-11)-Fallow-Aus rice (BRRI dhan48) variety combination in the base year 2017-18 (Table 11.3.26).

The farmers earned the highest net return (Tk. 112852.65 ha⁻¹) was in T. aman rice (Binadhan-17)-Grass pea (Binakeshari-1)-Aus rice (Binadhan-19) variety combination in 2020-21, followed by Tk. 96753.74 ha⁻¹ and 93040.51 ha⁻¹ in 2019-20 and 2018-19, respectively (Table 11.3.25, Table 11.3.24, Table 11.3.23). In the existing cropping pattern, the highest net return (Tk. 30092.83 ha⁻¹) was observed in T. aman rice (BRRI dhan22)-Fallow-Aus rice (BRRI dhan48) and the lowest net return (Tk. 24695.88 ha⁻¹)

was recorded from T. aman rice (BRRI dhan22)-Fallow-Aus rice (Binadhan-19) variety combination in the base year 2017-18 (Table 11.3.26).

The highest benefit cost ratios (BCR) were obtained from variety combination of T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) for 2020-21, 2019-20 and 2018-19, 1.58, 1.50 and 1.48, respectively (Table 11.4.3, Table 11.4.2, Table 11.4.1). In the existing cropping pattern, the highest BCR was 1.21 observed in T. aman rice (BRRI dhan22)-Fallow-Aus rice (BRRI dhan48) and the lowest BCR was obtained from T. aman rice (BRRI dhan22)-Fallow-Aus rice (Binadhan-19) variety combination (1.17) in the base year 2017-18 (Table 11.3.26).

Table 11.3.23 Profitability analysis of different variety combinations of the proposed T. aman rice-Grass pea-Aus rice cropping pattern for sadar, Sunamganj during 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Grass pea	Aus rice							
Binadhan-11	Binakhesari-1	Binadhan-19	13.69	269205.30	135340.30	188955.27	133865.00	80250.03	1.42
Binadhan-11	BARI Khesari-4	Binadhan-19	13.67	269057.10	138972.18	193379.32	130084.92	75677.78	1.38
Binadhan-11	Binakhesari-1	BRRRI dhan48	13.59	267501.00	135827.68	191819.51	131673.32	75681.49	1.39
Binadhan-11	BARI Khesari-4	BRRRI dhan48	14.07	276784.08	139843.20	196774.06	136940.89	80010.02	1.41
Binadhan-17	Binakhesari-1	Binadhan-19	14.60	287186.90	139045.69	194146.39	148141.21	93040.51	1.48
Binadhan-17	BARI Khesari-4	Binadhan-19	14.12	277740.52	138211.38	192314.97	139529.14	85425.55	1.44
Binadhan-17	Binakhesari-1	BRRRI dhan48	13.80	271439.28	131872.54	186227.57	139566.74	85211.71	1.46
Binadhan-17	BARI Khesari-4	BRRRI dhan48	14.28	280974.85	138727.48	195220.02	142247.37	85754.83	1.44
BRRRI dhan49	Binakhesari-1	Binadhan-19	14.05	276454.75	136679.07	190859.37	139775.68	85595.38	1.45
BRRRI dhan49	BARI Khesari-4	Binadhan-19	14.08	276866.42	139497.90	194149.41	137368.51	82717.01	1.43
BRRRI dhan49	Binakhesari-1	BRRRI dhan48	14.29	281140.89	136427.92	192649.57	144712.97	88491.32	1.46
BRRRI dhan49	BARI Khesari-4	BRRRI dhan48	13.99	275226.61	139108.37	195757.11	136118.24	79469.51	1.41

Source: Field survey, 2018-19

Selling price (Tk. kg⁻¹): Aman rice-18.10, Aus rice-21.25, Grass pea-46.88, REY including by-product

Table 11.3.24 Profitability analysis of different variety combinations of the proposed T. aman rice-Grass pea-Aus rice cropping pattern for sadar, Sunamganj during 2019-20

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Grass pea	Aus rice							
Binadhan-17	Binakhesari-1	Binadhan-19	14.51	290911.11	139053.26	194157.37	151857.85	96753.74	1.50
Binadhan-17	BARI Khesari-4	Binadhan-19	14.15	283802.45	138567.26	192810.07	145235.19	90992.38	1.47
Binadhan-17	Binakhesari-1	BRR1 dhan48	13.71	274828.67	131706.09	185966.85	143122.58	88861.82	1.48
Binadhan-17	BARI Khesari-4	BRR1 dhan48	14.04	281464.73	138874.80	195428.60	142589.93	86036.14	1.44
BRR1 dhan49	Binakhesari-1	Binadhan-19	13.97	280073.30	137685.19	192259.04	142388.11	87814.26	1.46
BRR1 dhan49	BARI Khesari-4	Binadhan-19	14.01	280855.47	140525.09	195569.66	140330.37	85285.81	1.44
BRR1 dhan49	Binakhesari-1	BRR1 dhan48	13.56	271911.32	134872.48	190410.10	137038.85	81501.22	1.43
BRR1 dhan49	BARI Khesari-4	BRR1 dhan48	13.49	270492.44	135581.38	190685.37	134911.07	79807.07	1.42

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-18.60, Aus rice-21.50, Grass pea- 48.70, REY including by-product

Table 11.3.25 Profitability analysis of different variety combinations of the proposed T. aman rice-Grass pea-Aus rice cropping pattern for sadar, Sunamganj during 2020-21

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Grass pea	Aus rice							
Binadhan-17	Binakhesari-1	Binadhan-19	13.70	308162.69	139884.50	195310.04	168278.19	112852.65	1.58
Binadhan-17	BARI Khesari-4	Binadhan-19	13.48	303291.30	140102.22	194937.56	163189.08	108353.74	1.56
Binadhan-17	Binakhesari-1	BRR1 dhan48	13.10	294760.19	135308.27	191046.96	159451.92	103713.23	1.54
Binadhan-17	BARI Khesari-4	BRR1 dhan48	13.47	303101.93	141554.97	199204.95	161546.96	103896.98	1.52
BRR1 dhan49	Binakhesari-1	Binadhan-19	13.36	300804.83	139426.54	194687.87	161378.30	106116.96	1.55
BRR1 dhan49	BARI Khesari-4	Binadhan-19	13.78	310157.90	143916.81	200262.66	166241.09	109895.24	1.55
BRR1 dhan49	Binakhesari-1	BRR1 dhan48	13.71	308520.84	141693.74	200037.62	166827.10	108483.22	1.54
BRR1 dhan49	BARI Khesari-4	BRR1 dhan48	13.65	307037.47	140041.37	196942.71	166996.09	110094.76	1.56

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-22.20, Aus rice-22.80, Grass pea- 49.40, REY including by-product

Table 11.3.26 Profitability analysis of farmers existing cropping pattern (T. aman rice-Fallow-Aus rice) at sadar, Sunamganj district during base year, 2017-18

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Fallow	Aus rice							
Binadhan-11	Fallow	Binadhan-19	9.85	169056.53	99930.70	142758.14	69125.83	26298.39	1.18
Binadhan-11	Fallow	BRR1 dhan48	9.63	165301.01	99430.34	138918.79	46186.01	26382.22	1.19
BRR1 dhan22	Fallow	Binadhan-19	9.63	163653.97	97891.29	138958.08	65762.68	24695.88	1.17
BRR1 dhan22	Fallow	BRR1 dhan48	9.96	171010.45	101622.84	140917.62	48174.63	30092.83	1.21

Source: Field survey, 2017-18

Selling price (Tk. kg⁻¹): Aman rice-16.25, Aus rice-18.10, REY including by-product

11.3.12 Comparative profitability of improved cropping pattern with existing cropping pattern for sadar, Sunamganj

Comparative profitability of the improved versus existing cropping pattern are presented in Table 11.3.27. In three years of cropping, based on BCR, the best profitable improved cropping pattern was T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19) (1.58) in year 2020-21 as compared to farmers' existing cropping pattern BCR (1.21) (Table 11.3.27, Fig.11.3.11).

Total return of the improved cropping pattern was Tk. 308162.69 ha⁻¹ which was 80% higher than farmers' existing pattern of Tk. 171010.45 ha⁻¹. The total cost of the improved cropping pattern (Tk. 195310.04 ha⁻¹) was higher than farmers' existing cropping pattern (Tk. 140917.62 ha⁻¹) due to introduction of Grass pea in fallow land and cost of fertilizers and other inputs.

The gross margin was higher in the improved cropping pattern (Tk. 168278.19 ha⁻¹) than the farmers' existing cropping pattern (Tk. 48174.63 ha⁻¹). The net return was higher in the improved cropping pattern (Tk. 112852.65 ha⁻¹) than farmers' existing cropping pattern (Tk. 30092.83 ha⁻¹). Due to inclusion of Grass pea as an extra crop in between T. aman rice and Aus rice, net return increased by 275% over farmers' existing cropping pattern (Table 11.3.27, Fig.11.3.11).

Table 11.3.27 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at sadar, Sunamganj

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Grass pea	Aus rice					
2018-19	Improved pattern	Binadhan-17	Binakhesari-1	Binadhan-19	287186.90	194146.39	148141.21	93040.51	1.48
2019-20		Binadhan-17	Binakhesari-1	Binadhan-19	290911.11	194157.37	151857.85	96753.74	1.50
2020-21		Binadhan-17	Binakhesari-1	Binadhan-19	308162.69	195310.04	168278.19	112852.65	1.58
Base year (2017-18)	Existing pattern	BRRRI dhan22	Fallow	BRRRI dhan48	171010.45	140917.62	48174.63	30092.83	1.21

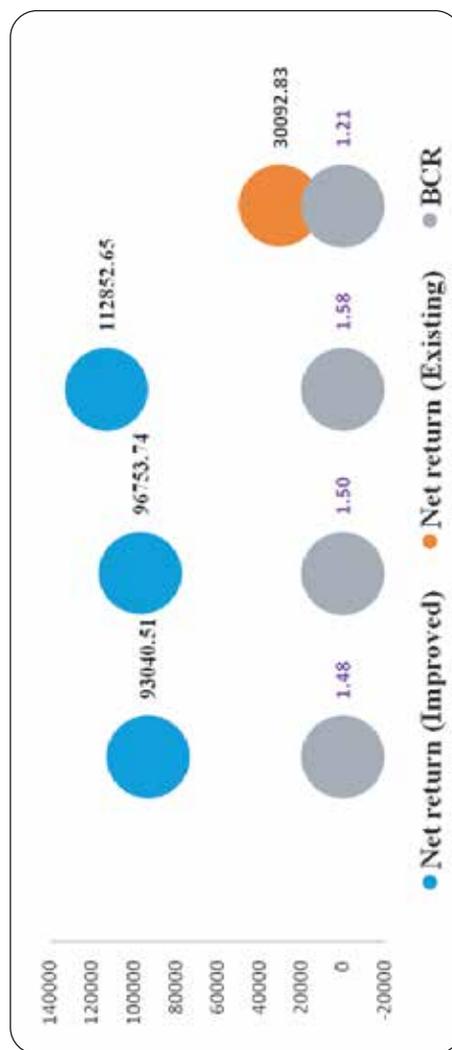


Fig: 11.3.11 Net return (Tk. ha⁻¹) and BCR of improved and existing cropping patterns in different years at Sunamganj

11.3.13 Profitability of improved three crops based (T. aman rice-Mustard-Boro rice) cropping pattern and existing two crops based (T. aman rice-Fallow-Boro rice) cropping pattern for Bishwambharpur, Sunamganj

Profitability of T. aman rice-Mustard-Boro versus T. aman rice-Fallow-Boro rice based cropping patterns variety combinations at Bishwambharpur upazila of Sunamganj during 2018-19, 2019-20, 2020-21 and base year 2017-18 are shown in Table 11.3.28, Table 11.3.29, Table 11.3.30, Table 11.3.31.

The variety combination T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) showed the highest total return Tk. 333693.08 ha⁻¹ in 2020-21, followed by Tk. 299781.55 ha⁻¹ in 2018-19 (Table 11.3.30, Table 11.3.28). In 2019-20, maximum return was Tk. 293027.76 ha⁻¹ from T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (Table 11.3.29). In the existing cropping pattern, the highest total return (Tk. 177121.45 ha⁻¹) was observed in T. aman rice (Binadhan-11)-Fallow-Boro rice (BRRI dhan29) variety combination in the base year 2017-18. The lowest total return (Tk. 168611.18 ha⁻¹) was also recorded from the existing cropping pattern T. aman rice (Binadhan-11)-Fallow-Boro rice (ACI Chakka) variety combination in the base year 2017-18 (Table 11.3.31).

The highest total cost (Tk. 214811.92 ha⁻¹) was obtained from T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combination in 2020-21, followed by Tk. 202362.30 ha⁻¹ in 2019-20 (Table 11.3.30, Table 11.3.29). In 2018-19, the highest total cost was Tk. 203816.44 ha⁻¹ from T. aman rice (Binadhan-11)-Mustard (BARI Sarisha-14)-Boro rice (BRRI dhan28) (Table 11.3.28). In the existing cropping pattern, the highest total cost (Tk. 144886.71 ha⁻¹) was observed in T. aman rice (Binadhan-11)-Fallow-Boro rice (BRRI dhan29) and the lowest total cost (Tk. 139718.42 ha⁻¹) was recorded in T. aman rice (Binadhan-11)-Fallow-Boro rice (ACI Chakka) variety combination in the base year 2017-18 (Table 11.3.31).

The highest gross margin was (Tk. 178168.25 ha⁻¹) found in T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) variety combination in 2020-21, followed by Tk. 155355.11 ha⁻¹ in 2018-19 (Table 11.3.30, Table 11.3.28). In 2019-20, the highest total cost was Tk. 149817.70 ha⁻¹ from T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (Table 11.3.29). In the existing cropping pattern, the highest gross margin (Tk. 75700.76 ha⁻¹) was observed in T. aman rice (Binadhan-11)-Fallow-Boro rice (BRRI dhan29) and the lowest gross margin (Tk. 68457.67 ha⁻¹) was recorded in T. aman rice (Binadhan-11)-Fallow-Boro rice (ACI Chakka) variety combination in the base year 2017-18 (Table 11.3.31).

The variety combination T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) showed the highest net return Tk. 118881.16 ha⁻¹ and Tk. 100259.75 ha⁻¹ in 2020-21 and 2018-19, respectively (Table 11.3.30, Table 11.3.28). In 2019-20, the highest total cost was Tk. 94614.97 ha⁻¹ from T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (Table 11.3.29). In the existing cropping pattern, the highest net return (Tk. 32904.64 ha⁻¹) was observed in T. aman rice (BRRI dhan46)-

Fallow-Boro rice (ACI Chakka) and the lowest net return (Tk. 28034.50 ha⁻¹) was recorded in T. aman rice (BRRI dhan46)-Fallow-Boro rice (BRRI dhan29) variety combination in the base year 2017-18 (Table 11.3.31).

The highest benefit cost ratios (BCR) were obtained from variety combination of (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) for 2020-21 and 2018-19, 1.55 and 1.50, respectively (Table 11.4.8, Table 11.4.6). In 2019-20, the highest BCR was 1.48 in T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) (Table 11.4.7) variety sequence. In the existing cropping pattern, the highest BCR was observed 1.23 in T. aman rice (BRRI dhan46)-Fallow-Boro rice (ACI Chakka) and the lowest BCR was obtained from T. aman rice (BRRI dhan46)-Fallow-Boro rice (BRRI dhan29) variety combination (1.19) in the base year 2017-18 (Table 11.3.31).

Table 11.3.28 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Bishwambharpur, Sunamganj during 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-11	Binasarisha-4	Binadhan-14	14.47	273679.82	137736.90	193591.00	135942.92	80088.82	1.42
Binadhan-11	Binasarisha-9	Binadhan-14	14.31	270725.72	135501.99	189606.46	135223.73	81119.26	1.43
Binadhan-11	BARI Sarisha-14	Binadhan-14	14.45	273324.12	134011.11	186723.08	139313.02	86601.04	1.46
Binadhan-11	Binasarisha-4	BRR1 dhan28	14.08	266447.13	130974.34	187106.21	135472.79	79340.93	1.41
Binadhan-11	Binasarisha-9	BRR1 dhan28	15.03	284404.03	139228.30	198226.83	145175.73	86177.20	1.43
Binadhan-11	BARI Sarisha-14	BRR1 dhan28	15.68	296577.02	143675.21	203816.44	152901.81	92760.58	1.46
Binadhan-17	Binasarisha-4	Binadhan-14	15.07	285209.43	143131.39	198960.18	142078.04	86249.25	1.43
Binadhan-17	Binasarisha-9	Binadhan-14	15.21	287745.85	142346.41	197268.61	145399.44	90477.24	1.46
Binadhan-17	BARI Sarisha-14	Binadhan-14	15.84	299781.55	144426.44	199521.80	155355.11	100259.75	1.50
Binadhan-17	Binasarisha-4	BRR1 dhan28	15.29	289424.31	140901.03	199225.67	148523.28	90198.64	1.45
Binadhan-17	Binasarisha-9	BRR1 dhan28	15.55	294179.06	141157.84	198923.92	153021.22	95255.14	1.48
Binadhan-17	BARI Sarisha-14	BRR1 dhan28	15.47	292620.90	144996.57	203623.30	147624.33	88997.60	1.44
BRR1 dhan49	Binasarisha-4	Binadhan-14	14.40	272444.33	135197.23	187119.15	137247.10	85325.19	1.46
BRR1 dhan49	Binasarisha-9	Binadhan-14	14.29	270487.87	134064.87	184906.49	136423.00	85581.38	1.46
BRR1 dhan49	BARI Sarisha-14	Binadhan-14	14.76	279217.33	137673.86	189284.05	141543.47	89933.28	1.48
BRR1 dhan49	Binasarisha-4	BRR1 dhan28	14.70	278161.11	136230.29	191833.51	141930.82	86327.60	1.45
BRR1 dhan49	Binasarisha-9	BRR1 dhan28	14.67	277722.26	138055.60	190403.61	139666.66	87318.65	1.46
BRR1 dhan49	BARI Sarisha-14	BRR1 dhan28	15.33	290136.15	140266.17	196132.68	149869.97	94003.47	1.48

Source: Field survey, 2018-19
Selling price (Tk. kg⁻¹): Aman rice-17.10, Boro rice-20.75, Mustard- 49.21, REY including by-product

Table 11.3.29 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Bishwambharpur, Sunamganj during 2019-20

T. aman	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-17	Binasarisha-9	Binadhan-14	15.59	293027.76	143210.07	198412.79	149817.70	94614.97	1.48
Binadhan-17	BARI Sarisha-14	Binadhan-14	15.46	290595.99	146481.89	202362.30	144114.10	88233.69	1.44
BRRi dhan49	Binasarisha-9	Binadhan-14	14.55	273355.81	136213.62	187862.00	137142.20	85493.81	1.46
BRRi dhan49	BARI Sarisha-14	Binadhan-14	14.82	278413.11	139354.93	191583.50	139058.18	86829.61	1.45

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-17.25, Boro rice-20.33, Mustard-50.63, REY including by-product

Table 11.3.30 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Boro rice cropping pattern for Bishwambharpur, Sunamganj during 2020-21

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Boro rice							
Binadhan-17	Binasarisha-9	Binadhan-14	14.65	311167.40	147089.54	203770.75	164077.86	107396.65	1.53
Binadhan-17	BARI Sarisha-14	Binadhan-14	15.71	333693.08	155524.83	214811.92	178168.25	118881.16	1.55
BRRi dhan49	Binasarisha-9	Binadhan-14	13.39	284548.57	138453.17	190964.47	146095.40	93584.10	1.49
BRRi dhan49	BARI Sarisha-14	Binadhan-14	14.10	299434.08	144041.81	198021.18	155392.27	101412.90	1.51

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.33, Boro rice-21.16, Mustard- 51.18, REY including by-product

Table 11.3.31 Profitability analysis of farmers existing cropping pattern (T. aman rice-Fallow-Boro rice) at Bishwambharpur, Sunamganj district during base year, 2017-18

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Fallow	Boro rice							
Binadhan-11	Fallow	ACI Chakka	9.31	168611.18	100153.51	139718.42	68457.67	28892.76	1.21
Binadhan-11	Fallow	BRR1 dhan29	9.77	177121.45	101420.69	144886.71	75700.76	32234.75	1.22
BRR1 dhan46	Fallow	ACI Chakka	9.72	176173.37	103285.96	143268.73	72887.42	32904.64	1.23
BRR1 dhan46	Fallow	BRR1 dhan29	9.49	172104.11	101508.08	144069.61	70596.03	28034.50	1.19

Source: Field survey, 2017-18

Selling price (Tk. kg⁻¹): Aman rice-16.75, Boro rice-19.50, REY including by-product

11.3.14 Comparative profitability of improved cropping pattern with existing cropping pattern for Bishwambharpur, Sunamganj

Comparative profitability of the improved versus existing cropping pattern are presented in Table 11.3.32. According to the BCR the best profitable improved cropping pattern was found for T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) (1.55) in the year 2020-21 as compared to farmers' existing cropping pattern BCR (1.23) (Table 11.3.32, Fig. 11.3.13).

In Table 11.3.32, it was observed that total return, total cost, gross margin, net return and BCR were different for different cropping patterns. Higher total return (Tk. 333693.08 ha⁻¹), total cost (Tk. 214811.92 ha⁻¹), gross margin (Tk. 178168.25 ha⁻¹) and net return (Tk 118881.16 ha⁻¹) were obtained in improved cropping pattern T. aman rice (Binadhan-17) Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) as compared to farmers' existing pattern. Due to inclusion of mustard as an extra crop in between T. aman rice and Boro rice, net return increased by 261% over farmers' existing cropping pattern (Fig. 11.3.12).

Table 11.3.32 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at Bishwambharpur, Sunamganj

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Mustard	Boro rice					
2018-19	Improved pattern	Binadhan-17	BARI Sarisha-14	Binadhan-14	299781.55	199521.80	155355.11	100259.75	1.50
2019-20		Binadhan-17	Binasarisha-9	Binadhan-14	293027.76	198412.79	149817.70	94614.97	1.48
2020-21		Binadhan-17	BARI Sarisha-14	Binadhan-14	333693.08	214811.92	178168.25	118881.16	1.55
Base year (2017-18)	Existing pattern	BRRI dhan46	Fallow	ACI Chakka	176173.37	143268.73	72887.42	32904.64	1.23

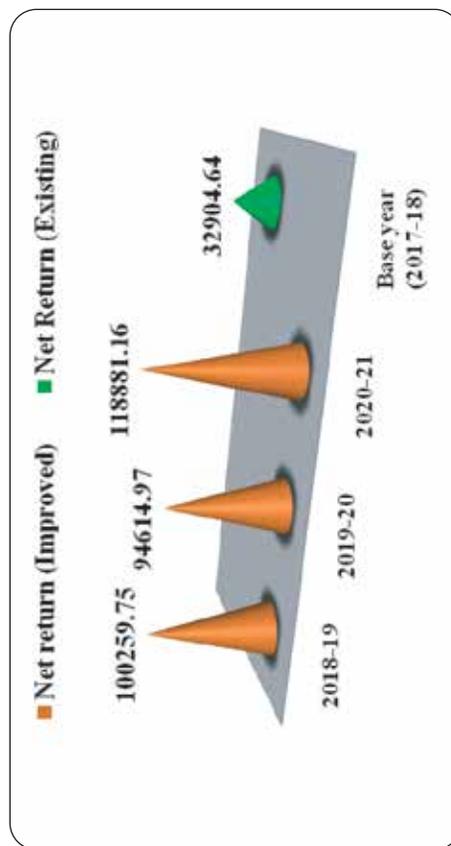


Fig: 11.3.12 Net return (Tk. ha⁻¹) of improved and existing cropping patterns in different years at Bishwambharpur, Sunamganj

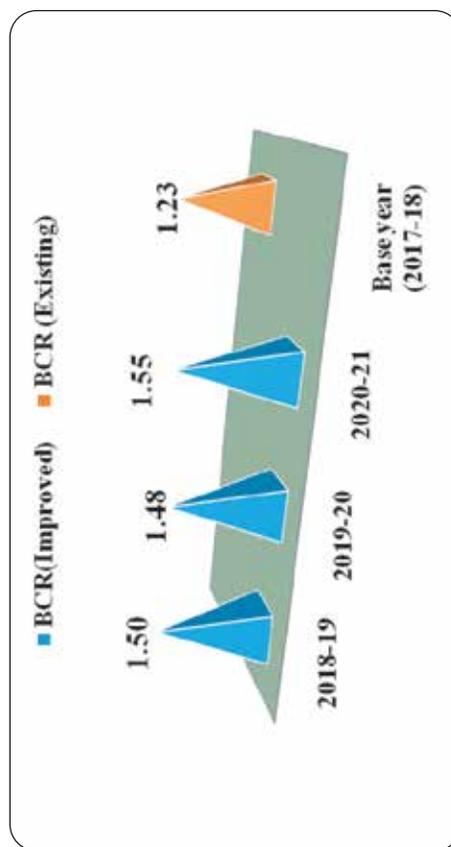


Fig: 11.3.13 BCR of improved and existing cropping patterns in different years at Bishwambharpur, Sunamganj

11.3.15 Profitability of improved three crops based (T. aman rice-Mustard-Aus rice/Jute) cropping pattern and existing two crops based (T. aman rice-Fallow-Jute) cropping pattern for Kashiani, Gopalganj

Profitability of improved three crops based T. aman rice-Mustard-Aus rice during 2018-19, T. aman rice-Mustard-Jute variety combinations during 2019-20 to 2020-21 and existing two crops based T. aman rice-Fallow-Jute pattern in base year 2017-18 at Kashiani, Gopalganj district revealed rice equivalent yield (REY), total return, total variable cost, total cost, gross margin, net return and benefit cost ratio (BCR) were different for different cropwise variety combinations in the study area (Table 11.3.33, Table 11.3.34, Table 11.3.35, Table 11.3.36). Most of the farmers in the study area sold their grain just after harvest. The total return from crop production included the values of grain and straw yield.

The variety combination T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Jute (JRO-524) had the highest total return (Tk. 321853.78 ha⁻¹) in 2020-21, followed by Tk. 292382.48 ha⁻¹ in 2019-20 (Table 11.3.35, Table 11.3.34). In 2018-19, the highest total return was Tk. 291475.97 ha⁻¹ from T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19) (Table 11.3.33). In the existing cropping pattern, the highest total return (Tk. 197194.09 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18. The lowest total return (Tk. 190354.81 ha⁻¹) was also recorded from the existing cropping pattern T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The highest total cost was recorded from T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Jute (JRO-524) variety combinations were Tk. 212938.72 ha⁻¹ and Tk. 201310.14 ha⁻¹ in 2020-21 and 2019-20, respectively (Table 11.3.35, Table 11.3.34). In 2018-19, the highest total cost was Tk. 194535.82 ha⁻¹ from T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19) (Table 11.3.33). In the existing cropping pattern, the highest total cost (Tk. 160059.67 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest total cost (Tk. 157465.59 ha⁻¹) was recorded in T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

For the variety combination, T. aman rice (Binadhan-16)-Mustard (BARI Sarisha-14)-Jute (JRO-524), the gross margin was the highest (Tk. 166408.52 ha⁻¹) in 2020-21, followed by Tk. 151857.85 ha⁻¹ in 2019-20 (Table 11.3.35, Table 11.3.34). In 2018-19, the highest gross margin was Tk. 151237.10 ha⁻¹ from T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19) (Table 11.3.33). In the existing cropping pattern, the highest gross margin (Tk. 80350.53 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest gross margin (Tk. 75404.93 ha⁻¹) was recorded in T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The highest net return (Tk. 111576.00 ha⁻¹) was obtained from T. aman rice (Binadhan-17)- Mustard (Binasarisha-9)-Jute (JRO-524) variety combination in 2020-21, followed by Tk. 93129.79 ha⁻¹ in 2019-20 (Table 11.3.35, Table 11.3.34). In 2018-19, the highest net return was Tk. 151237.10 ha⁻¹ from T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19) (Table 11.3.33). In the existing cropping pattern, the highest net return (Tk. 37134.42 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest net return (Tk. 32889.22 ha⁻¹) was recorded in T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The highest benefit cost ratios (BCR) were found for 2020-21 and 2019-20, 1.55 and 1.49, respectively in from variety combinations of T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14), (Table 11.5.3, Table 11.5.2). In 2018-19, the highest BCR 1.51 was obtained from T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Aus rice (Binadhan-19) (Table 11.5.1). In case of existing cropping pattern, the highest BCR was 1.24 observed in T. aman rice (Laksmidigha)-Fallow- Jute (JRO-524) and the lowest BCR obtained was from T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination (1.21) in the base year 2017-18 (Table 11.3.36).

Table 11.3.33 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Aus rice cropping pattern at Kashiani, Gopalganj during 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Aus rice							
Binadhan-7	Binasarisha-9	Binadhan-19	15.40	285411.01	140339.63	193302.08	145071.38	92108.93	1.48
Binadhan-7	BARI Sarisha-14	Binadhan-19	15.42	285665.98	139848.76	192674.02	145817.21	92991.96	1.48
Binadhan-7	Binasarisha-9	BRRI dhan48	13.83	256188.81	127763.61	181539.95	128425.19	74648.86	1.41
Binadhan-7	BARI Sarisha-14	BRRI dhan48	14.03	260053.49	130103.53	182996.54	129949.96	77056.95	1.42
Binadhan-16	Binasarisha-9	Binadhan-19	15.37	284868.84	138800.62	191196.26	146068.22	93672.58	1.49
Binadhan-16	BARI Sarisha-14	Binadhan-19	15.54	288083.44	141227.30	194535.82	146856.13	93547.61	1.48
Binadhan-16	Binasarisha-9	BRRI dhan48	14.67	271776.35	133797.52	186196.23	137978.83	85580.11	1.46
Binadhan-16	BARI Sarisha-14	BRRI dhan48	14.98	277580.85	134990.46	187841.22	142590.39	89739.62	1.48
Binadhan-17	Binasarisha-9	Binadhan-19	15.11	279940.07	136736.11	188390.11	143203.96	91549.96	1.49
Binadhan-17	BARI Sarisha-14	Binadhan-19	15.73	291475.97	140238.86	193208.26	151237.10	98267.71	1.51
Binadhan-17	Binasarisha-9	BRRI dhan48	14.51	268957.55	132319.54	184193.26	136638.01	84764.29	1.46
Binadhan-17	BARI Sarisha-14	BRRI dhan48	14.68	271974.69	133994.68	186520.45	137980.02	85454.25	1.46

Source: Field survey, 2018-19

Selling price (Tk. kg⁻¹): Aman rice-16.40, Aus rice-20.66, Mustard-46.72, REY including by-product

Table 11.3.34 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Jute cropping pattern at Kashiani, Gopalganj during 2019-20

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Jute							
Binadhan-16	Binasarisha-9	JRO-524	17.14	289744.99	144517.71	197969.46	145227.28	91775.53	1.46
Binadhan-16	BARI Sarisha-14	JRO-524	17.30	292382.48	146956.40	201310.14	145426.07	91072.34	1.44
Binadhan-17	Binasarisha-9	JRO-524	16.69	282096.34	137945.58	188966.55	144150.75	93129.79	1.49
Binadhan-17	BARI Sarisha-14	JRO-524	16.99	287184.71	142523.85	195238.15	144660.86	91946.56	1.47

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-16.90, Mustard- 44.80, Jute-46.60, REY including by-product

Table 11.3.35 Profitability analysis of different variety combinations of the proposed T. aman rice-Mustard-Jute cropping pattern at Kashiani, Gopalganj during 2020-21

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Mustard	Jute							
Binadhan-16	Binasarisha-9	JRO-524	14.72	318042.96	152883.61	209429.60	165159.35	108613.36	1.52
Binadhan-16	BARI Sarisha-14	JRO-524	14.90	321853.78	155445.26	212938.72	166408.52	108915.06	1.51
Binadhan-17	Binasarisha-9	JRO-524	14.54	314100.75	147843.07	202524.75	166257.68	111576.00	1.55
Binadhan-17	BARI Sarisha-14	JRO-524	14.74	318420.83	153784.66	210663.91	164636.17	107756.91	1.51

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.60, Mustard-45, Jute- 50.50, REY including by-product

Table 11.3.36 Profitability analysis of farmers existing cropping pattern (T. aman rice-Fallow-Jute) at Kashiani, Gopalganj during the base year, 2017-18

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Fallow	Jute							
Laksmidigha	Fallow	JRO-524	9.17	197194.09	116843.56	160059.67	80350.53	37134.42	1.24
BRR1 dhan39	Fallow	JRO-524	8.72	190354.81	114949.88	157465.59	75404.93	32889.22	1.21

Source: Field survey, 2017-18

Selling price (Tk. kg⁻¹): Aman rice-21.50, Jute-42.40, REY including by-product

11.3.16 Comparative profitability of improved cropping pattern with existing cropping pattern for Kashiani, Gopalganj

Based on three years' observations, comparative profitability of the cropping patterns are presented in Table 11.3.37. The improved cropping pattern showed its superiority over the farmers' existing cropping pattern during three consecutive years of cropping. In three years of cropping, according to BCR the best profitable improved cropping pattern was found T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524) in year 2020-21 (1.55) as compared to farmers' existing cropping pattern BCR (1.24) (Table 11.3.37, Fig 11.3.15).

Total return of the best profitable improved cropping pattern was Tk. 314100.75 ha⁻¹ which was 59% higher than farmers' existing cropping pattern of Tk. 197194.09 ha⁻¹. The total cost of the improved cropping pattern (Tk. 202524.75 ha⁻¹) was higher than farmers' existing cropping pattern (Tk. 160059.67 ha⁻¹) due to introduction of mustard in fallow land and cost of fertilizers and other inputs. The gross margin was higher in the improved cropping pattern (Tk. 166257.68 ha⁻¹) than farmers' existing cropping pattern (Tk. 80350.53 ha⁻¹).

The net return was higher in the improved cropping pattern (Tk. 111576.00 ha⁻¹) than the farmers' existing cropping pattern (Tk. 37134.42 ha⁻¹). Due to inclusion of mustard as an extra crop in between T. aman rice and Jute, net return increased by 200% over farmers' existing cropping pattern (Table 11.3.37, Fig 11.3.14).

Table 11.3.37 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at Kashiani, Gopalganj

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Mustard	Aus/Jute					
2018-19		Binadhan-17	BARI Sarisha-14	Binadhan-19	291475.97	193208.26	151237.10	98267.71	1.51
2019-20	Improved pattern	Binadhan-17	Binasarisha-9	JRO-524	282096.34	188966.55	144150.75	93129.79	1.49
2020-21		Binadhan-17	Binasarisha-9	JRO-524	314100.75	202524.75	166257.68	111576.00	1.55
Base year (2017-18)	Existing pattern	Lakhidigha	Fallow	JRO-524	197194.09	160059.67	80350.53	37134.42	1.24

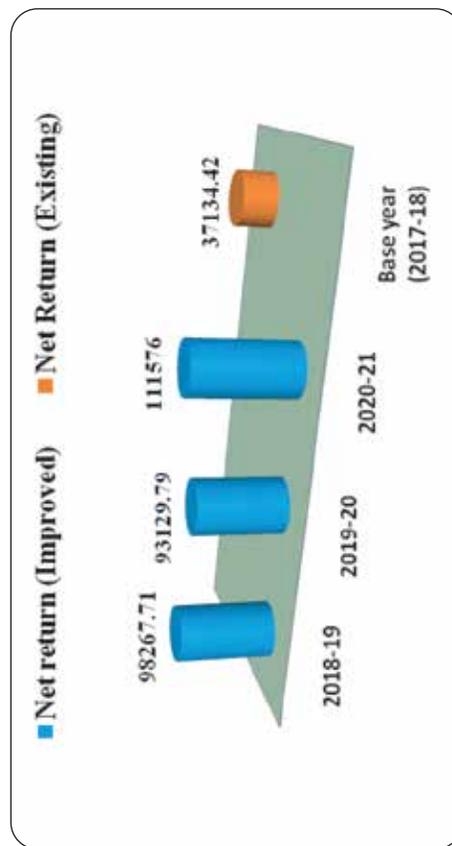


Fig: 11.3.14 Net return (Tk. ha⁻¹) of improved and existing cropping patterns in different years at Kashiani, Gopalganj

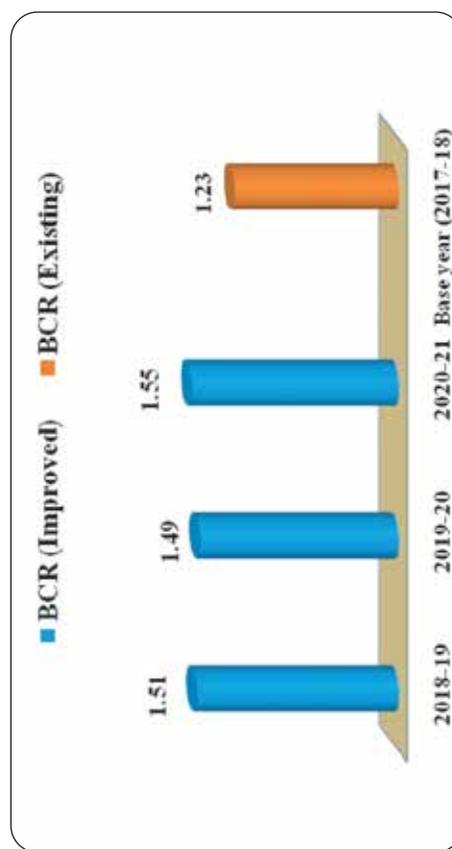


Fig: 11.3.15 BCR of improved and existing cropping patterns in different years at Kashiani, Gopalganj

11.3.17 Profitability of improved three crops based (T. aman rice-Grass pea-Aus rice/Jute) cropping pattern and existing two crops based (T. aman rice-Fallow-Jute) cropping pattern for Kashiani, Gopalganj

Profitability of improved three crops based cropping pattern T. aman rice-Grass pea-Aus rice during 2018-19, T. aman rice-Grass pea-Jute variety combinations during 2019-20 to 2020-21 and existing two crops based cropping pattern T. aman rice-Fallow-Jute pattern in the base year 2017-18 at Kashiani upazila of Gopalganj district are shown in Table 11.3.38, Table 11.3.39, Table 11.3.40, Table 11.3.36.

The highest total return (Tk. 339103.51 ha⁻¹) was obtained from T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) variety combination in 2020-21, followed by Tk. 298839.72 ha⁻¹ in 2019-20 (Table 11.3.40, Table 11.3.39). In 2018-19, the highest total return was Tk. 288142.96 ha⁻¹ from T. aman rice (Binadhan-7)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19) (Table 11.3.38). In the existing cropping pattern, the highest total return (Tk. 197194.09 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18. The lowest total return (Tk. 190354.81 ha⁻¹) was also recorded from existing cropping pattern T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The maximum total cost of cultivation (Tk. 210244.66 ha⁻¹) was obtained from T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) variety combination in 2020-21 (Table 11.3.40). In 2018-19, the highest total cost was Tk. 198678.57 ha⁻¹ from T. aman rice (Binadhan-7)-Grass pea (BARI Khesari-4)-Aus rice (Binadhan-19) (Table 11.3.38) and in 2019-20 was Tk. 198455.81 ha⁻¹ from T. aman rice (Binadhan-17)-Grass pea (BARI Khesari-4)-Jute (JRO-524) (Table 11.3.39). In the existing cropping pattern, the highest total cost of cultivation (Tk. 160059.67 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest total cost (Tk. 157465.59 ha⁻¹) was recorded in T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The variety combination T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) had the highest gross margin Tk. 185624.90 ha⁻¹ in 2020-21 followed by Tk. 155610.68 ha⁻¹ in 2019-20 (Table 11.3.40, Table 11.3.39). In 2018-19, the highest gross margin was obtained Tk. 147324.49 ha⁻¹ from T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19) (Table 11.3.38). In the existing cropping pattern, the highest gross margin (Tk. 80350.53 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest gross margin (Tk. 75404.93 ha⁻¹) was recorded from T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The highest net return was Tk. 128858.84 ha⁻¹ in 2020-21, followed by Tk. 102635.56 ha⁻¹ in 2019-20 from the variety combinations T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) (Table 11.3.40, Table 11.3.39). In 2018-19, the highest net return was Tk. 94525.45 ha⁻¹ from T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-

Aus rice (Binadhan-19) (Table 11.3.38). In the existing cropping pattern, the highest net return (Tk. 37134.42 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow- Jute (JRO-524) and the lowest net return (Tk. 32889.22 ha⁻¹) was recorded in T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The highest benefit cost ratios (BCR) in 2020-21 and 2019-20 were 1.61 and 1.52 respectively obtained from variety combination for T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) (Table 11.5.8, Table 11.5.7). In 2018-19, the highest BCR was 1.49 from T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19) (Table 11.5.6). In the existing cropping pattern, the highest BCR was 1.24 observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest BCR obtained was from in T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination (1.21) in the base year 2017-18 (Table 11.3.36).

Table 11.3.38 Profitability analysis of different variety combinations of the proposed T. aman rice-Grass pea-Aus rice cropping pattern for Kashiani, Gopalganj, 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Grass pea	Aus rice							
Binadhan-7	Binakhesari-1	Binadhan-19	15.14	280639.27	141222.15	195090.04	139417.12	85549.23	1.44
Binadhan-7	BARI Khesari-4	Binadhan-19	15.55	288142.96	144218.91	198678.57	143924.06	89464.40	1.45
Binadhan-7	Binakhesari-1	BRRI dhan48	14.23	263697.08	128958.59	182066.78	134738.49	81630.29	1.45
Binadhan-7	BARI Khesari-4	BRRI dhan48	14.32	265261.53	128673.96	181730.89	136587.58	83530.64	1.46
Binadhan-16	Binakhesari-1	Binadhan-19	15.30	283578.95	139304.99	192453.57	144273.96	91125.39	1.47
Binadhan-16	BARI Khesari-4	Binadhan-19	15.29	283438.99	143907.21	198228.13	139531.78	85210.86	1.44
Binadhan-16	Binakhesari-1	BRRI dhan48	14.62	270992.93	135232.70	188827.96	135760.23	82164.97	1.44
Binadhan-16	BARI Khesari-4	BRRI dhan48	15.04	278733.76	137284.17	190972.47	141449.59	87761.30	1.46
Binadhan-17	Binakhesari-1	Binadhan-19	15.41	285609.84	138285.35	191084.39	147324.49	94525.45	1.49
Binadhan-17	BARI Khesari-4	Binadhan-19	15.21	281903.35	139435.64	192088.11	142467.70	89815.24	1.47
Binadhan-17	Binakhesari-1	BRRI dhan48	13.94	258432.86	128893.09	179934.66	129539.77	78498.20	1.43
Binadhan-17	BARI Khesari-4	BRRI dhan48	15.56	269902.64	133479.49	185679.73	136423.15	84222.91	1.45

Source: Field survey, 2018-19

Selling price (Tk. kg⁻¹): Aman rice-16.40, Aus rice-20.66, Grass pea-46.48, REY including by-product

Table 11.3.39 Profitability analysis of different variety combinations of the proposed T. aman rice-Grass pea-Jute cropping pattern for Kashiani, Gopalganj, 2019-20

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Grass pea	Jute							
Binadhan-16	Binakhesari-1	JRO-524	17.22	291095.89	142044.04	194580.88	149051.85	96515.01	1.50
Binadhan-16	BARI Khesari-4	JRO-524	17.14	289708.19	142731.36	195522.42	146976.82	94185.77	1.48
Binadhan-17	Binakhesari-1	JRO-524	17.68	298839.72	143229.03	196204.15	155610.68	102635.56	1.52
Binadhan-17	BARI Khesari-4	JRO-524	17.28	292066.58	144872.74	198455.81	147193.84	93610.77	1.47

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-16.90, Grass pea-48.48, Jute= 46.60, REY including by-product

Table 11.3.40 Profitability analysis of different variety combinations of the proposed T. aman rice-Grass pea-Jute cropping pattern for Kashiani, Gopalganj, 2020-21

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Grass pea	Jute							
Binadhan-16	Binakhesari-1	JRO-524	15.10	326261.49	150451.62	206098.12	175809.86	120163.37	1.58
Binadhan-16	BARI Khesari-4	JRO-524	14.78	319292.95	150086.43	205597.85	169206.52	113695.10	1.55
Binadhan-17	Binakhesari-1	JRO-524	15.70	339103.51	153478.61	210244.66	185624.90	128858.84	1.61
Binadhan-17	BARI Khesari-4	JRO-524	15.17	327639.39	151380.00	207369.86	176259.39	120269.53	1.58

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.60, Grass pea-48.74, Jute-50.50, REY including by-product

11.3.18 Comparative profitability of improved cropping pattern with existing cropping pattern for Kashiani, Gopalganj

According to BCR, the best profitable improved cropping pattern was T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) (1.61) as compared to farmers' existing cropping pattern BCR (1.24) (Table 11.3.41, Fig. 11.3.17).

In Table 11.3.41, it was observed that total return, total cost, gross return, net return and BCR were different for different cropping patterns. Higher total return (Tk. 339103.51 ha⁻¹), total cost (Tk. 210244.66 ha⁻¹), gross margin (Tk. 185624.90 ha⁻¹) and net return (Tk. 128858.84 ha⁻¹) were obtained from improved cropping pattern T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) as compared to farmers' existing cropping pattern. Due to inclusion of Grass pea as an extra crop in between T. aman and Jute, net return increased by 247% over farmers' existing cropping pattern (Fig. 11.3.16).

Table 11.3.41 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at Kashiani, Gopalganj

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Grass pea	Aus/Jute					
2018-19		Binadhan-17	Binakhesari-I	Binadhan-19	285609.84	191084.39	147324.49	94525.45	1.49
2019-20	Improved pattern	Binadhan-17	Binakhesari-I	JRO-524	298839.72	196204.15	155610.68	102635.56	1.52
2020-21		Binadhan-17	Binakhesari-I	JRO-524	339103.51	210244.66	185624.90	128858.84	1.61
Base year (2017-18)	Existing pattern	Lakhidigha	Fallow	JRO-524	197194.09	160059.67	80350.53	37134.42	1.24

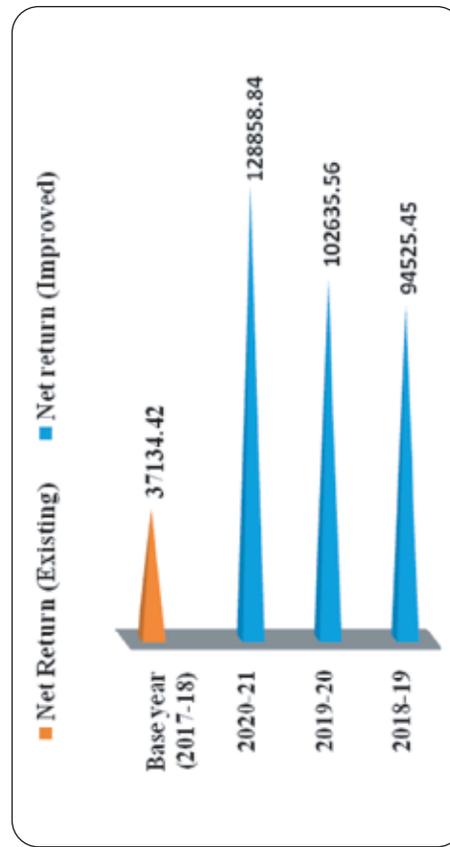


Fig: 11.3.16 Net return (Tk. ha⁻¹) of improved and existing cropping patterns in different years at Kashiani, Gopalganj

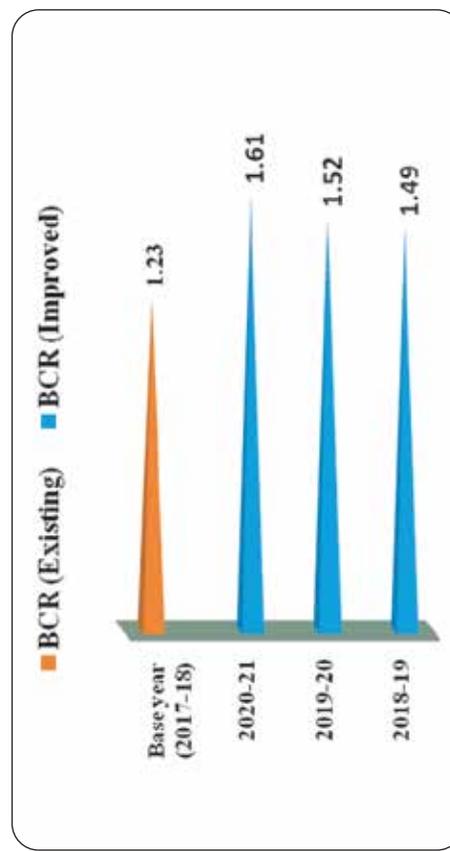


Fig: 11.3.17 BCR of improved and existing cropping patterns in different years at Kashiani, Gopalganj

11.3.19 Profitability of improved three crops based (T. aman rice-Lentil-Aus rice/Jute) cropping pattern and existing two crops based (T. aman rice-Fallow-Jute) cropping pattern for Kashiani, Gopalganj

Profitability of improved three crops based cropping pattern T. aman rice-Lentil-Aus rice variety combinations during 2018-19, T. aman rice-Lentil-Jute variety combinations during 2019-20 to 2020-21 versus existing two crops based cropping pattern T. aman rice-Fallow-Jute in the base year 2017-18 at Kashiani upazila of Gopalganj district are shown in Table 11.3.42, Table 11.43, Table 11.3.44, Table 11.3.36.

The variety combinations, T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524); T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Aus rice (Binadhan-19) and T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Jute (JRO-524) had the highest total return Tk. 359699.80 ha⁻¹, Tk. 327625.29 ha⁻¹ and Tk. 313292.55 ha⁻¹ in 2020-21, 2018-19 and 2019-20, respectively (Table 11.3.44, Table 11.3.42, Table 11.3.43). In the existing cropping pattern, the highest total return (Tk. 197194.09 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18. The lowest total return (Tk. 190354.81 ha⁻¹) was also recorded from the existing cropping pattern T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The variety combinations, T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Jute (JRO-524); T. aman rice (Binadhan-7)-Lentil (BARI Masur-8)-Aus rice (Binadhan-19) and T. aman rice (Binadhan-17)-Lentil (BARI Masur-8)-Jute (JRO-524) had the maximum total cost Tk. 230089.02 ha⁻¹, Tk. 215623.81 ha⁻¹ and Tk. 212929.72 ha⁻¹ in 2020-21, 2018-19 and 2019-20, respectively (Table 11.3.44, Table 11.3.42, Table 11.3.43). In the existing cropping pattern, the highest total cost (Tk. 160059.67 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest total cost (Tk. 157465.59 ha⁻¹) was recorded in T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

For T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524), T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Aus rice (Binadhan-19) and T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) variety combinations, the highest gross margin were Tk. 193708.72 ha⁻¹, Tk 171777.54 ha⁻¹ and Tk. 159970.68 ha⁻¹ in 2020-21, 2018-19 and 2019-20, respectively (Table 11.3.44, Table 11.3.42, Table 11.3.43). In the existing cropping pattern, the highest gross margin (Tk. 80350.53 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest gross margin (Tk. 75404.93 ha⁻¹) was recorded from T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The variety combinations, T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524); T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Aus rice (Binadhan-19) and T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) had the highest net return Tk. 132314.76 ha⁻¹, Tk 113044.02 ha⁻¹ and Tk. 104384.04 ha⁻¹ in 2020-21, 2018-19 and 2019-20, respectively (Table 11.3.44, Table 11.3.42, Table 11.3.43). In the existing

cropping pattern, the highest net return (Tk. 37134.42 ha⁻¹) was observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest net return (Tk. 32889.22 ha⁻¹) was recorded in T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination in the base year 2017-18 (Table 11.3.36).

The highest benefit cost ratio (BCR) were 1.57 and 1.51 in 2020-21 and 2019-20, respectively for the variety combination T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) (Table 11.3.44, Table 11.3.43). In 2018-19, the highest BCR was 1.53 from T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Aus rice (Binadhan-19) (Table 11.3.42). In case of existing cropping pattern, the highest BCR was 1.24 observed in T. aman rice (Laksmidigha)-Fallow-Jute (JRO-524) and the lowest BCR obtained from T. aman rice (BRRI dhan39)-Fallow-Jute (JRO-524) variety combination (1.21) in the base year 2017-18 (Table 11.3.36).

Table 11.3.42 Profitability analysis of different variety combinations of the proposed T. aman rice-Lentil-Aus rice cropping pattern for Kashiani, Gopalganj, 2018-19

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Lentil	Aus rice							
Binadhan-7	Binamasur-8	Binadhan-19	16.76	310662.90	151671.39	208822.64	158991.50	101840.25	1.49
Binadhan-7	BARI Masur-8	Binadhan-19	17.22	319120.76	156602.11	215623.81	162518.64	103496.94	1.48
Binadhan-7	Binamasur-8	BRR1 dhan48	15.55	288173.66	140064.79	196706.99	148108.87	91466.67	1.46
Binadhan-7	BARI Masur-8	BRR1 dhan48	15.24	282554.28	137624.18	193366.34	144930.11	89187.95	1.46
Binadhan-16	Binamasur-8	Binadhan-19	16.62	307985.61	152408.07	209854.19	155577.54	98131.41	1.47
Binadhan-16	BARI Masur-8	Binadhan-19	16.65	307985.32	152257.34	209656.29	155727.97	98329.02	1.47
Binadhan-16	Binamasur-8	BRR1 dhan48	15.97	296049.33	149033.42	207180.66	147015.91	88868.67	1.43
Binadhan-16	BARI Masur-8	BRR1 dhan48	15.66	290249.35	142672.60	198321.39	147576.76	91927.96	1.46
Binadhan-17	Binamasur-8	Binadhan-19	17.68	327625.29	155847.75	214581.27	171777.54	113044.02	1.53
Binadhan-17	BARI Masur-8	Binadhan-19	17.27	320023.68	154836.44	213208.55	165187.24	106815.13	1.50
Binadhan-17	Binamasur-8	BRR1 dhan48	15.11	279976.15	135389.79	188264.10	144586.36	91712.05	1.49
Binadhan-17	BARI Masur-8	BRR1 dhan48	15.73	291451.27	144302.20	200651.62	147149.07	90799.65	1.45

Source: Field survey, 2018-19
Selling price (Tk. kg⁻¹): Aman rice-16.40, Aus rice-20.66, Lentil-53.02, REY including by-product

Table 11.3.43 Profitability analysis of different variety combinations of the proposed T. aman rice-Lentil-Jute cropping pattern for Kashiani, Gopalganj, 2019-20

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Lentil	Jute							
Binadhan-16	Binamasur-8	JRO-524	17.87	302069.05	149523.14	204826.22	152545.91	97242.83	1.47
Binadhan-16	BARI Masur-8	JRO-524	18.24	308370.00	151538.34	207586.76	156831.66	100783.24	1.49
Binadhan-17	Binamasur-8	JRO-524	18.36	310260.50	150289.82	205876.46	159970.68	104384.04	1.51
Binadhan-17	BARI Masur-8	JRO-524	18.53	313292.55	155438.70	212929.72	157853.86	100362.83	1.47

Source: Field survey, 2019-20

Selling price (Tk. kg⁻¹): Aman rice-16.90, Lentil-50.69, Jute-46.60, REY including by-product

Table 11.3.44 Profitability analysis of different variety combinations of the proposed T. aman rice-Lentil-Jute cropping pattern for Kashiani, Gopalganj, 2020-21

T. aman rice	Cropwise variety combinations		REY (t ha ⁻¹)	Total return (Tk. ha ⁻¹)	Total variable cost (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Lentil	Jute							
Binadhan-16	Binamasur-8	JRO-524	15.98	345268.14	161946.35	221844.32	183321.79	123423.82	1.55
Binadhan-16	BARI Masur-8	JRO-524	15.83	342046.42	161456.70	221173.56	180589.72	120872.86	1.55
Binadhan-17	Binamasur-8	JRO-524	16.65	359699.80	165991.08	227385.04	193708.72	132314.76	1.57
Binadhan-17	BARI Masur-8	JRO-524	16.46	355476.90	167964.99	230089.02	187511.91	125387.88	1.54

Source: Field survey, 2020-21

Selling price (Tk. kg⁻¹): Aman rice-21.60, Lentil-58.97, Jute-50.50, REY including by-product

11.3.20 Comparative profitability of improved cropping pattern with existing cropping pattern for Kashiani, Gopalganj

Three crops based improved cropping pattern showed its domination over farmers' existing cropping pattern during three years of cropping. In the year 2020-21, according to BCR, the best profitable improved cropping pattern is T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) (1.57) as compared to farmers' existing cropping pattern BCR (1.24) (Table 11.3.45, Fig. 11.3.19).

In Table 11.3.45, it was observed that total return, total cost, gross return, net return and BCR were different for different cropping patterns. Higher total return (Tk. 359699.80 ha⁻¹), total cost (Tk. 227385.04 ha⁻¹), gross margin (Tk. 193708.72 ha⁻¹) and net return (Tk. 132314.76 ha⁻¹) were obtained in improved cropping pattern T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) as compared to farmers' existing cropping pattern. Due to the inclusion of lentil as an extra crop in between T. aman rice and Jute, net return increased by 256% over farmers' existing cropping pattern (Fig. 11.3.18).

Table 11.3.45 Comparative profitability of improved cropping pattern and farmers existing cropping pattern at Kashiani, Gopalganj

Year	Parameters				Total return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
	Pattern	T. aman rice	Lentil	Aus/Jute					
2018-19	Improved pattern	Binadhan-17	Binamasur-8	Binadhan-19	327625.29	214581.27	171777.54	113044.02	1.53
2019-20		Binadhan-17	Binamasur-8	JRO-524	310260.50	205876.46	159970.68	104384.04	1.51
2020-21		Binadhan-17	Binamasur-8	JRO-524	359699.80	227385.04	193708.72	132314.76	1.57
Base year (2017-18)	Existing pattern	Lakhidigha	Fallow	JRO-524	197194.09	160059.67	80350.53	37134.42	1.24

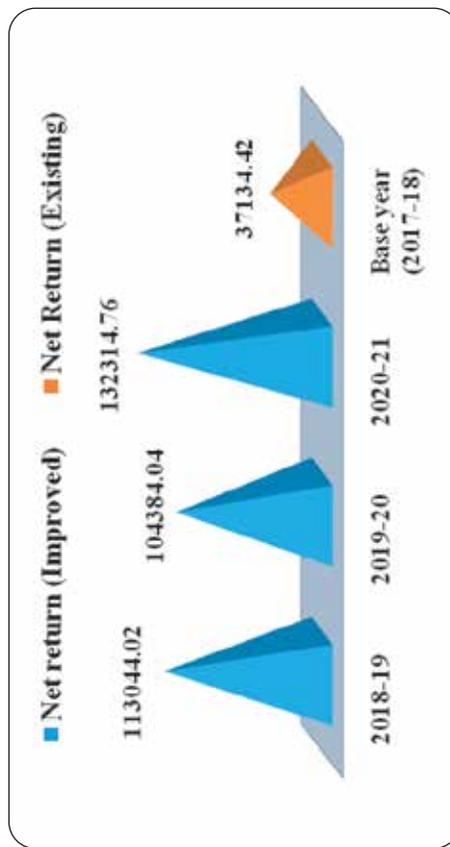


Fig: 11.3.18 Net return (Tk. ha⁻¹) of improved and existing cropping patterns in different years at Kashiani, Gopalganj

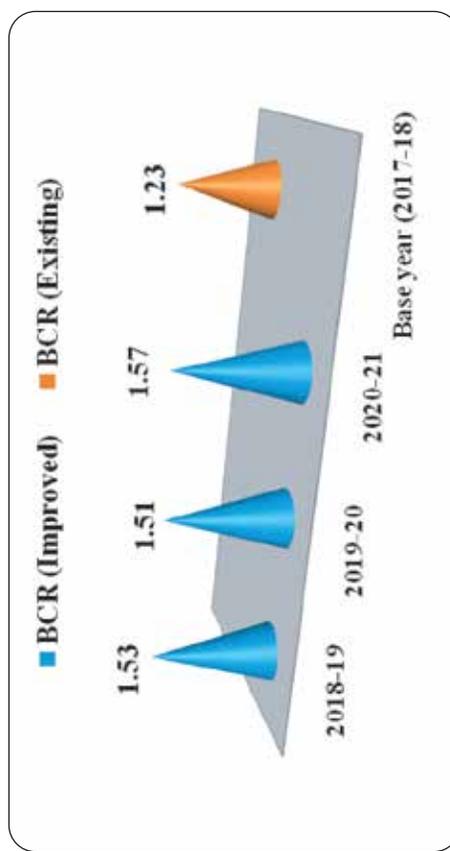


Fig: 11.3.19 BCR of improved and existing cropping patterns in different years at Kashiani, Gopalganj

A livelihood is the set of capabilities, assets and activities that furnish the means for people to meet their basic needs and support their well being. The building of livelihoods reflects and seeks to fulfill both material and experiential needs. Livelihoods are not simply a localized phenomenon, but connected by environmental, economic, political and cultural process to wider national, regional and global arenas (Castro, 2002).

11.3.20.1 Livelihood Assets

The members of a household combine their capabilities, skills and knowledge with the different resources at their disposal to create activities that will enable them to achieve the best possible livelihood for themselves and the household as a whole: Everything that goes towards creating that livelihood can be thought of as a livelihood asset (DFID, 1999). The livelihood framework identifies five core assets or capital upon which livelihoods are built. Increasing access which can take the form of ownership or the right to use these assets is a primary concern for DFID in its support of livelihoods and poverty elimination. These assets can be divided into five different “types” shown in Figure 11.3.20.

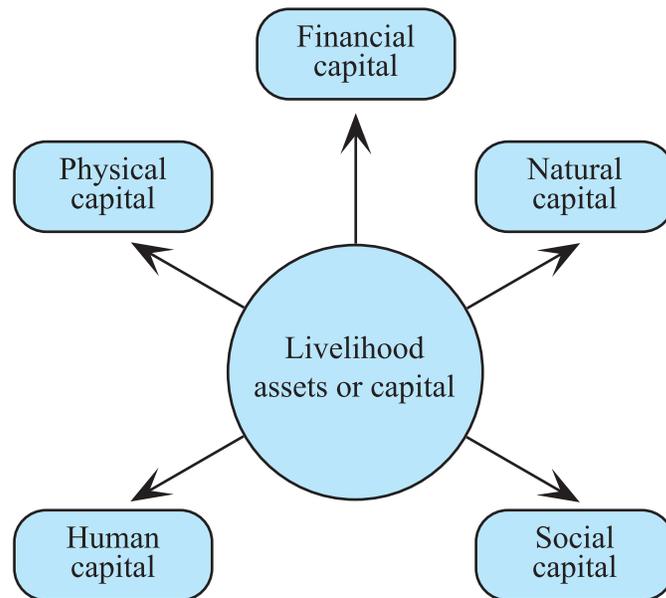


Fig: 11.3.20 Different types of assets

This asset can provide a useful starting point for household livelihood analysis, as it encourages investigators to take into account all the different kinds of assets and resources that are likely to play a role in household livelihood. In the past, development workers often tended to focus very much on the physical capital, the financial capital and the human capital. But very often people’s access to natural capital and the key role of the social capital of households has not been properly taken into account. Using this pentagon as guide can help investigators to get a more complete picture of the household and its livelihood assets.

11.3.20.2 Livelihood Capital: Livelihood capital refers to tangible or intangible assets that are held by a person or household for use to produce more wealth. Various forms of capital can be accumulated, exchanged, expended and lost, thereby affecting the level of households' livelihood security, quality of life, and its options for coping strategies (CARE, 2002). The different types of livelihood capitals of the ethnic minorities are discussed below:

11.3.20.3 Improvements of livelihood assets:

The findings revealed that households introducing new crop in their cropping pattern have higher income and had a positive effect on farm households' livelihood patterns. The asset pentagon approach shows that there is a noteworthy improvement based on different capitals (namely, financial capital, physical capital, natural capital, human capital and social capital) of farm households practicing more crops (Figure 11.3.21).

Table 11.3.46 shows the improvement of livelihood assets for all sampled farmers. The overall improvement was 14.24 %. It reveals that 12.77, 14.60, 13.75, 16.25 and 14.58 percent of all kind of livelihood assets increased due to the change in cropping patterns in the study area of the sampled farmers.

Table 11.3.46 Improvements of livelihood assets

(in percentage of respondent's number)

Capital	(%)
Financial Capital	12.77
Physical Capital	14.60
Natural Capital	13.75
Human Capital	16.25
Social Capital	14.58
Overall improvement	14.24

Source: Field survey, 2021

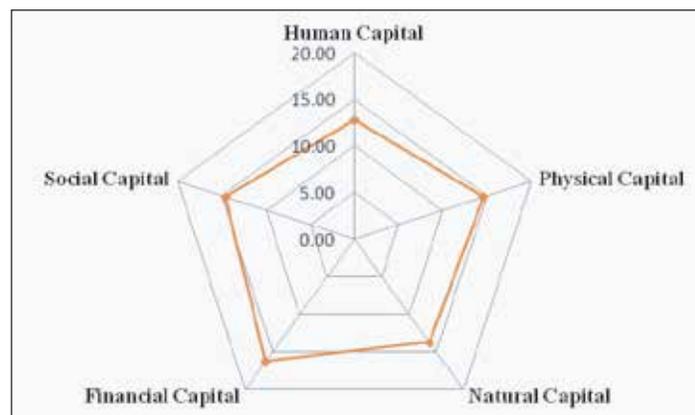


Fig: 11.3.21 Improvement of livelihood assets

Human capital: Human capital is important to the pursuit of livelihood strategies i.e. health and sanitation, education, knowledge by receiving demonstrations etc. Table 11.3.47

shows that the sampled farmer's health and sanitation condition increased 12.50 percent due to the changing cropping patterns. In case of education and knowledge, the situation increased 9.17 and 16.67 percent, respectively.

Physical capital: Physical capital refers to the household goods, tools and equipment and physical infrastructure of the household. Housing increased 12.50 percent and mobile phone increased 16.67 percent in the study areas. Physical capital increased due to the improved cropping patterns.

Natural capital: Natural capital consists of natural resources, including their flows and services. In the present study information about land (purchased), land (rent/mortgage), pond and tube well water access as the natural capital of sample farmers. In the study areas, rented out and tree plantation increased 13.33 and 14.17 percent, respectively.

Financial capital: Financial capital includes financial resources such as savings, cash in hand, bonds, debenture, etc. In case of financial capital cash in hand increased 18.33 percent and savings increased 14.17 percent (Table 11.3.47).

Social capital: Social capital refers to formal and informal social relationship, including their degree of trust, reliability and adaptability. The way in which people work together, both within the household and in wider community, is of key importance of household livelihoods. The table reveals that their involvement in social group/activities increased 13.33 percent. Social network also increased 15.83 percent. So, social capital of the farmers was also increased significantly after being involved in improved/new cropping patterns.

Table 11.3.47 Changes of respondents' livelihood in five types of capital

(in percentage of respondent's number)

Components	Increased	Decreased	Unchanged
Human Capital			
Health and sanitation	12.50	5.83	81.67
Education	9.17	20.00	70.83
Knowledge	16.67	0.00	83.33
Social Capital			
Involved in social activities	13.33	12.50	74.17
Social network	15.83	13.33	70.83
Physical Capital			
Housing	12.50	0.00	87.50
Mobile Phone	16.67	0.00	83.33
Natural Capital			
Rented out	13.33	0.00	86.67
Tree plantation	14.17	5.00	80.83
Financial Capital			
Cash in hand	18.33	6.67	75.00
Savings	14.17	5.83	80.00

Source: Field survey, 2021

Among the five locations the overall changes of income was 17.09%. The highest income changes was seen in Rangpur districts 20.22%, followed by Mymensingh 17.54%, Sunamganj 16.22%, Gopalganj 15.56% and the lowest was found in Sherpur districts 14.56%, respectively (Table11.3.48, Fig. 11.3.22).

Table 11.3.48 Annual income changes of respondents

Districts	Before (Tk.)	After (Tk.)	Differences (Tk.)	%
Gopalganj	121034.48	139862.10	18827.62	15.56
Sunamganj	98631.58	114631.60	16000.02	16.22
Rangpur	152500.00	183333.30	30833.30	20.22
Mymensingh	119708.33	140708.30	20999.97	17.54
Sherpur	102166.66	117041.70	14875.04	14.56
Total annual income	594041.05	695577.00	101535.95	17.09

Source: Field survey, 2021

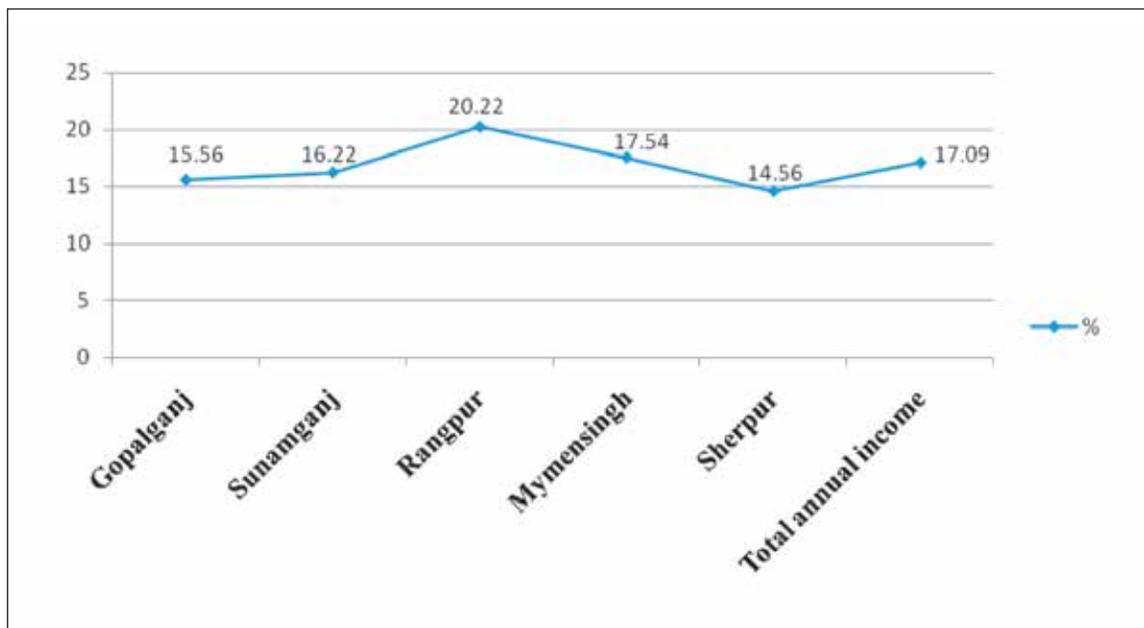


Fig: 11.3.22 Annual income changes of respondents

11.1 DISCUSSION

Bangladesh achieved self sufficiency in rice production although it has to import large amount of edible oil and pulses every year in exchange of huge hard earned foreign currencies. There is little scope to increase total production of edible oil producing crops and pulses by increasing land area or by increasing per unit yield because these crops have serious competition with Boro rice. Farmers presently are not ready to grow these crops at the cost of Boro rice. The only scope remaining is to incorporate these crops in about 2.1 million ha of land where the pattern T. aman rice-Fallow-Boro rice is followed. Researches for more than four decades targeting the incorporation of these crops in the mentioned pattern resulted some outstanding short duration T. aman rice varieties which allow timely sowing/planting of these crops. But due to unavailability of suitable high yielding and short duration oilseed crop (mustard/rapeseed) and pulse varieties, farmers do not feel comfort to transplant Boro rice after harvest of mustard/pulse crops. Because late transplanting of Boro rice imposes many challenges like high temperature induced sterility, hailstorms during grain filling, heavy rainfall during harvest and uncertainty in post harvest processing. To combat these challenges, BINA developed the late transplanting potential Boro rice variety Binadhan-14 which is popularly known as a BRAUS rice variety as well. This variety is tolerant to high temperature ($\geq 38^{\circ}\text{C}$), short duration (105-125 days) can be harvested before onset of heavy rainfall, high yielding (average yield is 6.9 t/ha), lodging resistant with long fine grains. This variety can be transplanted during 15 February to last week of March. In the existing T. aman rice-Fallow-Boro rice cropping pattern of the country farmers usually use long duration T. aman varieties which usually do not permit timely sowing of mustard and pulse crops.

In this regard, this sub-project "Development of profitable cropping pattern through crop intensification in some selected areas of Bangladesh" was undertaken with general objective of increasing cropping intensity through introducing improved cropping patterns for improving the farmers' livelihood. The specific objectives were (a) to identify location specific suitable improved crop varieties, (b) to increase cropping intensity, system productivity and farm profitability through designing suitable three or four cropping pattern, (c) to improve knowledge and skill of farmers and extension personnel on improved techniques of cropping pattern, (d) to assess the profitability of improved cropping pattern over existing one and (e) to determine the increase level of farmers' income and their livelihood improvement. The original title of the sub-project was "Establishment of profitable cropping pattern through crop intensification in underutilized unfavorable ecosystem" which was later modified as above following the suggestions, comments and recommendations of the daylong Inception Workshop arranged at BARC at the very beginning of the project in 2018 under Coordination Component with attendance from different stakeholders of Agriculture.

To fulfill the objectives, seven improved cropping patterns with 3/4 crops (i) T. aman rice-Mustard-Boro rice, (ii) T. aman rice-Mustard-Patshak (Jute leaf)-Aus rice, (iii) T. aman rice-Potato-Boro rice, (iv) T. aman rice-Grass pea-Aus rice, (v) T. aman rice-Mustard-Jute, (vi) T. aman rice-Lentil-Jute and (vii) T. aman rice-Grass pea-Jute were conducted at five locations viz. Mymensingh sadar, Nalitabari upazila of Sherpur district,

Rangpur sadar upazila, Sunamganj sadar and Bishwambharpur upazila of Sunamganj district and Kashiani upazila of Gopalganj district against existing patterns with two crops. At each location, there were 24 farmers who altogether had 3.12 ha of adjacent land. The experiments were conducted during 2018-19, 2019-20 and 2020-21 along with the base line survey and economic profitability analysis. In 2018-19, the best/better component crop varieties were selected for all the patterns based on rice equivalent yield (REY), field duration (FD) and benefit cost ratio (BCR). During 2019-20 and 2020-21 block demonstrations were conducted to confirm the findings of 2018-19 based on higher BCR than the existing two crops based pattern, FD and REY.

In 2018-19, suitable varieties of the component crops were selected. For Char Ghagra, Mymensingh sadar upazila, the component crop varieties BRRI dhan71 and Binadhan-11 of T. aman rice, BARI Sarisha-14 and Binasarisha-9 of mustard/rapeseed and Binadhan-14 of Boro rice were selected for the proposed T. aman rice-Mustard-Boro rice pattern (Table 11.1.1.1, Table 11.3.1). For four crops based proposed pattern T. aman rice-Mustard-Patshak (jute leaf)-Aus rice, the component crop varieties of T. aman rice and mustard were same as mentioned above. But Binapatshak-1 for Patshak and Binadhan-19 for Aus rice were selected in 2019-20 (Table 11.1.2.1, Table 11.3.6).

For Nalitabari upazila of Sherpur district, the component crop varieties Binadhan-17 and Binadhan-7 of T. aman rice, Binasarisha-9 and BARI Sarisha-14 of mustard and Binadhan-14 and BRRI dhan58 of Boro rice were selected for block demonstrations for the proposed improved cropping pattern T. aman rice-Mustard-Boro rice (Table 11.1.8.1, Table 11.3.9).

For Rangpur sadar, the component varieties Binadhan-17 and Binadhan-7 of T. aman rice and Binadhan-14 of Boro rice were selected for both the proposed improved pattern T. aman rice-Mustard-Boro rice and T. aman rice-Potato-Boro rice. Binasarisha-9 and BARI Sarisha-14 for the first pattern while potato variety Asterix was selected for the second pattern (Table 11.1.12.1, Table 11.1.13.1, Table 11.3.14, Table 11.3.19).

For Bishwambharpur upazila of Sunamganj district, the component varieties Binadhan-17 and BRRI dhan49 of T. aman rice; Binasarisha-9 and BARI Sarisha-14 of mustard/rapeseed and Binadhan-14 of Boro rice were selected for T. aman rice-Mustard-Boro rice pattern. In contrast, Binadhan-17 and BRRI dhan49 of T. aman rice, Binakhesari-1 and BARI Khesari-4 of Grass pea and Binadhan-19 and BRRI dhan48 of Aus rice were selected for T. aman rice-Grass pea-Aus rice pattern for Sunamganj sadar (Table 11.1.20.1, Table 11.1.21.1 Table 11.3.28, Table 11.3.23).

For Kashiani upazila of Gopalganj, the component varieties Binadhan-16 and Binadhan-17 of T. aman rice, Binasarisha-9 and BARI Sarisha-14 of mustard/rapeseed for T. aman rice-Mustard-Aus rice pattern, Binamasur-8 and BARI Masur-8 of lentil for T. aman rice-Lentil-Aus rice pattern and Binakhesari-1 and BARI Khesari-4 were selected for T. aman rice-Grass pea-Aus rice pattern. But farmers were reluctant to grow Aus rice instead of Jute. Therefore, jute was included in the pattern in the block demonstrations during 2019-20 and 2020-21 (Table 11.1.28.1, Table 11.1.29.1, Table 11.1.30.1, Table 11.3.33, Table 11.3.38, Table 11.3.42).

Incorporation of short duration T. aman rice varieties like Binadhan-7, Binadhan-16, Binadhan-17, BRRRI dhan33 and BRRRI dhan71 allowed sowing of mustard/rapeseed during second and third week of November (Table 11.1.1, Table 11.1.2, Table 11.1.3, Table 11.2.4, Table 11.1.5, Table 11.1.8, Table 11.1.9, Table 11.1.10, Table 11.1.12, Table 11.1.14, Table 11.1.16, Table 11.1.20, Table 11.1.22, Table 11.2.24, Table 11.1.28, Table 11.1.31, Table 11.1.34; Fig. 10.1.2, Fig. 10.1.3, Fig. 10.1.9, Fig. 10.1.15, Fig. 10.1.19, Fig. 10.2.3); pulses during 3rd week to 4th week of December (Table 11.1.21, Table 11.1.25, Table 11.1.29, Table 11.1.30, Table 11.1.32, Table 11.1.33, Table 11.1.35, Table 11.1.36; Fig. 10.1.16, Fig. 10.1.20, Fig. 10.1.21, Fig. 10.1.22) and potato during 2nd week to 4th week of November (Table 11.1.13, Table 11.1.15, Table 11.1.17, Table 11.2.1; Fig. 10.1.12).

After harvest of mustard/rapeseed/potato, Binadhan-14 alone or along with BRRRI dhan28/BRRRI dhan58 were transplanted at seedling age of 25-28 days during 19 February to 15 March at Mymensingh sadar upazila, Nalitabari upazila of Sherpur district. Muktarpara, Rangpur sadar upazila of Rangpur district and Bishwambharpur of Sunamganj district (Table 11.1.1, Table 11.1.2, Table 11.1.4, Table 11.1.8, Table 11.1.9, Table 11.1.10, Table 11.1.12, Table 11.1.13, Table 11.1.14, Table 11.1.15, Table 11.1.16, Table 11.1.17, Table 11.1.20, Table 11.1.22, Table 11.1.24; Fig. 10.1.14). Binadhan-14 was harvested between 05 May to 20 June at 116-126 DAS, BRRRI dhan-28 between 21 May to 16 June at 136-138 DAS and BRRRI dhan58 between 25 May to 17 June at 142-148 DAS. Binadhan-14 produced grain yield between 5.10 to 6.60 t/ha, BRRRI dhan28 between 5.20 to 5.60 t/ha and BRRRI dhan58 between 5.5 to 6.10 t/ha.

After harvest of patshak at Mymensingh sadar upazila (Table 11.1.3, Table 11.1.5, Table 11.2.1), grass pea at Sunamganj sadar upazila (Table 11.1.21, Table 11.1.23, Table 11.1.25) and mustard/rapeseed, lentil and grass pea at Kashiani upazila of Gopalganj district (Table 11.1.28, Table 11.1.29, Table 11.1.30) the short duration Aus rice variety, Binadhan-19 and BRRRI dhan48 were transplanted during 28 April to 13 May at seedling age of 22-25 days. Binadhan-19 was harvested after 98-106 DAS with grain yield of 4.40 to 5.20 t ha⁻¹ but BRRRI dhan48 after 110 -112 DAS with lower grain yield of 4.12 to 4.35 t ha⁻¹.

From the two years (2019-20 and 2020-21) results of block demonstrations it was found that, at Char Ghagra, Mymensingh, the improved pattern T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) had the highest BCR (1.57) against the existing two crops based pattern (1.23). It also had lower FD (267 days) and medium REY (16.70 t ha⁻¹). Therefore, this pattern was recommended for Mymensingh sadar upazila (Table 11.1.6). Similarly, the four crops based pattern T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) could be also recommended for Mymensingh sadar upazila (Table 11.1.7).

Nalitabari upazila of Sherpur district, the cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) was recommended for the pattern T. aman rice-Mustard/Rapeseed -Boro rice for its higher BCR and lower FD.

For Rangpur sadar upazila, the crop wise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) was recommended for the pattern

T. aman rice-Mustard/Rapeseed-Boro rice as it had the highest BCR (1.53) along with the highest NR and REY (Table 11.1.18) while the cropwise variety combination T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) was recommended for the pattern T. aman rice-Potato-Boro rice for having the highest BCR (1.55), NR and REY and the lowest FD (275 days) (Table 11.1.19).

At Bishwambharpur upazila of Sunamganj district, the cropwise variety combination T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) was recommended for the pattern T. aman rice-Mustard-Boro for the highest BCR (1.51) and REY (15.73 t ha⁻¹) (Table 11.1.26) while for sadar upazila of Sunamganj district, the cropwise variety combination was recommended for the pattern T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus rice (Binadhan-19) for its highest BCR (1.54), net return (Tk. 104803.20), REY (14.10 t ha⁻¹) and the lowest FD (279 days) (Table 11.1.27).

From the above discussion, it was revealed that the incorporation of late transplanting potential, short duration and heat tolerant Boro rice variety, Binadhan-14 and the short duration, high yielding Aus rice variety, Binadhan-19 made the new improved cropping pattern profitable and comfortable to the farmers (Table 11.1.1, Table 11.1.2, Table 11.1.3, Table 11.1.4, Table 11.1.5, Table 11.1.8, Table 11.1.9, Table 11.1.10, Table 11.1.12, Table 11.1.13, Table 11.1.14, Table 11.1.15, Table 11.1.16, Table 11.1.17, Table 11.1.20, Table 11.1.21, Table 11.1.22, Table 11.1.23, Table 11.1.24, Table 11.1.25, Table 11.1.28, Table 11.1.29, Table 11.1.30).

The cropwise variety combination T. aman rice (Binadhan-17)-Mustard/Rapeseed (Binasarisha-9)-Jute (JRO-524) was recommended for Kashiani upazila of Gopalganj district for the improved pattern T. aman rice-Mustard/Rapeseed-Jute pattern as it had the highest BCR (1.52) and net return (Tk. 102352.90) (Table 11.1.37). For T. aman rice-Lentil-Jute pattern, the cropwise variety combination T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) had the highest BCR (1.54) and net return (Tk. 118349.40) (Table 11.1.38) while for the pattern T. aman rice-Grass pea-Jute, the cropwise variety combination T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) showed the highest BCR (1.57), net return (Tk. 115747.20) and the second highest REY (18.05 t ha⁻¹) (Table 11.1.39).

Of the seven new improved patterns recommended, the four crops-based cropping pattern T. aman rice-Mustard-Patshak-Aus rice was also successfully disseminated at all 13 Upazilas of Mymensingh district. Average yield of Binasarisha-9 was 1.45 t ha⁻¹ at 91 days and that of Binapatshak-1, Binadhan-19 and Binadhan-11 were 3.40 t ha⁻¹ at 36 days, 4.90 t ha⁻¹ at 102 days and 4.18 t ha⁻¹ at 113 days, respectively (Table 11.2.1).

Among the five locations, overall changes of income were 17.09%. The highest income was found in Rangpur (20.22%) followed by Mymensingh (17.54%), Sunamganj (16.22%), Gopalganj (15.56%) and the lowest in Sherpur (14.56%) (Table 11.3.38).

It was also revealed the significant role of the late transplanting potential, short duration and heat tolerant Boro rice variety, Binadhan-14 to modify the two crops based patterns to three crops based patterns. The project farmers attained required knowledge and skills

for using the cropping patterns, particularly the production technologies of the modern varieties of component crops through Focus Group Discussion (FGD) and Field Days arranged each year before season and during harvest, respectively.

Finally, it could be concluded that to attain double farm productivity target of sustainable development goal (SDG) of UNO together with enhanced supply of nutritious food to the common people of Bangladesh, these technologies will play significant role.

12. Research highlights

Title of the sub-project: Development of profitable cropping pattern through crop intensification in some selected areas of Bangladesh.

Background: Bangladesh is a small country with 8.56 million ha of cultivated land and nearly 160 million populations. The population is being increased by 1.37% annually while the cultivable land is being decreased by 0.74%. The present cropping intensity of Bangladesh is 194% (BBS 2017) which is the average of 2.36 million ha of one cropped, 3.85 million ha of two cropped and 1.71 million ha of three cropped land. The share of land areas for pulses and oilseeds crops in this cropping intensity is 0.85 million ha and 0.90 million ha only; and the productions are 11,99,700 and 9,31,210 tons which meet 20% and 30% of country's demand, respectively. There is little scope to increase land for growing pulse and oilseeds. Increase of cropping intensity is the only way to boost up pulses and oilseed production. By incorporating short duration, late transplanting, potential and high temperature tolerant Boro rice, pulse and oilseed varieties in rice based cropping sequence, cropping intensity is possible to increase from 194 to 400% and productivity and farmers livelihood as well. Cultivation of traditional varieties, imbalance use of fertilizers, seed sowing inappropriate time, non adoption of modern production technologies, natural calamities, socio-economic barrier, large yield gap (20-60%), nutrient mining in existing cropping pattern, unavailability of seeds of suitable HYV varieties, drought, flash flood and other biotic and abiotic stresses are the main constraints of maximizing farm productivity. On the other hand, according to the 7th Five Year Plan and SDGs, poverty alleviation, end hunger, achieve food security and improved nutrition and promote sustainable agriculture are the new challenges for researchers, extensionists and farmers. BINA and BIRRI developed short duration T. aman and Aus rice varieties that mature within 90-120 days and producing grain yield of 5-6 t/ha, which created opportunity of crop intensification. BINA and BARI already developed pulses and oilseeds varieties with high yield and less crop duration that could be fitted in the cropping sequence of the area of underutilized and unfavourable ecosystems. Based on above facts, some areas like Sunamganj, Rangpur, Gopalganj, Nalitabari (Sherpur) and Mymensingh are considered for establishing alternative profitable cropping pattern(s). Proposed activities of adaptation trials, farmers motivation to adopt improved technologies, their knowledge and skill development and up-scaling using suitable varieties and proper time of sowing/transplanting technique based on integrated nutrient management, identification of suitable area for mustard, lentil, grass pea, sesame etc. cultivation to address the constraints above rice, oilseeds, pulses and other crops cultivation following appropriate technologies in proper time will maximize

the farm productivity and profitability by reducing yield gap and improving cropping pattern in the above areas.

General Objective: Increasing cropping intensity through introducing improved cropping patterns for improving the farmers' livelihood.

12.1 Component-1

Specific Objectives:

- a) To identify location specific suitable improved crop varieties;
- b) To increase cropping intensity, system productivity and farm profitability through designing suitable three or four cropping pattern(s);
- c) To improve knowledge and skill of farmers and extension personnel on improved techniques of cropping pattern production technology.

Methodology: The following steps were taken to establish profitable cropping pattern at farmers' level successfully:

Activity 1: Farmer and site selection for establishing cropping patterns.

Twenty four farmers having 3.12 ha of adjacent land (who use traditional methods) were selected under each of the five locations.

Activity 2: Farmers' motivation/FGD and orientation with technologies.

Before initiation of action program a Focus Group Discussions (FGDs) were arranged in each location on using modern technologies following improved cropping sequence in every season.

Activity 3: Procurement and recruitment

Procurement of minor capital and research inputs were done as per the Public Procurement Rule 2008. Recruitment of part time scientific assistant and other staffs were done from the existing manpower of BINA and a SO was recruited through the selection process of BARC.

Activity 4: Performance of modern crop varieties under probable cropping sequence instead of traditional technology at farmer's field/ plot:

- Suitable varieties for the component crops of the proposed improved cropping patterns were selected in first year (2018-19) based on field duration, REY and BCR.
- In 2019-20 and 2020-21, block demonstrations were conducted with the selected best/better performing varieties of each of seven improved cropping pattern.
- Recommended seed rate, fertilizer dose, irrigation, pest management and cultural practices were followed.
- Location specific profitable cropping patterns were designed with the selected crops, such as
 - i) Short duration T. aman rice-HYV mustard/lentil/potato/grass pea-short duration late boro rice/Jute and ii) Short duration T. aman rice-HYV mustard-Patshak-Aus rice

- This pattern based block farming helped motivating farmers, making seed available locally and created demand of improved varieties seeds among farming community.
- **Locations:** Mymensingh (Sadar), Sunamganj (Sadar and Bishwambharpur), Sherpur (Nalitabari), Gopalganj (Kashiani) and Rangpur (Sadar).
- Unit plot size for demonstration was 0.13 ha for each farmer.
- A total area of demonstration was 3.12 ha in each location.

Activity 5: Field days, mass media, campaign etc.

Field days and media campaign etc. were organized in 1st, 2nd and 3rd year to transfer profitable cropping pattern and modern technologies. Total thirty field days were organized at selected location in the presence of target farmers, local progressive farmers, DAE personnel and representative from electronic and print media.

Activity 6: Data collection

Agronomic practices data from sowing to harvesting were recorded.

Activity 7: Linkage develop of targeted farmers with Personnel of Extension Service

Linkage developed of targeted farmers with Personnel of Extension Service through participation in FGD, field days organized under the project.

Key findings:

a) Selected varieties:

Area wise suitable crop varieties were selected from 1st year trial

Mymensingh:

T. aman rice- Binadhan-11; Mustard- Binasarisha-9; Boro rice- Binadhan-14; Patshak: Binapatshak-1; Aus rice: Binadhan-19

Nalitabari, Sherpur-

T. aman rice-Binadhan-17; Mustard- Binasarisha-9; Boro rice- Binadhan-14

Rangpur:

T. aman rice-Binadhan-17; Mustard-Binasarisha-9; Potato-Asterix; Boro rice-Binadhan-14

Sunamganj:

T. aman rice-Binadhan-17; Mustard- Binasarisha-9; Boro rice- Binadhan-14; Grass pea- Binakhesari-1; Aus rice- Binadhan-19

Gopalganj:

T. aman rice-Binadhan-17; Mustard- Binasarisha-9; Lentil- Binamasur-8; Grass pea- Binakhesari-1; Jute-JRO-524

b) Profitable cropping patterns:

Developed seven profitable cropping patterns at different five project locations with the best crop variety combinations are given below-

Mymensingh

i. T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro (Binadhan-14) cropping pattern

ii. T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus (Binadhan-19) cropping pattern

Sherpur

T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro (Binadhan-14) cropping pattern

Rangpur

i. T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro (Binadhan-14) cropping pattern

ii. T. aman rice (Binadhan-17)-Potato (Asterix)-Boro (Binadhan-14) cropping pattern

Sunamganj

T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro (Binadhan-14) cropping pattern

T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus (Binadhan-19) cropping pattern

Gopalganj

i. T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524) cropping pattern

ii. T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) cropping pattern

iii. T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) cropping pattern

12.2 Component -2 (Agricultural Economies Division)

The following objectives were followed in this study:

- i. To assess the profitability of improved cropping pattern over existing one;
- ii. To determine the increase level of farmers' income and their livelihood improvement.

The project was implemented by Agricultural Economics Division of BINA as a coordinated approach in order to establish profitable cropping pattern at Mymensingh, Sherpur (Nalitabari), Rangpur, Gopalganj and Sunamganj district. The Agricultural Economics Division of BINA was implemented the proposed study in collaboration with ARED and four substations of BINA following participatory approach at farmer's field in selected locations. In this component, main activity was collection of baseline information from selected farmers related to establishment of profitable cropping pattern, data collection from selected farmers related to farm profitability, data analysis and reporting.

Farmers for data collection were selected in consultation with the ARED and Sub-station personnel. In total 48 farmers were selected at each location to fulfill the objectives of the study. For five locations total farmers were $48 \times 5 = 240$. Baseline survey was conducted on the base year 2017-18 before validation/demonstration trials; all information was collected/recorded regarding existing cropping pattern, pattern based profitability, farmers' yearly farm income, their facilities and constraints through structured questionnaire. Data on cost, return and other related factors were collected from selected farmers at the end of each crop season such as Aman, Rabi, Boro/Kharif-1 to determine pattern based profitability in each location for each year. The total number of famers for collecting data of five locations in three year was 2160 (5 locations \times 9 season \times 48 HHs). Almost all cropping patterns were considered for cost-benefit analysis. An in-depth literature review was conducted to supplement secondary information. A strong survey team had been formed with the scientists and trained enumerators of each locations for collecting primary data with the help of substations and DAE personnel. Coordinator and

PIs of the components of this project had monitored the data collection activities on a regular basis. Collected data were edited and scrutinized for analysis. Most appropriate, available and necessary descriptive methods, tools and techniques were used for data analysis. Tabular and diagrammatic analyses were also being carried out. Per hectare profitability of cropping pattern from the view points of individual farmers was measured in terms of Rice equivalent yield (REY), Total return, Gross margin, Net return and Benefit cost ratio (BCR). At the end of the project change of farmers' income and livelihood was identified.

Key Findings

Mymensingh: For the three crops based cropping pattern, the net return was higher in the improved pattern (Tk. 131610.44 ha⁻¹) than farmers' existing pattern (Tk. 33326.74 ha⁻¹). Due to inclusion of mustard as an extra crop in between T. aman and Boro rice net return increased by 295% over farmers' existing pattern. Higher BCR (1.64) was found in T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.23).

For four crops based cropping pattern, the net return was significantly higher (Tk. 156530.58 ha⁻¹) than farmers' existing pattern (Tk. 33326.74 ha⁻¹). Due to inclusion of mustard and patshak as extra crops in between T. aman rice and Aus rice net return increased by 369% over farmers' existing pattern. Higher BCR (1.82) was found in T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.23).

Nalitabari, Sherpur: Due to inclusion of mustard as an extra crop in between T. aman rice and Boro rice, net return increased by 216% over farmers' existing pattern. The highest BCR (1.62) was found in T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (BRRI dhan58) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.25).

Rangpur: The net return was substantially higher in the improved pattern (Tk. 110541.94 ha⁻¹) than farmers' existing pattern (Tk. 33043.66 ha⁻¹). Due to inclusion of mustard as an extra crop in between T. aman rice and Boro rice net return increased by 235% over farmers' existing pattern. Higher BCR (1.56) was also found in T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.22).

Due to inclusion of potato as an extra crop in between T. aman rice and Boro rice net return increased by 535% over farmers' existing pattern. The highest BCR (1.60) was found in T. aman rice (Binadhan-17)-Potato (Asterix)-Boro rice (Binadhan-14) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.22).

Sunamganj: The net return was higher in the improved pattern (Tk. 112852.65 ha⁻¹) than farmers' existing pattern (Tk. 30092.83 ha⁻¹). Due to inclusion of Grass pea as an extra crop in between T. aman rice and Aus rice, net return increased by 275% over farmers' existing pattern. Higher BCR (1.58) was found in T. aman rice (Binadhan-17)-Grass pea

(Binakhesari-1)-Aus rice (Binadhan-19) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.21).

In Bishwambharpur, due to inclusion of mustard as an extra crop in between T. aman rice and Boro rice, net return increased by 261% over farmers' existing pattern. The highest BCR (1.55) was found in T. aman rice (Binadhan-17)-Mustard (BARI Sarisha-14)-Boro rice (Binadhan-14) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.23).

Kashiani, Gopalganj: The net return was higher in the improved pattern (Tk. 111576.00 ha⁻¹) than farmers' existing pattern (Tk. 37134.42 ha⁻¹). Due to inclusion of mustard as an extra crop in between T. aman rice and Jute, net return increased by 200% over farmers' existing pattern. Higher BCR (1.55) was found in T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.24).

Due to inclusion of Grass pea as an extra crop in between T. aman rice and Jute, net return increased by 247% over farmers' existing pattern. The highest BCR (1.61) was found in T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.24).

Due to inclusion of lentil as an extra crop in between T. aman rice and Jute, net return increased by 256% over farmers' existing pattern. The highest BCR (1.57) was found in T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) improved cropping pattern as compared to farmers' existing cropping pattern BCR (1.24).

The overall livelihood improvement was 14.24%. It revealed that 12.77, 14.60, 13.75, 16.25 and 14.58 percent of all kind of livelihood assets increased due to the change in cropping patterns in the study areas of the sampled farmers. Among the five locations, the overall changes of income was 17.09%. The highest change of income was found in Rangpur districts 20.22%, followed by Mymensingh 17.54%, Sunamganj 16.22%, Gopalganj 15.56% and the lowest was found in Sherpur district 14.56%. The four crops based cropping pattern would play a vital role to ensure food security of the country in upcoming days.

Key words: Profitability, Improved cropping pattern, Income and Livelihood, Focus group discussion, Rice equivalent yield, Field duration

B. Implementation status

1. Procurement

1.1 Coordination compornet

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment	5	36000	5	35200	
(b) Lab & field equipment	6	180000	6	167250	
(c) Other capital items	-	-	-	-	

1.2 Component-1

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment	15	142500	15	138500	
(b) Lab & field equipment	21	755000	21	749750	
(c) Other capital items					

1.3 Component-2

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment	11	87000	11	87000	
(b) Lab & field equipment	07	195000	07	194300	
(c) Other capital items					

2. Establishment/renovation facilities:

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/ seminar/workshop/conference organized:

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) SAAO and Farmers Training	45	7	52	One day	
(b) Workshop					
i. Inception workshop	99	18	117	One day	
ii. 'Dissemination of technology of four crops based cropping pattern'	83	20	103	One day	
(c) Others (if any)	-	-	-		

C. Financial and physical progress

Coordination compornet

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	547210	-	547210	00.00	100.00	
b. Field research/lab expenses and supplies	316600	-	316600	00.00	100.00	
c. Operating expenses	192481	-	192481	00.00	100.00	
d. Vehicle hire and fuel, oil & maintenance	156445	-	156445	00.00	100.00	
e. Training/workshop/ seminar etc.	258900	-	252600	00.00	100.00	
f. Publications and printing	285250	-	282350	00.00	100.00	
g. Miscellaneous	30664	-	30664	00.00	100.00	
h. Capital expenses	202450	-	202450	00.00	100.00	
Total	1990000	1980800	1980800	00.00	100.00	

Component-1

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	2948981	-	2948981	00.00	100.00	
b. Field research/lab expenses and supplies	5638956	-	5635645	00.00	100.00	
c. Operating expenses	1098036	-	1097247	00.00	100.00	
d. Vehicle hire and fuel oil & maintenance	644000	-	644000	00.00	100.00	
e. Training/workshop/ seminar etc.	0	-	0	00.00	100.00	
f. Publications and printing	80000	-	77100	00.00	100.00	
g. Miscellaneous	131777	-	128277	00.00	100.00	
h. Capital expenses	888250	-	888250	00.00	100.00	
Total	11430000	11419500	11419500	00.00	100.00	

Component-2

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	221090.00	-	221090.00	00.00	100.00	
b. Field research/lab expenses and supplies	1157600.00	-	1157600.00	00.00	100.00	
c. Operating expenses	477072.00	-	473953.00	00.00	100.00	
d. Vehicle hire and fuel oil & maintenance	428138.00	-	428138.00	00.00	100.00	
e. Training/workshop/ seminar etc.	00.00	-	00.00	00.00	00.00	
f. Publications and printing	00.00	-	00.00	00.00	00.00	
g. Miscellaneous	14800.00	-	14800.00	00.00	100.00	
h. Capital expenses	281300.00	-	281300.00	00.00	100.00	
Total	2580000.00	2576881.00	2576881.00	00.00	100.00	

D. Achievement of Sub-project by objectives (Tangible form): Technology generated/developed

Component-1

General/specific objectives of the 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 increase cropping intensity, system productivity and farm profitability through designing suitable three or four cropping patterns	120 bock demonstrations in each year were conducted in the season of Aman, Rabi and Boro/Aus/Jute for three years.	Developed seven profitable cropping patterns i. T. aman rice-Musatrd- Boro rice for Mymensingh sadar, Nalitabari of Sherpur, Rangpur sadar and Bishwambharpur and sadar of Sunamganj ii. T. aman rice-Mustard-Patshak-Aus rice for Mymensingh sadar iii. T. aman rice-Potato-Boro rice for Rangpur sadar iv. T. aman rice-Grass pea-Aus rice for Sunamganj sadar and v. T. aman rice-Mustard-Jute vi. T. aman rice-Lentil-Jute vii. T. aman rice-Grass pea-Jute for Kashiani of Gopalganj.	Increased farmers income 295%-369% in Mymensingh, 216% at Sherpur, 235%-535% in Rangpur, 261%-275% at Sunamganj and 200%-256% at Gopalganj.

E: Information/Knowledge generated/Policy generated

Component-1

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
To identify location specific suitable improved crop varieties	120 block trials were conducted including more number of crops varieties for screening suitable varieties in aman, rabi and Boro/Aus/Jute in 2018-19	<p>Mymensingh: T. aman rice- Binadhan-11 ; Mustard- Binasarisha-9; Boro rice- Binadhan-14; Patshak: Binapatsh ak-1; Aus rice: Binadhan-19.</p> <p>Nalitabari, Sherpur: T. aman rice-Binadhan-17; Mustard- Binasarisha-9;Boro rice- Binadhan-14.</p> <p>Rangpur: T. aman rice-Binadhan-17; Mustard- Binasarisha-9; Potato-Asterix; Boro rice- Binadhan-14.</p> <p>Sunamganj: T. aman rice-Binadhan-17; Mustard- Binasarisha-9; Boro rice- Binadhan-14; Grass pea- Binakhesari-1; Aus rice- Binadhan-19.</p> <p>Gopalganj: T. aman rice-Binadhan-17; Mustard- Binasarisha-9; Lentil- Binamasur-8; Grass pea- Binakhesari-1; Jute- JRO-524</p>	Farmers are following the cropping patterns.
To improve knowledge and skill of farmers and extension personnel on improved techniques of cropping pattern.	<ul style="list-style-type: none"> ● Training of SAAO and Farmers ● Focus Group Discussion (FGD) ● Monitoring and field visit depending on growing seasons ● Organize field days depending on growing seasons ● Distribution of leaflet, booklet, 	Improved knowledge and skill of farmers and extension personnel on improved cropping pattern.	

Component-2

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (short term effect of the research)
To assess the profitability of improved cropping pattern over existing one	Suitable site selection, baseline survey, data collection, data entry, data analysis	One best profitable improved cropping pattern over existing one was identified. Improved cropping patterns are as follows: T. aman rice-Mustard-Boro rice (1) T. aman rice-Mustard-Patshak-Aus rice (2) T. aman rice-Potato-Boro rice (3) T. aman rice-Grass pea-Aus rice (4) T. aman rice-Mustrad-Jute (5) T. aman rice-Lentil-Jute (6) and T. aman rice-Grass pea-Jute (7) gave higher yield, net return and BCR over existing cropping patterns T. aman rice-Fallow-Boro rice (1) T. aman rice-Fallow-Aus rice (2) and T. aman rice-Fallow-Jute (3)	About 216%-535% net return increased from improved cropping patterns over farmers existing patterns.
To determine the increase level of farmers income and their livelihood improvement	Data collection, data entry, data analysis	The change of farmer's income and livelihood improvement was 17.09% and 14.24%, respectively.	Farmers' income increased due to include as an extra one or two crops in between T. aman rice and Boro rice/Aus rice/Jute over farmers' existing pattern

F. Materials development/Publication made under the Sub-project

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.	Seven Technology bulletin		
Journal publication	-		
Video clip/TV program	One video clip	Five TV program in BTV, Banglavision, Channel i, Ekushey TV, Maasranga	
News Paper/ Popular Article	-	The Daily Sangbad, The Daily Audhamy Bangla, The Daily Sabuj, The Daily Shawjan, The Dainik Swadesh Sangbad, The Ajker Bangladesh, The Daily KalerAlo	
Other publications, if any	-		

G. Description of generated Technology/Knowledge/Policy

- i. Technology Fact sheet (title of the technology, introduction, description, suitable location/ecosystem, benefits, name and contact address of author)

1. Title of the technology: T. aman rice-Mustard-Patshak-Aus rice cropping pattern

Introduction

In Mymensingh district, two crops are mostly grown annually in about 66% land following the cropping pattern T. aman rice-Fallow-Boro rice. To ensure food and nutritional security of the ever growing population, to reduce the import of edible oil and to save scarce ground water, the improved cropping pattern, T. aman rice-Mustard-Patshak (Jute for leaf)-Aus rice was developed incorporating two additional crops mustard and patshak. The improved cropping pattern increases net return by up to 369% and cropping intensity by up to 400% compare to the existing pattern.

Description

Management practices	T. aman rice	Mustard	Patshak	Aus rice
Varieties	Binadhan-11	Binasarisha-9	Binapatshak-1	Binadhan-19
Seed rate (kg ha ⁻¹)	30	7.5	15	30
Seed treatment* (10 kg)	20-25 g Noin/Provax	25 g Noin/Provax	25 g Noin/Provax	As like T. aman rice
Sowing/and transplanting time	Transplanting of seedling at last week of July to last week of August at the age of 20-25 days	October to mid-November	Third week of March to 3rd week of May	Seedling transplanting at April-May at the age of 15-20 days. Broadcasting/ dibbling of seeds may also be followed.
Fertilizer** (kg ha ⁻¹)	Urea 150-160 TSP 110-120 MOP 50-60 Gypsum 55 Zinc sulphate 5.5-6.0	Urea 200-220 TSP 170-200 MoP 110-135 Gypsum 125-150 Zinc sulphate 10 Boric acid 7.5	Urea 50 TSP 40 MoP 40 Farm yard manure 5 t	Urea 163-185 TSP 75-100 MoP 60-80 Gypsum 66-88
Irrigation	T. aman rice is rainfed; in case of prolonged drought, 1-2 supplementary irrigations may be required.	In case of lack of moisture in the soil, the first irrigation should be applied at 20-25 days after the seed germination and the second irrigation should be applied after flowering, if necessary.	No need to irrigate but if the soil becomes dry then one irrigation may be applied	Normally cultivated in rainfed condition. However, in case of extreme drought, 1-2 irrigations can be given at tillering and panicle initiation stages

Management practices	T. aman rice	Mustard	Patshak	Aus rice
Weeding and mulching	Weeding can be done manually or with the help of hoe for 2-3 times followed by mulching. Weeds can be controlled by applying pre-emergence Pretilachlor 50 EC or Pendimethalin and post-emergence Bispyribac or Phenoxalam weedicide.	Weeds should be removed once at 15-20 days of seedling growth along with excess seedlings should be thinned.	One hand weeding followed by mulching for loosening the soil.	As like T. aman
Pest management	In case of infestation of stem borer Marshal 6G can be used. Folicure may be used for sheath blight or leaf blight diseases at the rate of 200 ml/acre and to control blast Trooper/Nativo should be applied at the rate of 180 g/acre.	For controlling leaf and pod blight 2-3 g of Rovral 50WP/liter water should be sprayed for 3-4 times at 8-10 days interval.	No chemical control measure is suggested. Yellow mosaic disease infected plants should be pulled out and buried.	Virtako 40 WG may be used to control the infestation of leafhoppers and leaf-rolling insects
Duration (days)	110-115	80-84	30-40	95-105
Yield (t ha ⁻¹)	5.00-5.50	1.70	3.00-3.50	4.50-5.00

**For seed treatment, seeds are soaked in pure water; the impurities along with unfilled seeds are removed with the water. Then the seed treating fungicide (Noin/Provax) are mixed properly with the seeds and are kept in a cool place within a closed container until the surface moisture is evaporated.*

****Rice:** *The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP should be applied during the final land preparation. Urea should be applied at three equal installments; the 1st installment after 7-10 days after transplanting, the second and 3rd doses after 20-25 days and 30-35 days of transplanting, respectively, along with the remaining amount of MoP. TSP and Zinc sulphate should not be applied at the same time.*

****Mustard:** *The whole amount of TSP, Gypsum, Boric acid, ZnSO₄ and 1/2 of Urea should be applied during the final land preparation. Rest of the Urea should be applied after 20-25 days of seed sowing as top dress.*

****Patshak:** *The whole amount of fertilizers should applied during the final land preparation and the farm yard manure (FYM) before two weeks of land preparation.*

Suitable location/ecosystem: All Upazilas of Mymensingh and all over the country having medium to medium high land, sandy loam and clay loam soil along with similar climatic condition.

Benefits:

- Increased cropping intensity up to 400%;
- Due to incorporation of two extra crops and replacing Boro rice by Aus rice, net return increased up to 369 % over existing pattern;
- BCR for four crops is 1.82 against 1.23 for existing cropping pattern;
- Ground water saving due to cultivation of Aus rice instead of Boro rice.



T. aman rice (Binadhan-11)



Mustard (Binasarisha-9)



Patshak (Binapatshak-1)



Aus rice (Binadhan-19)

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2. Title of the technology: T. aman rice-Mustard-Boro rice cropping pattern

Introduction

To reduce the import of edible oil, the improved cropping pattern, T. aman rice-Mustard-Boro rice was developed for Mymensingh sadar, Nalitabari of Sherpur, Rangpur sadar and Bishwambharpur of Sunamganj by incorporating one additional crop mustard in the existing two crops based cropping pattern, T. aman rice-Fallow-Boro rice. The improved cropping pattern increases net return by up to 216-295% and cropping intensity by up to 300% than the existing pattern.

Description

Management practices	T. aman rice	Mustard	Boro rice
Varieties	Binadhan-11/Binadhan-17	Binasarisha-9	Binadhan-14
Seed rate (kg ha ⁻¹)	30	7.5	30
Seed treatment* (10 kg)	20-25 g Noin/Provax	25 g Noin/Provax	As like T. aman rice
Sowing/and transplanting time	Transplanting of seedling at last week of July to last week of August at the age of 20-25 days	October to mid-November	Seedling transplanting during 2 nd week of February to 3 rd week of March at age of 20-25 days.
Fertilizer** (kg ha ⁻¹)	Urea 150-160 TSP 110-120 MOP 50-60 Gypsum 55 Zinc sulphate 5.5-6.0	Urea 200-220 TSP 170-200 MoP 110-135 Gypsum 125-150 Zinc sulphate 10 Boric acid 7.5	Urea 220-260 TSP 100-125 MoP 140-180 Gypsum 65-80 Zinc sulphate 7-8
Irrigation	T. aman rice is rainfed; in case of prolonged drought, 1-2 supplementary irrigations may be required.	In case of lack of moisture in the soil, the first irrigation should be applied at 20-25 days after the seed germination and the second irrigation should be applied after flowering, if necessary.	Should maintain sufficient irrigation water during panicle initiation to milking stages.
Weeding and mulching	Weeding can be done manually or with the help of hoe for 2-3 times followed by mulching. Weeds can be controlled by applying pre-emergence Pretilachlor 50 EC or Pendimethalin and post-emergence Bispyribac or Phenoxalam weedicide.	Weeds should be removed once at 15-20 days of seedling growth along with excess seedlings should be thinned.	As like T. aman rice

Management practices	T. aman rice	Mustard	Boro rice
Pest management	In case of infestation of stem borer Marshal 6G can be used. Folicure may be used for sheath blight or leaf blight diseases at the rate of 200 ml/acre and to control blast Trooper/Nativo should be applied at the rate of 180 g/acre.	For controlling leaf and pod blight 2-3 g of Rovral 50WP/liter water should be sprayed for 3-4 times at 8-10 days interval.	Virtako 40 WG may be used to control the infestation of leaf hoppers and leaf rolling insects
Duration (days)	Binadha-11: 110-115 Binadhan-17: 112-118	80-84	120-130
Yield (t ha ⁻¹)	Binadha-11: 5.0-5.5 Binadhan-17: 6.8-8.0	1.70	6.90

**For seed treatment, seeds are soaked in pure water, the impurities along with unfilled seeds are removed with the water. Then the seed treating fungicide (Noin/Provax) are mixed properly with the seeds and are kept in a cool place within a closed container until the surface moisture is evaporated.*

****Rice:** The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP should be applied during the final land preparation. Urea should be applied at three equal installments; the 1st installment after 7-10 days after transplanting, the second and 3rd doses after 20-25 days and 30-35 days of transplanting, respectively, along with the remaining amount of MoP. TSP and Zinc sulphate should not be applied at the same time.

****Mustard:** The whole amount of TSP, Gypsum, Boric acid, ZnSO₄ and 1/2 of Urea should be applied during the final land preparation. Rest of the Urea should be applied after 20-25 days of seed sowing as top dress.

Suitable location/ecosystem: Mymensingh sadar, Nalitabari of Sherpur, Rangpur sadar, Bishwambharpur of Sunamganj and all over the country having medium to medium high land, sandy loam and clay loam soil along with similar climatic condition.

Benefits:

- Increased cropping intensity up to 300%;
- Due to incorporation of one additional crop, net return increased up to 295 % at Mymensingh sadar, 216% at Nalitabari of Sherpur, 235% at Rangpur sadar and 261% at Bishwambharpur of Sunamganj over existing pattern;
- BCR at Mymensingh sadar was found 1.64 against existing pattern 1.23, 1.62 at Nalitabari of Sherpur against existing pattern 1.25, 1.56 at Rangpur sadar against existing pattern 1.22 and 1.55 at Bishwambharpur of Sunamganj against existing pattern 1.23.



T. aman rice (Binadhan-11)



Mustard (Binasarisha-9)



Boro rice (Binadhan-14)

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3. Title of the technology: T. aman rice-Potato-Boro rice cropping pattern

Introduction

Two crops are cultivated in some lands of Rangpur sadar annually. To attain double farm productivity target of sustainable development goal (SDG) of UNO together with enhanced supply of nutritious food to the common people of Bangladesh within 2030, the improved cropping pattern, T. aman rice-Potato-Boro rice was developed by incorporating an additional crop potato which increases net return up to 535% and cropping intensity up to 300% compare to the existing pattern.

Description

Management practices	T. aman rice	Potato	Boro rice
Varieties	Binadhan-17	Asterix	Binadhan-14
Seed rate (kg ha ⁻¹)	30	1.5-2.0 t	30
Seed treatment* (10 kg)	20-25 g Noin/Provax	30 g of 3% Boric acid mixed in one liter water ; seeds are soaked for 15-20 minutes and then dried	As like T. aman rice
Sowing/and transplanting time	Transplanting of seedling at last week of July to last week of August at the age of 20-25 days	November	Seedling transplanting during 2 nd week of February to 3 rd week of March at age of 20-25 days.
Fertilizer** (kg ha ⁻¹)	Urea 150-160 TSP 110-120 MOP 50-60 Gypsum 55 Zinc sulphate 5.5-6.0	Urea 325-350 TSP 200-220 MoP 250-300 Gypsum 100-120 Zinc sulphate 10 Boric acid 7.5 Cow dung 8-10 t	Urea 220-260 TSP 100-125 MoP 140-180 Gypsum 65-80 Zinc sulphate 7-8
Irrigation	T. aman rice is rainfed; in case of prolonged drought, 1-2 supplementary irrigations may be required.	In case of lack of moisture in the soil after seed sowing for 2-3 times carefully avoiding standing water. First after the seed germination and the second irrigation should be done after flowering, if necessary	Should maintain sufficient irrigation water during panicle initiation to milking stages.
Weeding and mulching	Weeding can be done manually or with the help of hoe for 2-3 times followed by mulching. Weeds can be controlled by applying pre-emergence Pretilachlor 50 EC or Pendimethalin and post-emergence Bispyribac or Phenoxalam weedicide.	Weeds should be removed once at 15-20 days of seedling growth along with extra seedlings should be thinned	As like T. aman rice

Management practices	T. aman rice	Potato	Boro rice
Pest management	In case of infestation of stem borer Marshal 6G can be used. Folicure may be used for sheath blight or leaf blight diseases at the rate of 200 ml/acre and to control blast Trooper/Nativo should be applied at the rate of 180 g/acre.	In case of infestation, Acrovat MZ 2 g/litre water should be spread in 7-10 days interval.	Virtako 40 WG may be used to control the infestation of leaf hoppers and leaf rolling insects
Duration (days)	112-118	90-95	120-130
Yield (t ha ⁻¹)	6.8-8.0	25-30	6.90

**For seed treatment, seeds are soaked in pure water; the impurities along with unfilled seeds are removed with the water. Then the seed treating fungicide (Noin/Provax) are mixed properly with the seeds and are kept in a cool place within a closed container until the surface moisture is evaporated.*

***Rice:* The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP should be applied during the final land preparation. Urea should be applied at three equal installments; the 1st installment after 7-10 days after transplanting, the second and 3rd doses after 20-25 days and 30-35 days of transplanting, respectively, along with the remaining amount of MoP. TSP and Zinc sulphate should not be applied at the same time.

***Potato:* The whole amount of TSP, MoP, Boric acid and 1/2 of Urea should be applied during final land preparation. Rest of the Urea should be applied after 30-35 days of seed sowing. Cowdung should be applied two weeks before land preparation.

Suitable location/ecosystem: Rangpur sadar and all over the country having medium to medium high land, sandy loam soil along with similar climatic condition.

Benefits:

- Increased cropping intensity up to 300%;
- Due to incorporation of one more crop, net return increased up to 535% over existing pattern;
- BCR is 1.60 against 1.22 for existing cropping pattern.



T. aman rice (Binadhan-17)



Potato (Asterix)



Boro rice (Binadhan-14)

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4. Title of the technology: T. aman rice -Grass pea-Aus rice cropping pattern

Introduction

For reducing the import of pulse, the improved cropping pattern, T. aman rice-Grass pea-Aus rice was developed for Sunamganj sadar incorporating one more crop in the existing cropping pattern T. aman rice-Fallow-Aus rice pattern which increased return up to 275% and cropping intensity up to 300% compare to the existing pattern.

Description

Management practices	T. aman rice	Grass pea	Aus rice
Varieties	Binadhan-17	Binakheshari-1	Binadhan-19
Seed rate (kg ha ⁻¹)	30	40	30
Seed treatment* (10 kg)	20-25 g Noin/Provax	20-25 g Vitavax-200/Bavistin	As like T. aman rice
Sowing/and transplanting time	Transplanting of seedling at last week of July to last week of August at the age of 20-25 days	1 st week of November to 2 nd week of December	Seedling transplanting at April-May at the age of 15-20 days. Broadcasting/dibbling of seeds may also be followed.
Fertilizer** (kg ha ⁻¹)	Urea 150-160 TSP 110-120 MoP 50-60 Gypsum 55 Zinc sulphate 5.5-6.0	Urea 30-40 TSP 50-70 MoP 40-50 Gypsum 30-50 Biofertilizer 2	Urea 163-185 TSP 75-100 MoP 60-80 Gypsum 66-88
Irrigation	T. aman rice is rainfed; in case of prolonged drought, 1-2 supplementary irrigations may be required.	In case of insufficient moisture in the soil, one irrigation may be applied.	Normally cultivated in rainfed condition. However, in case of extreme drought, 1-2 irrigations can be given at tillering and panicle initiation stages
Weeding and mulching	Weeding can be done manually or with the help of hoe for 2-3 times followed by mulching. Weeds can be controlled by applying pre-emergence Pretilachlor 50 EC or Pendimethalin and post-emergence Bispyribac or Phenoxalam weedicide.	Weeds should be removed once at 15-20 days of seedling growth.	As like T. aman rice

Management practices	T. aman rice	Grass pea	Aus rice
Pest management	In case of infestation of stem borer Marshal 6G can be used. Folicure may be used for sheath blight or leaf blight diseases at the rate of 200 ml/acre and to control blast Trooper/Nativo should be applied at the rate of 180 g/acre.	To control insect pest, Sobicron-425 EC or Malathion-57 EC should be applied at specific dose in the afternoon.	Virtako 40 WG may be used to control the infestation of leafhoppers and leaf-rolling insects
Duration (days)	112-118	115-125	95-105
Yield (t ha ⁻¹)	6.8-8.0	1.9	4.50-5.00

**For seed treatment, seeds are soaked in pure water, the impurities along with unfilled seeds are removed with the water. Then the seed treating fungicide (Noin/Provax) are mixed properly with the seeds and are kept in a cool place within a closed container until the surface moisture is evaporated.*

****Rice:** The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP should be applied during the final land preparation. Urea should be applied at three equal installments; the 1st installment after 7-10 days after transplanting, the second and 3rd doses after 20-25 days and 30-35 days of transplanting, respectively, along with the remaining amount of MoP. TSP and Zinc sulphate should not be applied at the same time.

****Grass pea:** The whole amount of fertilizers should be applied during final land preparation.

Suitable location/ecosystem: Sunamganj sadar and all over the country having medium to medium high land along with similar climatic condition.

Benefits:

- Increased cropping intensity up to 300%;
- Due to incorporation of one more crop, net return increased up to 275% over existing pattern;
- BCR is 1.58 against 1.21 for existing cropping pattern.



T. aman rice (Binadhan-17)



Grass pea (Binakheshari-1)



Aus rice (Binadhan-19)

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5. Title of the technology: T. aman rice-Mustard-Jute cropping pattern

Introduction

To increase the production of oil crops for reducing the import of edible oil, the improved cropping pattern, T. aman rice-Mustard-Jute was developed for Kashiani, Gopalganj by incorporating an additional crop mustard crop in the cropping pattern T. aman rice-Fallow-Jute which increased net return by up to 200% and cropping intensity by up to 300% compare to the existing pattern.

Description

Management practices	T. aman rice	Mustard	Jute
Varieties	Binadhan-17	Binasarisha-9	JRO-524
Seed rate (kg ha ⁻¹)	30	7.5	10
Seed treatment* (10 kg)	20-25 g Noin/Provax	25 g Noin/Provax	50 g Vitavax-200
Sowing/and transplanting time	Transplanting of seedling at last week of July to last week of August at the age of 20-25 days	October to mid-November	1st week of April to 1 st week of May.
Fertilizer** (kg ha ⁻¹)	Urea 150-160 TSP 110-120 MoP 50-60 Gypsum 55 Zinc sulphate 5.5-6.0	Urea 200-220 TSP 170-200 MoP 110-135 Gypsum 125-150 Zinc sulphate 10 Boric acid 7.5	Urea 175-225 TSP 80-100 MoP 80-120 Gypsum 60-75
Irrigation	T. aman rice is rainfed; in case of prolonged drought, 1-2 supplementary irrigations may be required.	In case of lack of moisture in the soil, the first irrigation should be applied at 20-25 days after the seed germination and the second irrigation should be applied after flowering, if necessary.	In case of lack of moisture in the soil during seed sowing a light irrigation should be applied.
Weeding and mulching	Weeding can be done manually or with the help of hoe for 2-3 times followed by mulching. Weeds can be controlled by applying pre-emergence Pretilachlor 50 EC or Pendimethalin and post-emergence Bispyribac or Phenoxalam weedicide.	Weeds should be removed once at 15-20 days of seedling growth along with excess seedlings should be thinned.	2-3 times weeding should be done manually or with the help of hoe followed by mulching.

Management practices	T. aman rice	Mustard	Jute
Pest management	In case of infestation of stem borer Marshal 6G can be used. Folicure may be used for sheath blight or leaf blight diseases at the rate of 200 ml/acre and to control blast Trooper/Nativo should be applied at the rate of 180 g/acre.	For controlling leaf and pod blight 2-3 g of Rovral 50WP/liter water should be sprayed for 3-4 times at 8-10 days interval.	To control the infestation of red and white mites Thiovit WP 10.5 g/litre water should be applied for every five decimal of land. For stem rot, Dithane M-45 should be applied at the rate of 4.5 g/liter water
Duration (days)	112-118	80-84	120-150
Yield (t ha ⁻¹)	6.8-8.0	1.70	2.70-2.80

**For seed treatment, seeds are soaked in pure water, the impurities along with unfilled seeds are removed with the water. Then the seed treating fungicide (Noin/Provax) are mixed properly with the seeds and are kept in a cool place within a closed container until the surface moisture is evaporated.*

****Rice:** The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP should be applied during the final land preparation. Urea should be applied at three equal installments; the 1st installment after 7-10 days after transplanting, the second and 3rd doses after 20-25 days and 30-35 days of transplanting, respectively, along with the remaining amount of MoP. TSP and Zinc sulphate should not be applied at the same time.

****Mustard:** The whole amount of TSP, Gypsum, Boric acid, ZnSO₄ and 1/2 of Urea should be applied during the final land preparation. Rest of the Urea should be applied after 20-25 days of seed sowing as top dress.

****Jute:** The whole amount of Urea, TSP, MoP and Gypsum should be applied during the final land preparation. Additional 40 kg of Urea hectare⁻¹ should be applied carefully.

Suitable location/ecosystem: Kashiani of Gopalganj and all over the country having medium to medium high land, sandy loam soil along with similar climatic condition.

Benefits:

- Increased cropping intensity up to 300%;
- Due to incorporation of one additional crop, net return increased up to 200% over existing pattern;
- BCR is 1.55 against existing pattern 1.24.



T. aman rice (Binadhan-17)



Mustard (Binasarisha-9)



Jute (JRO-524)

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6. Title of the technology: T. aman rice-Grass pea-Jute cropping pattern

Introduction

To reduce the import of pulse, the improved cropping pattern, T. aman rice-Grass pea-Jute was developed for Kashiani, Gopalganj by incorporating an additional crop grass pea in the two crops based existing cropping pattern T. aman rice-Fallow-Jute which increased net return by up to 247% and cropping intensity by up to 300% compare to the existing pattern.

Description

Management practices	T. aman rice	Grass pea	Jute
Varieties	Binadhan-17	Binakhesari-1	JRO-524
Seed rate (kg ha ⁻¹)	30	40	10
Seed treatment* (10 kg)	20-25 g Noin/Provax	20-25 g Vitavax-200/Bavistin	50 g Vitavax-200
Sowing/and transplanting time	Transplanting of seedling at last week of July to last week of August at the age of 20-25 days	1 st week of November to 2 nd week of December	1 st week of April to 1 st week of May.
Fertilizer** (kg ha ⁻¹)	Urea 150-160 TSP 110-120 MoP 50-60 Gypsum 55 Zinc sulphate 5.5-6.0	Urea 30-40 TSP 50-70 MoP 40-50 Gypsum 30-50 Biofertilizer 2	Urea 175-225 TSP 80-100 MoP 80-120 Gypsum 60-75
Irrigation	T. aman rice is rainfed; in case of prolonged drought, 1-2 supplementary irrigations may be required.	In case of insufficient moisture in the soil, one irrigation may be applied.	In case of lack of moisture in the soil during seed sowing a light irrigation should be applied.
Weeding and mulching	Weeding can be done manually or with the help of hoe for 2-3 times followed by mulching. Weeds can be controlled by applying pre-emergence Pretilachlor 50 EC or Pendimethalin and post-emergence Bispyribac or Phenoxalam weedicide.	Weeds should be removed once at 15-20 days of seedling growth.	2-3 times weeding should be done manually or with the help of hoe followed by mulching.

Management practices	T. aman rice	Grass pea	Jute
Pest management	In case of infestation of stem borer Marshal 6G can be used. Folicure may be used for sheath blight or leaf blight diseases at the rate of 200 ml/acre and to control blast Trooper/Nativo should be applied at the rate of 180 g/acre.	To control insect pest, Sobicron-425 EC or Malathion-57 EC should be applied at specific dose in the afternoon.	To control the infestation of red and white mites Thiovit WP 10.5 g/litre water should be applied for every five decimal of land. For stem rot, Dithane M-45 should be applied at the rate of 4.5 g/liter water
Duration (days)	112-118	115-125	120-150
Yield (t ha ⁻¹)	6.8-8.0	1.90	2.70-2.80

**For seed treatment, seeds are soaked in pure water, the impurities along with unfilled seeds are removed with the water. Then the seed treating fungicide (Noin/Provax) are mixed properly with the seeds and are kept in a cool place within a closed container until the surface moisture is evaporated.*

****Rice:** *The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP should be applied during the final land preparation. Urea should be applied at three equal installments; the 1st installment after 7-10 days after transplanting, the second and 3rd doses after 20-25 days and 30-35 days of transplanting, respectively, along with the remaining amount of MoP. TSP and Zinc sulphate should not be applied at the same time.*

****Grass pea:** *The whole amount of fertilizers should be applied during final land preparation.*

****Jute:** *The whole amount of Urea, TSP, MoP and Gypsum should be applied during the final land preparation. Additional 40 kg of Urea/hectare should be applied carefully.*

Suitable location/ecosystem: Kashiani of Gopalganj and all over the country having medium to medium high land, sandy loam soil along with similar climatic condition.

Benefits:

- Increased cropping intensity up to 300%;
- Due to incorporation of an additional crop, net return increased up to 247% over existing pattern;
- BCR is 1.61 against existing pattern 1.24.



T. aman rice (Binadhan-17)



Grass pea (Binakhesari-1)



Jute (JRO-524)

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7. Title of the technology: T. aman rice-Lentil-Jute cropping pattern

Introduction

The existing cropping pattern of Kashiani, Gopalganj is mostly T. aman rice-Fallow-Jute. To meet up the required pulse of the ever growing population of Bangladesh, the improved cropping pattern, T. aman rice-Lentil-Jute was developed incorporating an additional crop lentil which increased net return by up to 256% and cropping intensity by up to 300% compare to the existing pattern.

Description

Management practices	T. aman rice	Lentil	Jute
Varieties	Binadhan-17	Binamasur-8	JRO-524
Seed rate (kg ha ⁻¹)	30	14-16	10
Seed treatment* (10 kg)	20-25 g Noin/Provax	25 g Vitavax-200	50 g Vitavax-200
Sowing/and transplanting time	Transplanting of seedling at last week of July to last week of August at the age of 20-25 days	Last week of October to 2 nd week of November	1 st week of April to 1 st week of May.
Fertilizer** (kg ha ⁻¹)	Urea 150-160 TSP 110-120 MoP 50-60 Gypsum 55 Zinc sulphate 5.5-6.0	Urea 30-35 TSP 80-90 MoP 30-35 Gypsum 25-30 Zinc sulphate 2-3	Urea 175-225 TSP 80-100 MoP 80-120 Gypsum 60-75
Irrigation	T. aman rice is rainfed; in case of prolonged drought, 1-2 supplementary irrigations may be required.	In case of extreme drought, one irrigation may be done	In case of lack of moisture in the soil during seed sowing a light irrigation should be applied.
Weeding and mulching	Weeding can be done manually or with the help of hoe for 2-3 times followed by mulching. Weeds can be controlled by applying pre-emergence Pretilachlor 50 EC or Pendimethalin and post-emergence Bispyribac or Phenoxalam weedicide.	Weeds should be removed once at 25-35 days of seedling growth	2-3 times weeding should be done manually or with the help of hoe followed by mulching.

Management practices	T. aman rice	Lentil	Jute
Pest management	In case of infestation of stem borer Marshal 6G can be used. Folicure may be used for sheath blight or leaf blight diseases at the rate of 200 ml/acre and to control blast Trooper/Nativo should be applied at the rate of 180 g/acre.	To control stemphylium blight, Rovral 50 WP (0.2%) should be applied at 10 days interval for 2-3 times and to control insect pest, Sobicron-425 EC or Malathion-57 EC should be applied at recommended dose in the afternoon.	To control the infestation of red and white mites Thiovit WP 10.5 g/litre water should be applied for every five decimal of land. For stem rot, Dithane M-45 should be applied at the rate of 4.5 g/liter water
Duration (days)	112-118	95-100	120-150
Yield (t ha ⁻¹)	6.80-8.00	2.20-2.40	2.70-2.80

**For seed treatment, soak the seeds in pure water to remove the impurities and unfilled seeds followed by removal of the water. Finally, mix the fungicide (Noin/Provax) properly with the seed and keep in a cool place within a closed container until surface moisture dry.*

****Rice:** The whole amount of TSP, Gypsum, ZnSO₄ and 2/3rd of MoP should be applied during the final land preparation. Urea should be applied at three equal installments; the 1st installment after seedling establishment, the second and 3rd doses after 20-25 days and 30-35 days of planting, respectively. The remaining amount of MoP should apply with the last dose of urea. TSP and Zinc sulphate fertilizers should not be applied at the same time.

****Lentil:** The whole amount of fertilizers should be applied during the final land preparation. TSP and Zinc sulphate fertilizers should not be applied at the same time.

****Jute:** The whole amount of Urea, TSP, MoP and Gypsum should be applied during the final land preparation. Additional 40 kg of Urea/hectare should be applied carefully.

Suitable location/ecosystem: Kashiani of Gopalganj and all over the country having medium to medium high land, sandy loam soil along with similar climatic condition.

Benefits:

- Increased cropping intensity up to 300%;
- Due to incorporation of an additional crop, net return increased up to 256% over existing pattern;
- BCR is 1.57 against existing pattern 1.24.



T. aman rice (Binadhan-17)



Lentil (Binamasur-8)



Jute (JRO-524)

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- ii. Effectiveness in policy support (if applicable)

H. Technology/Knowledge generation/Policy Support (as applied)

- i. Immediate impact on generated technology (commodity & non-commodity)
- (a) **T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) cropping pattern**
 - Increased cropping intensity by 200%
 - Due to incorporation of two extra crops and shifting of Boro rice by Aus rice net return increased 369 % over existing pattern
 - BCR for four crops 1.82 while 1.23 for existing cropping pattern
 - Irrigation water saves due to cultivation of Aus rice instead of Boro rice
 - Total Rice Equivalent Yield (REY) was found 17.85 t ha⁻¹.
 - (b) **T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Boro rice (Binadhan-14) cropping pattern**
 - Increased cropping intensity by 100%
 - Due to incorporation of one extra crop net return increased 216%-295% over existing pattern
 - BCR was increased to 1.55-1.64 against existing pattern 1.22-1.25
 - Total Rice Equivalent Yield (REY) was found 16.18-17.18
 - (c) **T. aman rice (Binadhan-17)-Potato (Asterix)-Boro (Binadhan-14) cropping pattern**
 - Increased cropping intensity (100%)
 - Due to incorporation of one crop net return increased 535% over existing pattern
 - BCR for four crops 1.60 while 1.22 for existing cropping pattern
 - Total Rice Equivalent Yield (REY) was found 29.56 t ha⁻¹.
 - (d) **T. aman rice (Binadhan-17)-Grass pea (Binakhesari-1)-Aus (Binadhan-19) cropping pattern**
 - Increased cropping intensity by 100%
 - Due to incorporation of one crop net return increased 275% over existing pattern
 - BCR for four crops 1.58 while 1.21 for existing cropping pattern
 - Total Rice Equivalent Yield (REY) was found 14.71 t ha⁻¹.
 - (e) **T. aman rice (Binadhan-17)-Mustard (Binasarisha-9)-Jute (JRO-524) cropping pattern**
 - Increased cropping intensity by 100%
 - Due to incorporation of one crop net return increased 200% over existing pattern
 - BCR for four crops 1.55 while 1.24 for existing cropping pattern
 - Total Rice Equivalent Yield (REY) was found 17.92 t ha⁻¹.

(f) T. aman rice (Binadhan-17)-Lentil (Binamasur-8)-Jute (JRO-524) cropping pattern

- Increased cropping intensity by 100%
- Due to incorporation of one crop net return increased 256% over existing pattern
- BCR for four crops 1.57 while 1.24 for existing cropping pattern
- Total Rice Equivalent Yield (REY) was found 20.04 t ha⁻¹.

(g) T. aman roce (Binadhan-17)-Grass pea (Binakhesari-1)-Jute (JRO-524)

- Increased cropping intensity by 100%
- Due to incorporation of one crop net return increased 247% over existing pattern
- BCR for four crops 1.61 while 1.24 for existing cropping pattern
- Total Rice Equivalent Yield (REY) was found 19.04 t ha⁻¹.

ii. Generation of new knowledge that help in developing more technology in future

One to two crops like mustard/potato/lentil/grass pea/patshak (jute leaf) with suitable varieties can be incorporated between T. aman and Boro/Aus/Jute that would help intensification and diversification of crops to improve farmers' income as well as livelihood.

iii. Technology transferred that help increased agricultural productivity and farmers' income

T. aman rice (Binadhan-11)-Mustard (Binasarisha-9)-Patshak (Binapatshak-1)-Aus rice (Binadhan-19) cropping pattern.

iv. Policy support

The generated knowledge of increased farmers' income by 369% for adoption of 3-4 crops based pattern instead of 2 crops based pattern may help achieving the SDG target doubling farm income by 2030.

I. Information regarding desk and field monitoring

i. Desk Monitoring description & output of consultation meeting, monitoring workshops/seminars etc.)

- a. 02.10.2019
- b. 30.09.2021

ii. Field Monitoring (date & no. of visit, name and addresses of team visit and output)

- a. 20.01.2020
- b. 02.11.2019
- c. 07.11.2019
- d. 06.03.2019

iii. Weather data

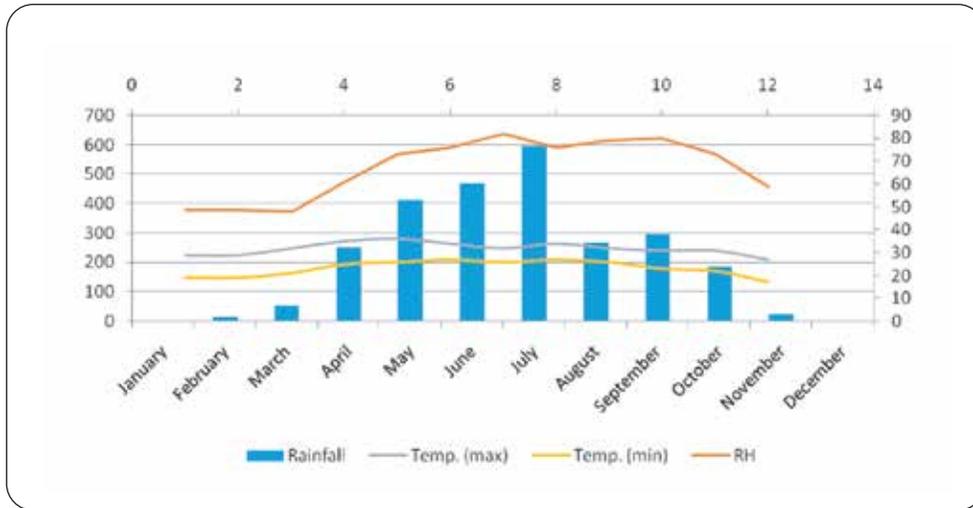


Fig. I.iii.1 Rainfall, Temperature and Relative Humidity at Mymensingh, 2019

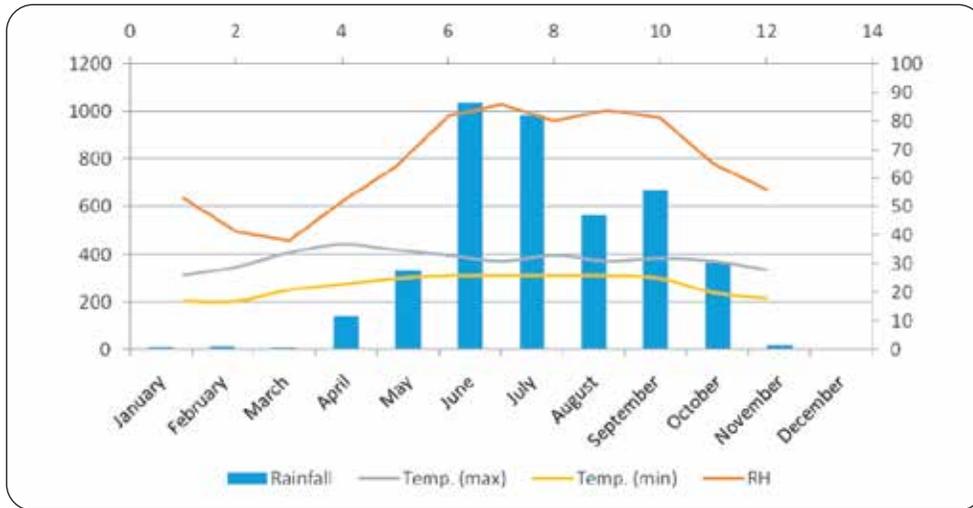


Fig. I.iii.2 Rainfall, Temperature and Relative Humidity at Mymensingh, 2020

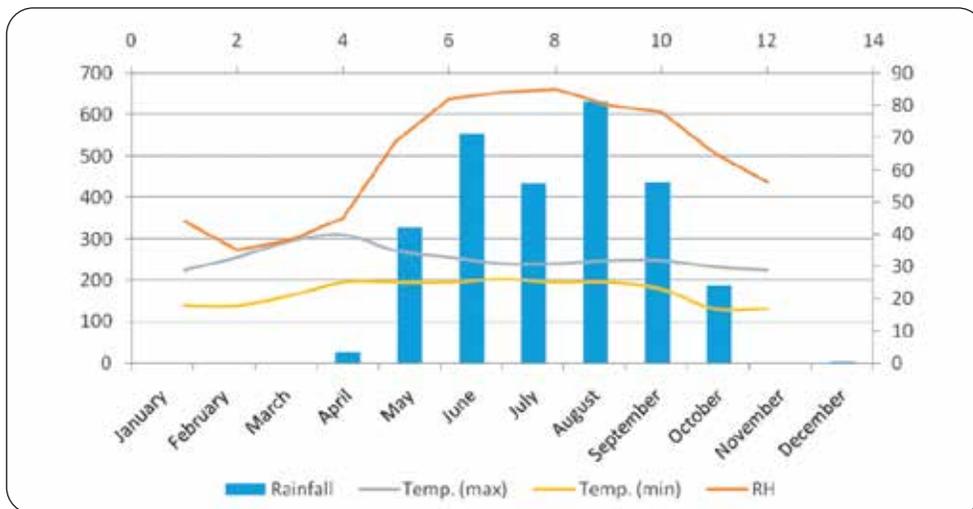


Fig. I.iii.3 Rainfall, Temperature and Relative Humidity at Mymensingh, 2021

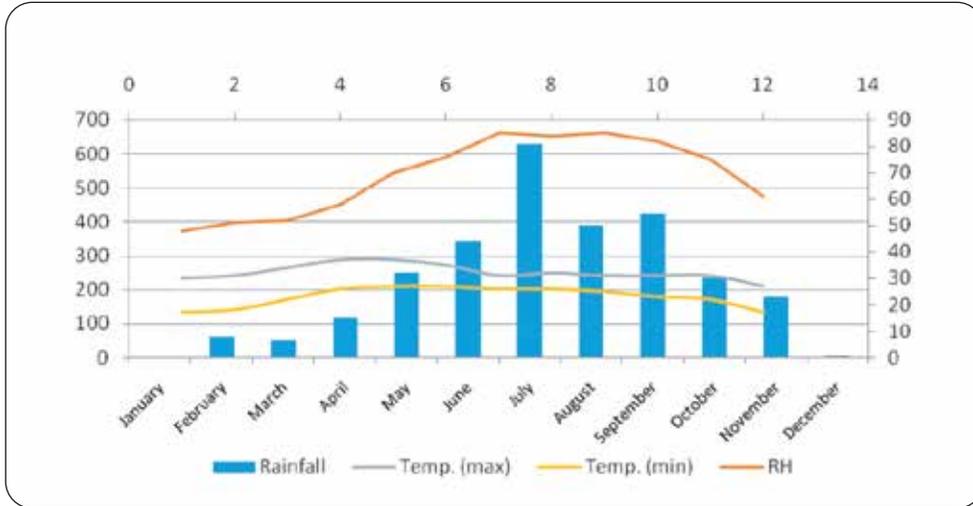


Fig. I.iii.4 Rainfall, Temperature and Relative Humidity at Sherpur, 2019

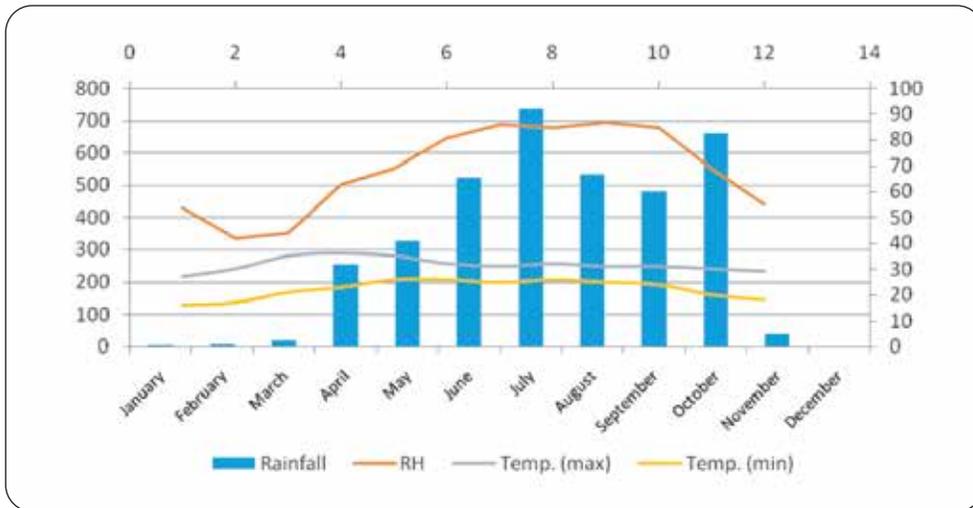


Fig. I.iii.5 Rainfall, Temperature and Relative Humidity at Sherpur, 2020

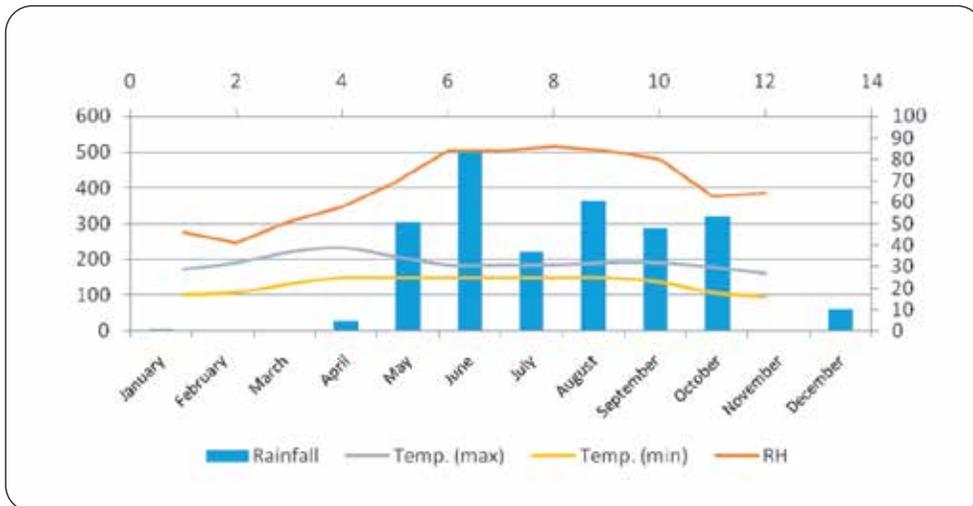


Fig. I.iii.6 Rainfall, Temperature and Relative Humidity at Sherpur, 2021

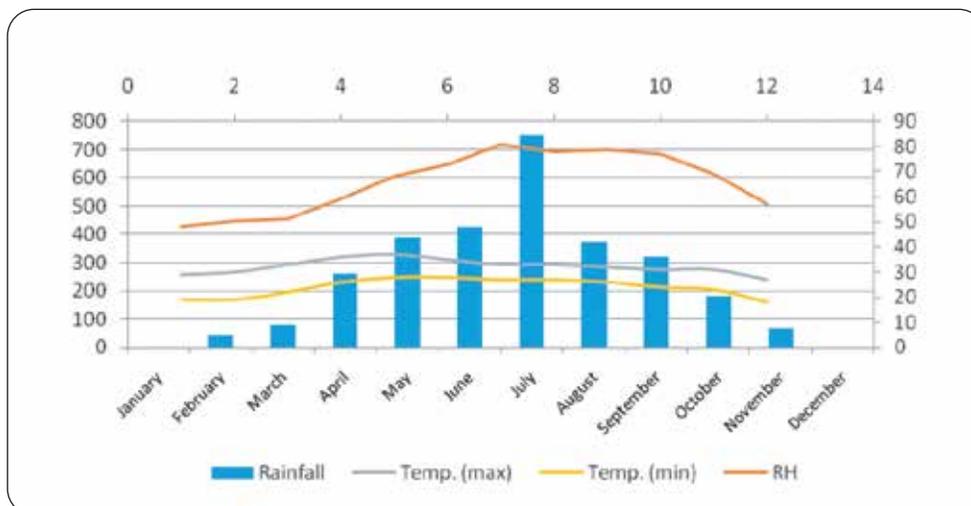


Fig.7.iii.7 Rainfall, Temperature and Relative Humidity at Rangpur, 2019

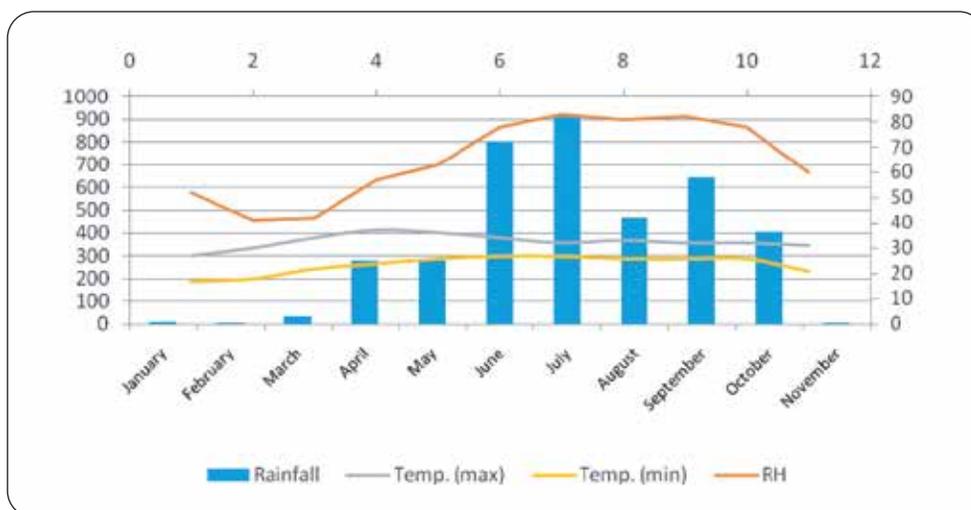


Fig. I.iii.8 Rainfall, Temperature and Relative Humidity at Rangpur, 2020

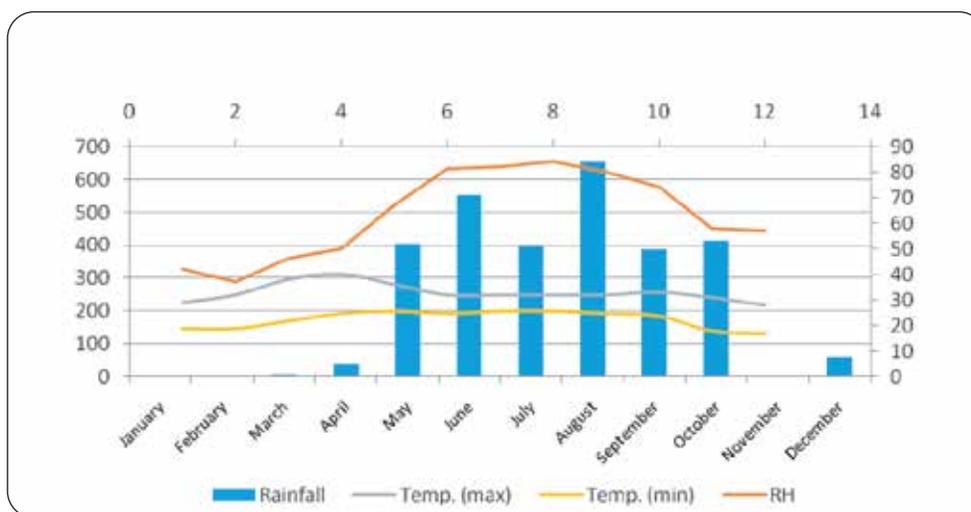


Fig. I.iii.9 Rainfall, Temperature and Relative Humidity at Rangpur, 2021

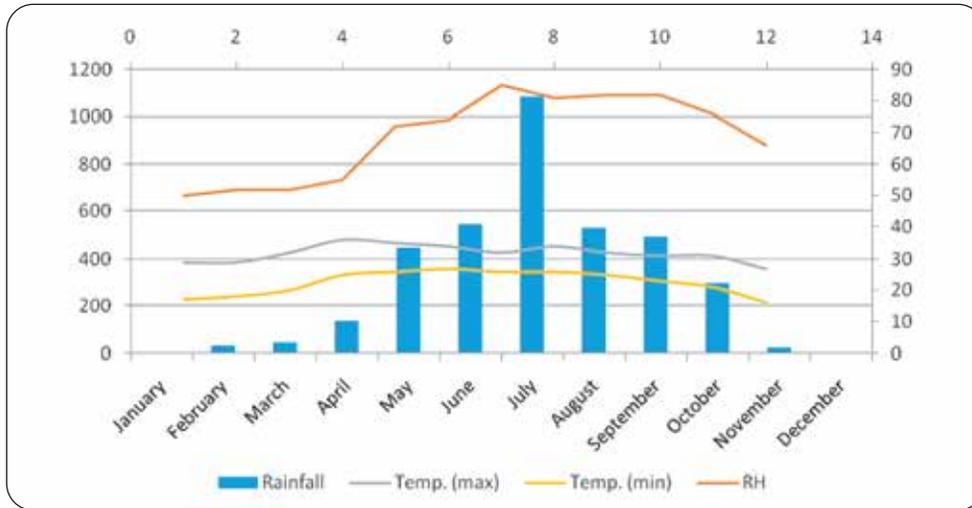


Fig. I.iii.10 Rainfall, Temperature and Relative Humidity at Sunamganj, 2019

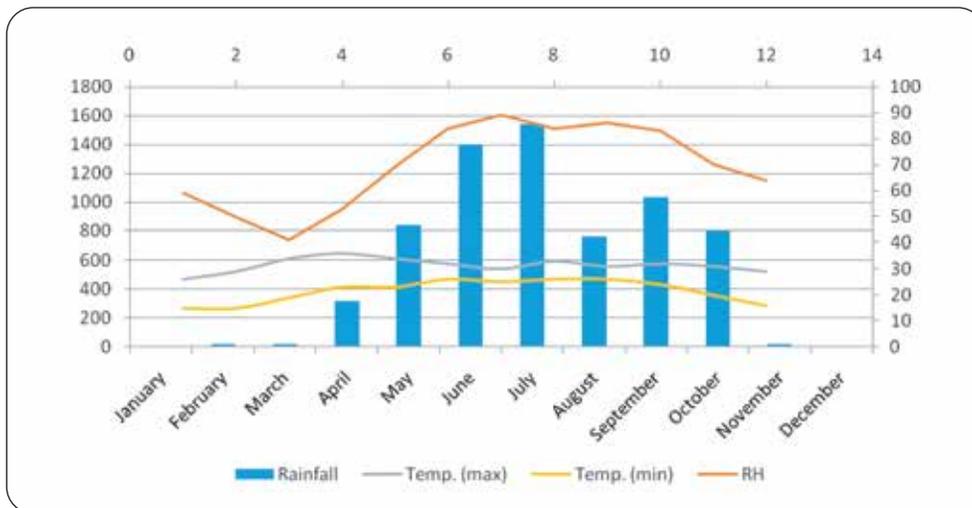


Fig. I.iii.11 Rainfall, Temperature and Relative Humidity at Sunamganj, 2020

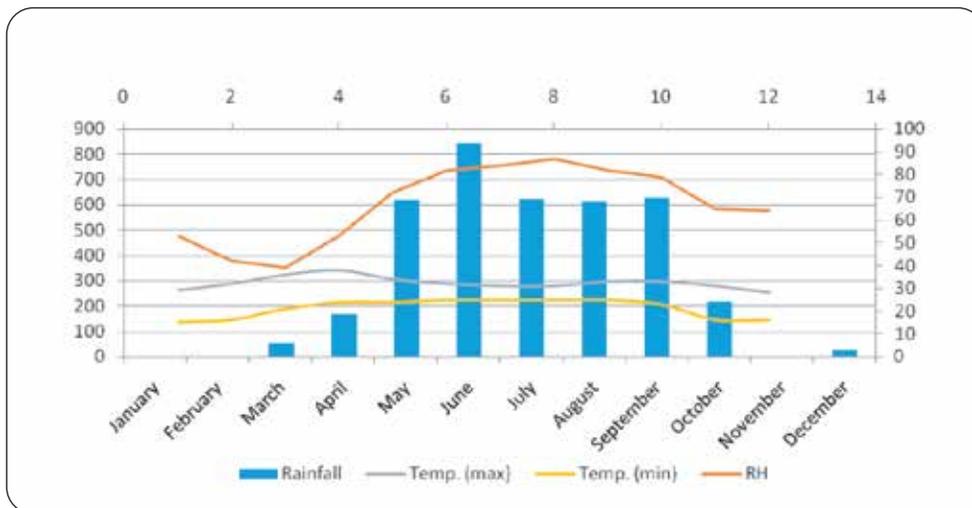


Fig. I.iii.12 Rainfall, Temperature and Relative Humidity at Sunamganj, 2021

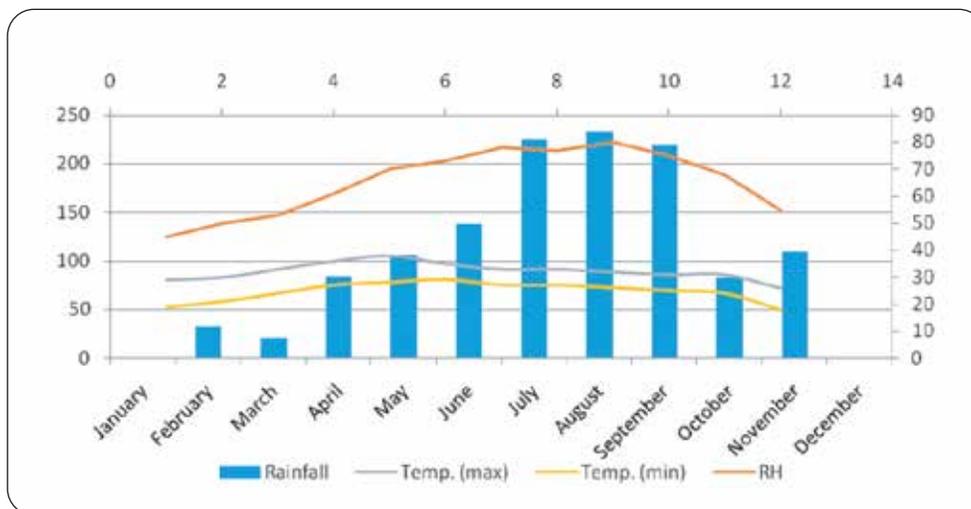


Fig. I.iii.13 Rainfall, Temperature and Relative Humidity at Gopalganj, 2019

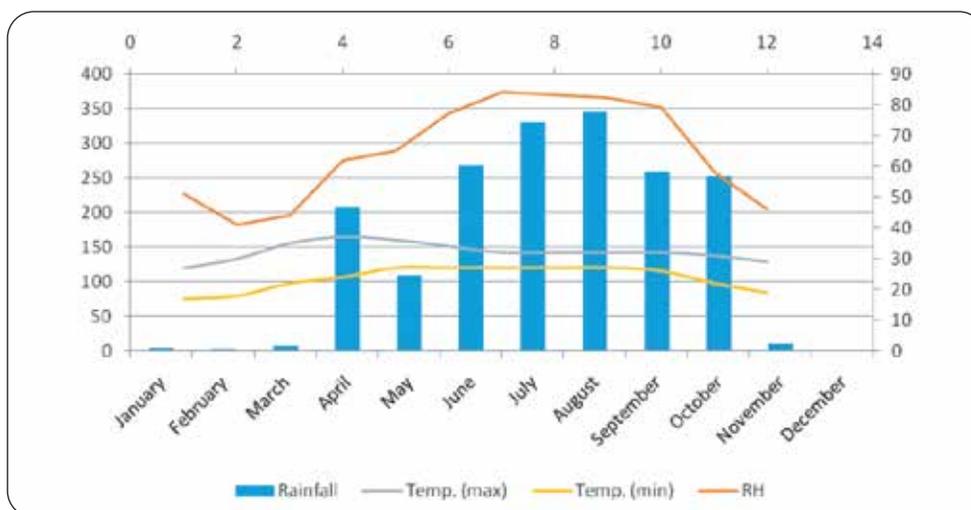


Fig. I.iii.14 Rainfall, Temperature and Relative Humidity at Gopalganj, 2020

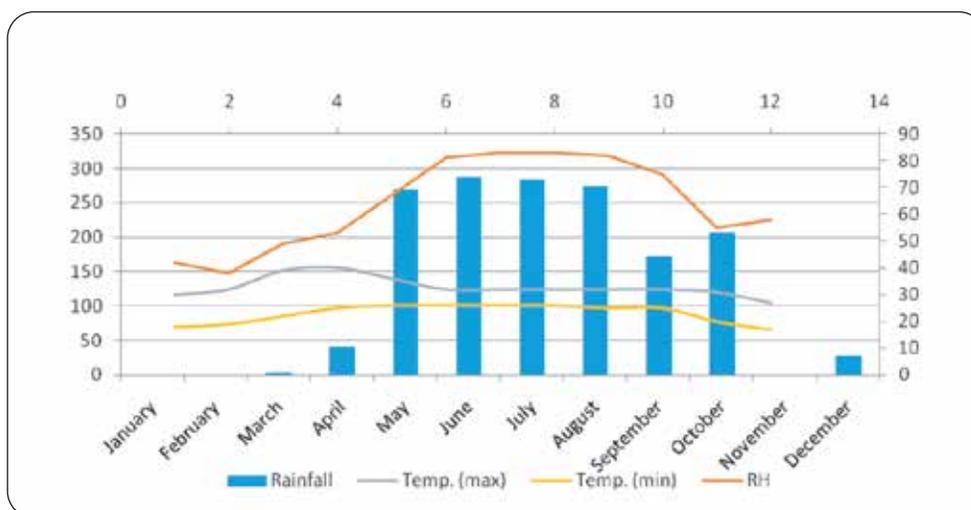


Fig. I.iii.15 Rainfall, Temperature and Relative Humidity at Gopalganj, 2021

J. Sub-project auditing (covers all types of audit performed)

Coordination component

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Government	-	314464		
Government	-	579231		
Government	-	663039		

Component-1

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Government	-	3376786		
Government	-	3694051		
Government	-	2893515		

Component-2

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Government	-	590685		
Government	-	898067		
Government	-	768047		

K. Lessons learned:

- i) Incorporation of the late transplanting potential, heat tolerant and short duration Boro rice variety Binadhan-14 allows one more crop like mustard/potato in the existing pattern T. aman rice-Fallow-Boro in Mymensingh, Sherpur, Rangpur and Sunamganj.
- ii) Incorporation of short duration, drought tolerant Aus rice variety Binadhan-19 allows two more crops like mustard and patshak (Jute leaf) in Mymensingh but one more crop like lentil/grass pea at Sunamganj.
- iii) Farmers' income increased 14.56%-20.22% by adopting the improved three and four crops based cropping pattern over farmers' two crops based existing pattern.
- iv) For successful and timely completion of any sub-project, timely allocation of fund/resources needs to be ensured.

- v) Present agricultural production may be increased by using newly developed technologies.

L. Challenges (if any):

- i) Farmers' negative attitude towards new technology is a great challenge.
- ii) COVID-19 pandemic was a great challenge for smooth running of the project.
- iii) Soil fertility declination.

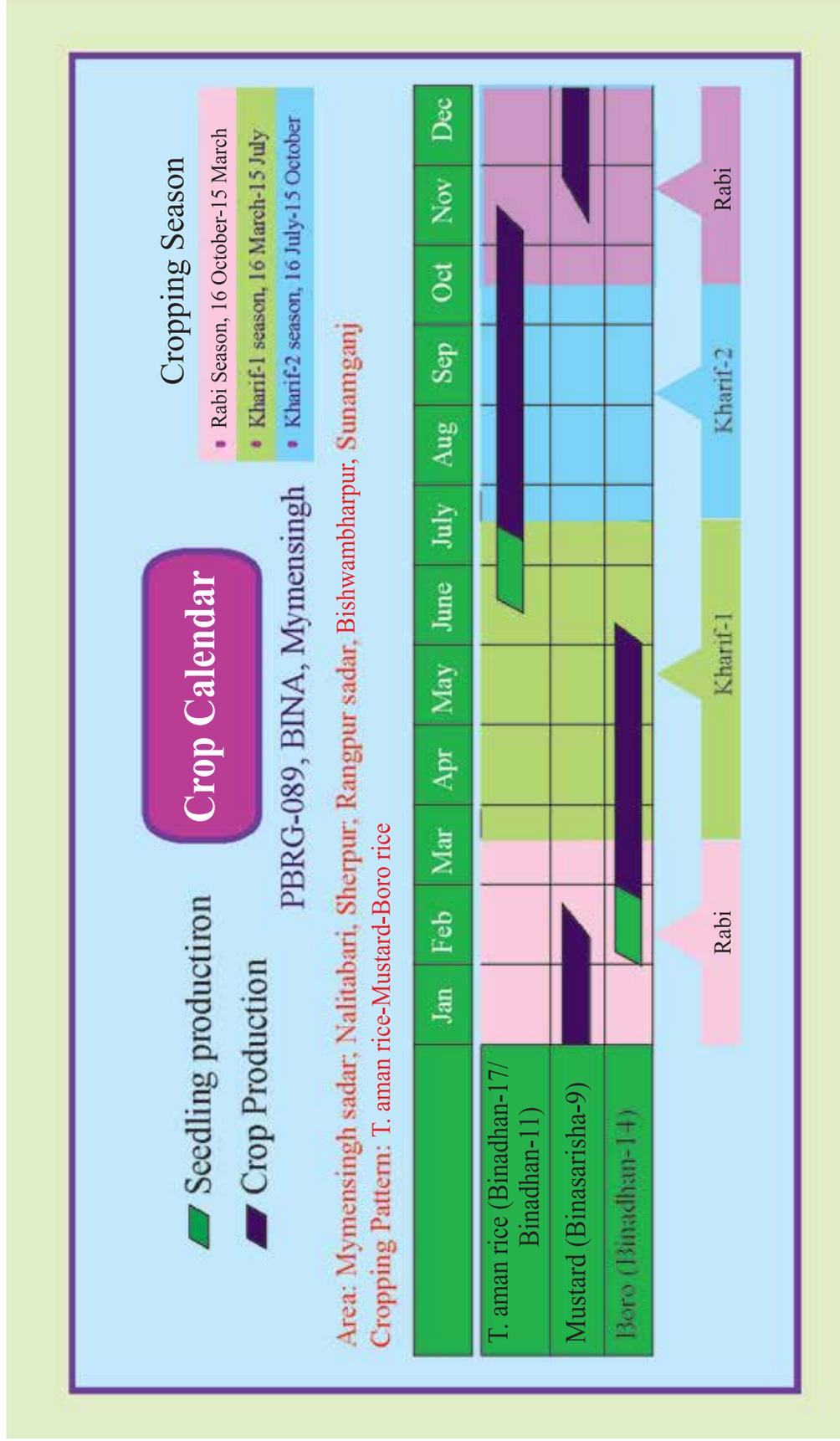
M. Suggestions for future planning (if any):

- i) Following integrated soil management practices (IMNS) is inevitably important for improved cropping pattern with 3-4 crops.
- ii) To develop a short duration high yielding aromatic T. aman variety for Sherpur district.
- iii) Development of tossa jute variety like JRO-524 is needed for Gopalganj district.
- iv) Needs to know whether is there is any nutrient missing of the soil for growing 3-4 crops in the same year in the same land.
- v) Developed technology will be helpful for increasing cropping intensity of the country for the other locations also.

N. References (in alphabetical order):

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- Castro, P.A. (2002). Sustainable Livelihoods Analysis: An introduction. Syracuse University: New York.
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- Lal B, Gautam P, Panda BB, Raja R, Singh T, Tripathi R (2017). Crop and varietal diversification of rainfed rice based cropping systems for higher productivity and profitability in Eastern India. PLoS ONE. 12(4): e0175709

O. Crop Calendar for the improved cropping patterns



Seedling production

Crop Production

Crop Calendar

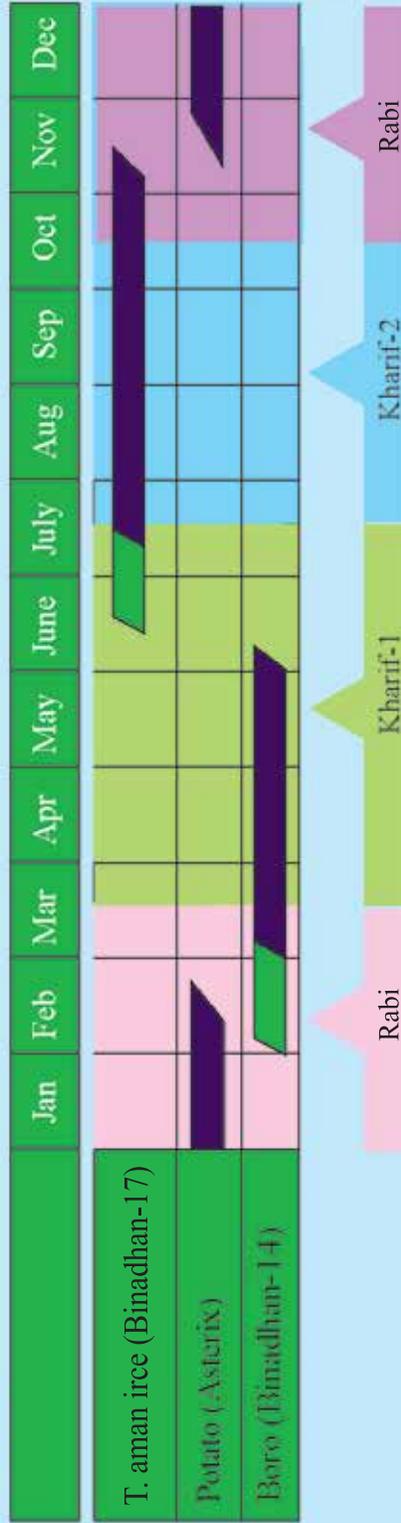
Cropping Season

- Rabi Season, 16 October-15 March
- Kharif-1 season, 16 March-15 July
- Kharif-2 season, 16 July-15 October

PBRG-089, BINA, Mymensingh

Area: Rangpur sadar

Cropping Pattern: T. aman rice-Potato-Boro rice



Crop Calendar

Seedling production
Crop Production

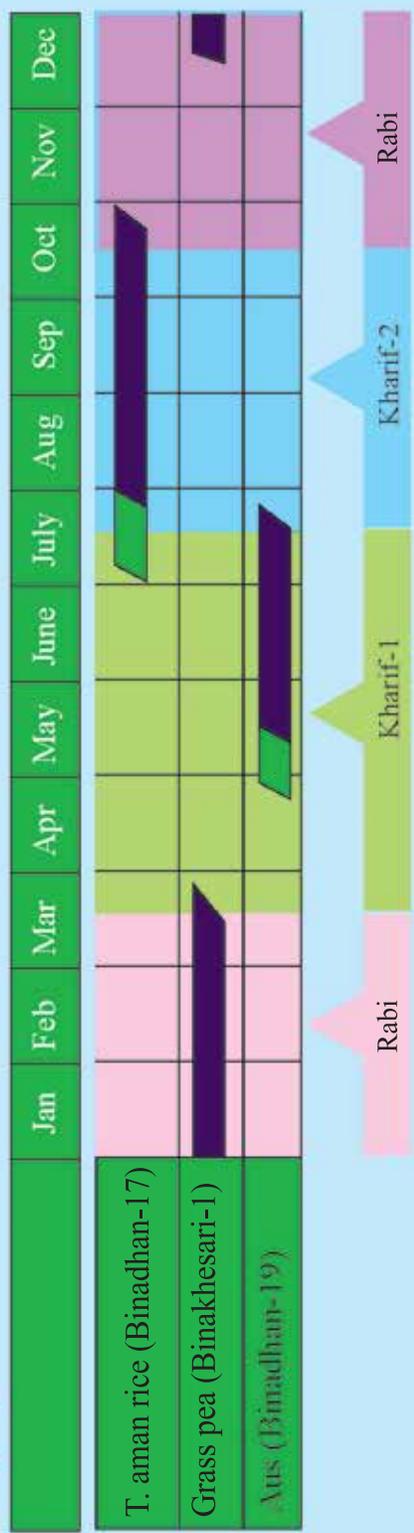
Cropping Season

- Rabi Season, 16 October-15 March
- Kharif-1 season, 16 March-15 July
- Kharif-2 season, 16 July-15 October

PBRG-089, BINA, Mymensingh

Area: Sunamganj sadar

Cropping Pattern: T. aman rice-Grass pea-Aus rice



Seedling production

Crop Production

Crop Calendar

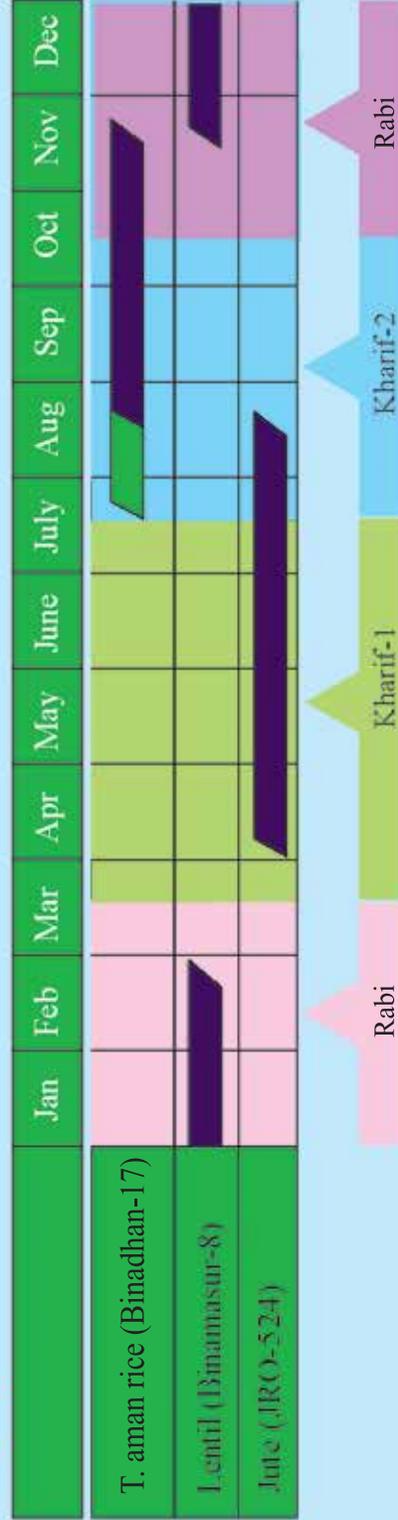
Cropping Season

- Rabi Season, 16 October-15 March
- Kharif-1 season, 16 March-15 July
- Kharif-2 season, 16 July-15 October

PBRG-089, BINA, Mymensingh

Area: Kashiani, Gopalganj

Cropping Pattern: T. aman rice-Lentil-Jute



Seedling production

Crop Production

Crop Calendar

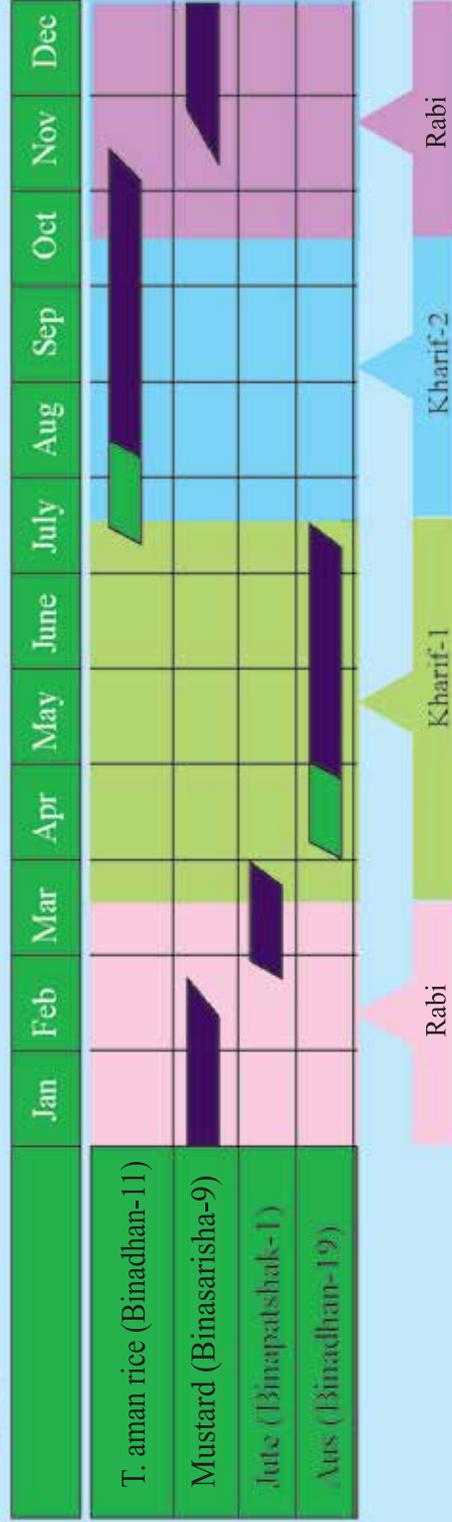
Cropping Season

- Rabi Season, 16 October-15 March
- Kharif-1 season, 16 March-15 July
- Kharif-2 season, 16 July-15 October

PBRG-089, BINA, Mymensingh

Area: Mymensingh sadar

Cropping Pattern: T. aman rice-Mustard-Patshak-Aus rice



Seedling production

Crop Production

Crop Calendar

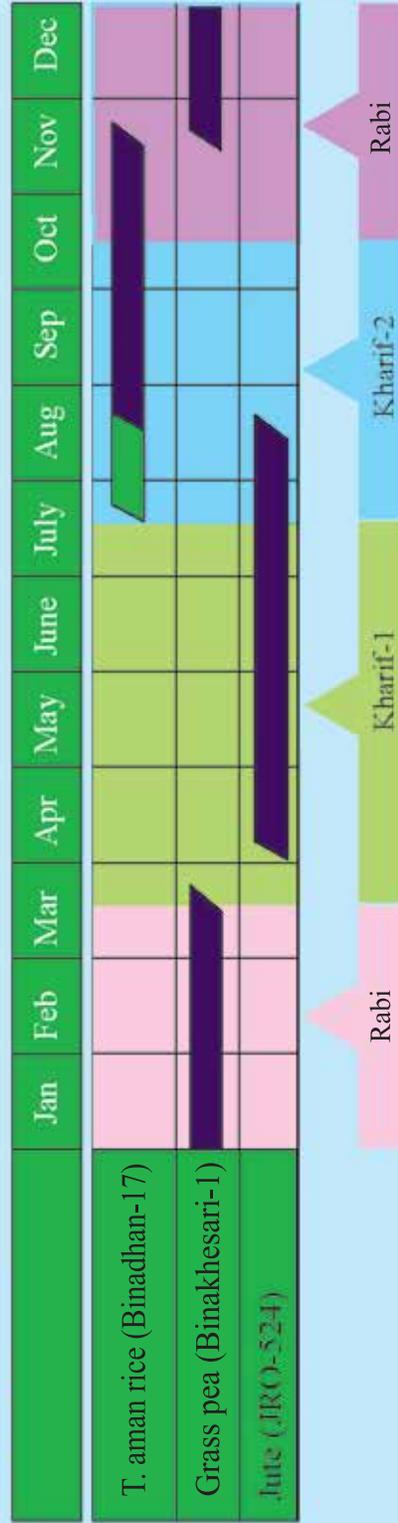
Cropping Season

- Rabi Season, 16 October-15 March
- Khharif-1 season, 16 March-15 July
- Khharif-2 season, 16 July-15 October

PBRG-089, BINA, Mymensingh

Area: Kashiani, Gorpalganj

Cropping Pattern: T. aman rice-Grass pae-Jute



Crop Calendar

Seedling production
Crop Production

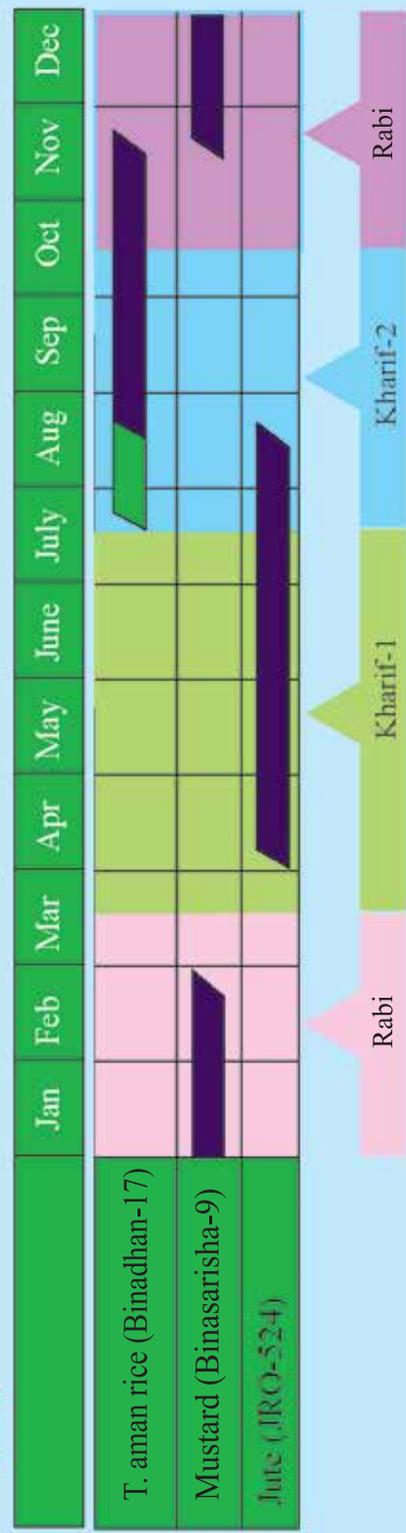
Cropping Season

- Rabi Season, 16 October-15 March
- Kharif-1 season, 16 March-15 July
- Kharif-2 season, 16 July-15 October

PBRG-089, BINA, Mymensingh

Area: Kashiani

Cropping Pattern: T. aman rice-Mustard-Jute



Signature of the Coordinator

Date

Seal

Counter signature of the Head

of the organization/authorized representative

Date

Seal