

Opportunities for improving the processing quality of potatoes in Bangladesh.

A feasibility study

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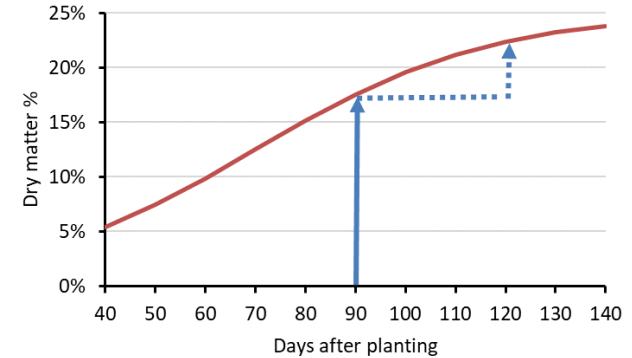


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Problem statement

Bangladesh is the third largest potato producer in Asia, but the quality of the produced potatoes for processing (flakes, crisps, French fries) is low because of the **low dry matter content**.

Major reasons for the **poor processing quality** are the used potato varieties and short grow duration. Typically, potatoes are harvested after 90 days, which is too short to accumulate sufficient dry matter (top right Figure). Increasing the current grow duration of 90 days to 120 days could improve the dry matter content but potentially interferes with the *Aman* rice crop, preceding potato, and the *Boro* rice crop that follows potato in the rotation (bottom right Figure) .



Simplified relationship between dry matter content of potatoes and growth duration

Questions answered in this study

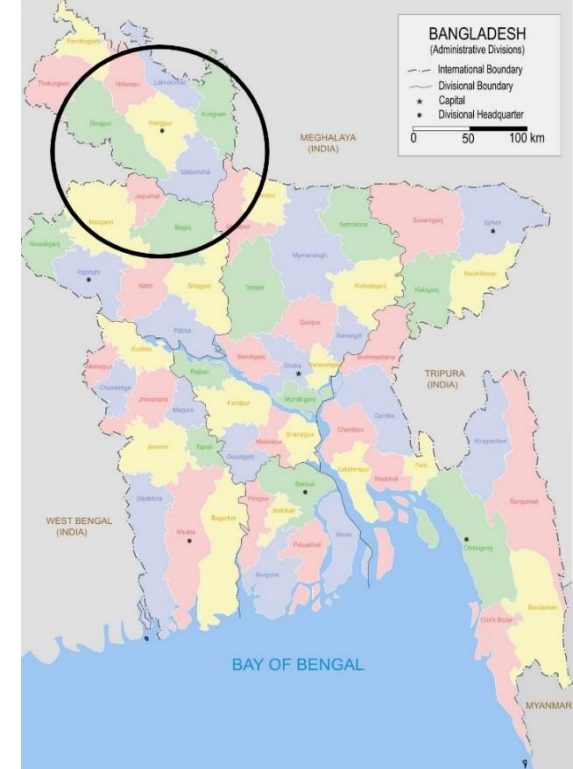
- Is it agronomically feasible to produce a long-season potato crop with better quality?
- What is the effect of a long season potato crop for both rice crops in the current cropping system?
- What is the financial result for farmers at crop level and cropping system level?



Typical *Aman* rice-potato-*Boro* rice crop rotation in Bangladesh

Approach & methods

- Focus on Northern Bangladesh (districts of Rangpur, Dinajpur and Nilfamari)
- 10 years with observed daily weather data from the Bangladesh Meteorological Department, and daily radiation data from NASA.
- Potato and rice simulation models were run for a great number of planting/harvesting dates (Bouman et al 2001, van Oort et al 2015, de Wit et al 2019). The simulated crop yields were used as input in the Cropping Calendar Construction (CCC) Model (van Oort et al 2016).
- The CCC model generates and optimizes potato-rice-rice systems (rotations) based on the simulated crop yields realised at the different planting dates.
- Net returns of potato-rice-rice systems based on crop yields times product prices and estimated production costs from the literature and own collected data.
- Three farmer group discussions to validate CCC input data, cost-benefit analyses, and to identify farmer' barriers to grow long season potato crop.
- Survey local potato processors to identify quality problems and quality rewarding system (premium prices).

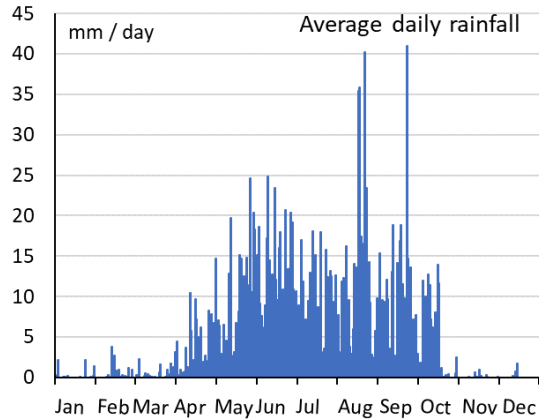


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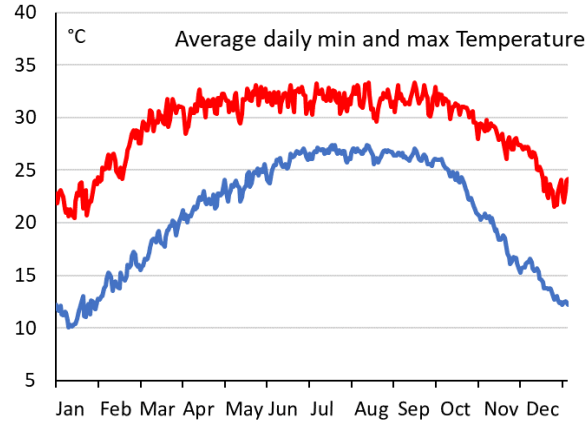
Analysis of weather data



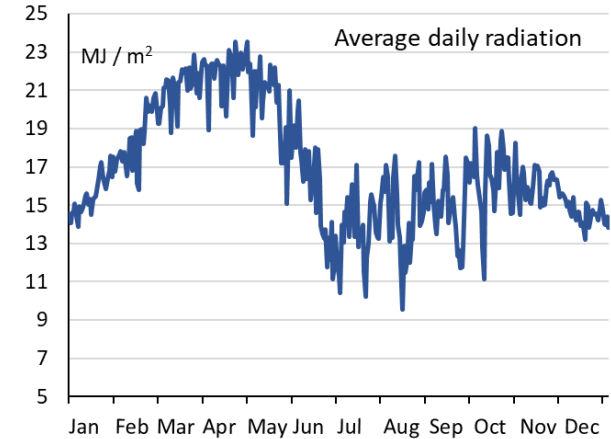
Average daily weather data from Rangpur (2006-2015)



Commonly, the rainy season starts at the end of March and ends mid October in Northern Bangladesh.



Daily minimum temperatures start to drop rapidly in the beginning of October and start to increase again in the second week of January. Between the second week of November and the last week of March daily minimum temperatures are < 20 °C.



Radiation levels increase rapidly in the beginning of January and reach peak levels in April/May. The rainy season July – October shows cloudy periods associated with heavy rainfall. The typical foggy days, from mid December to mid January during the winter potato season, do not show up in the average radiation levels.

What do farmers say?



- Farmers prefer a 90 day potato crop because of rapid cash flow.
- Farmers grow a 90 day potato crop because they are used to do it this way. It fits well in current cropping system with two rice crops.
- *Boro* and *Aman* rice are both grown because they differ in taste and are part of the local diet.
- Not all farmers are aware that the dry matter content of potato increases with a longer growing season.
- Farmers do not know long-season potato varieties
- Although the potato area is flat in Northern Bangladesh, terrain differences (lower and higher areas) may differ in the suitability to plant potato earlier. During the *Aman* season, land is commonly flooded. Late Aman rains may result in inundation problems because of poorly drained soils.
- Rapid pay-out after harvest is important for farmers that produce potatoes on contract.



What do potato processors say?



Most used potato varieties and their characteristics for processing:

	Crisps & flakes		French fries	
	Courage	Lady Rosetta	Diamant	Santana
Dry matter (%)	22	23	19	23
Sugar content (%)	2	2	3	3
Size (mm)	>40	>40	>55	>55
colour	yellow	white	yellow	white
Shape	oval	oval	long	long



- Dry matter content, size and shape are most important characteristics for processors.
- Low dry matter content of potato is the major problem for processors in Bangladesh.
- What is needed to improve the quality according processors: 1) new potato varieties, 2) better quality seed, 3) timely potato planting, 4) early *Aman* rice planting, 5) training of farmers
- Commonly, processors pay contracted farmers a premium price, which is set early in the season but also sometimes at the end of the season depending on the processor.
- Most potatoes for processing are sourced through contracted potato farmers.

Analyses of cropping calendars



Feasibility of alternative cropping calendars

Late October, two weeks after the rainy season stops, is the earliest planting date of potato. Late March is the latest harvesting moment because daily minimum and maximum temperatures become too high, i.e. $> 20^{\circ}\text{C}$ and $> 30^{\circ}\text{C}$, respectively. See also the weather analyses on page 6. Using these planting and harvesting dates, a potential growing season of ≈ 150 days for potatoes is available.

Four cropping systems with potato and two rice crops have been analysed:

- The current cropping system with a 90 days potato crop, and three alternative systems with a 120 days potato crop.
- The three scenarios that differ in the timing of planting and / or harvesting of the potato and rice crops are based on optimized yields of both potato and rice crops using the simulated crop yields obtained at different planting dates.
- Actual yields were calculated from simulated potential yields and the yield gap. Yield gaps were 45% for rice (actual yields are 55% of simulated potential) and 15% for potato (actual yields 85% of potential)

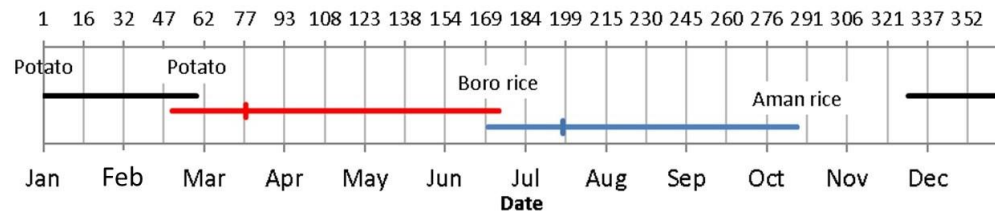


Four cropping systems with potato and two rice crops:

1. Current cropping system:

Potato planting: Nov 24

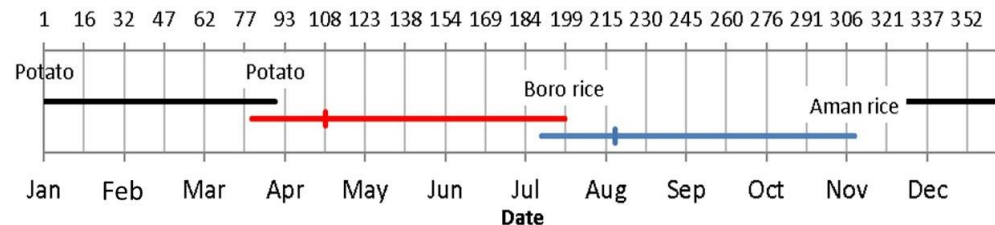
Potato harvesting: Feb 28



2. Late potato harvesting (scenario 1):

Potato planting: Nov 24

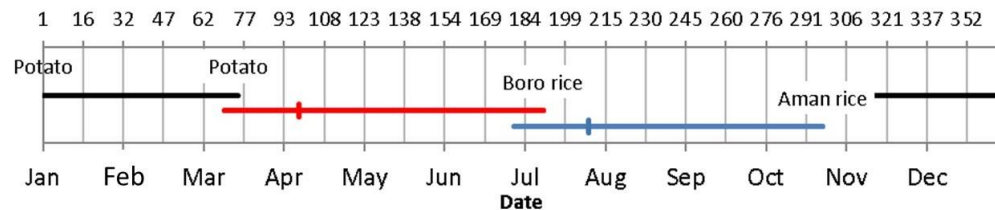
Potato harvesting: Mar 29 (+30 days)



3. Early potato planting & late harvesting (scenario 2):

Potato planting: Nov 10 (-14 days)

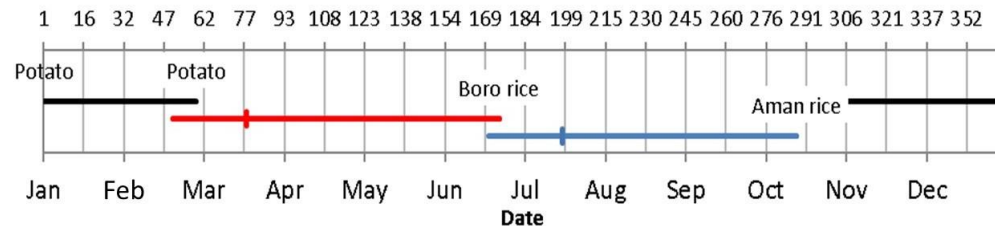
Potato harvesting: Mar 15 (+15 days)



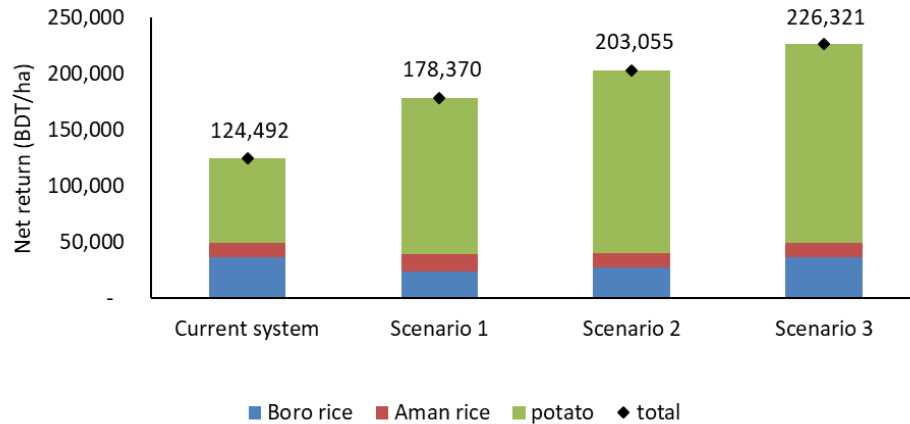
4. Early potato planting (scenario 3):

Potato planting: Oct 25 (-30 days)

Potato harvesting: Feb 28



Yields and net returns of the four cropping systems



Corresponding yields in t/ha:

Potato	23.5	32.0	34.3	35.6
Aman rice	4.1	4.2	4.1	4.1
Boro rice	5.4	4.7	4.9	5.4

100 BDT ≈ 1 Euro

The scenarios considered:

- Higher production costs of long season potatoes, i.e. costs increase with 15% in the three alternative scenarios.
- Increase of dry matter content with longer growing season from 17.4% to 22.5%.
- Sufficient time between crops to do the necessary field preparations

The scenarios did **not** consider:

- Premium prices for better quality potatoes in the alternative systems.
- Possible lower costs of late blight control because of shifting the growing season to months with less late blight pressure.

Conclusions

1. Potato is by far the most profitable crop in the current potato-rice-rice system.
2. Extension of the growing season from 90 to 120 days increases potato yields with 36 to 51% compared to current potato yields depending on the planting date. Higher yields go together with a higher dry matter content.
3. The earlier the planting, the better for improving potato yield, quality and net returns of the cropping system. Net returns increase with > 82% compared to the current system. (Scenario 3)
4. Two weeks earlier planting and two weeks later harvesting than in the current situation still results in 63% higher net returns (Scenario 2).
5. Late harvesting is least effective to increase net returns (scenario 1) of the rice-rice-potato cropping system. However, the delivery time of imported seed potatoes to Bangladesh is not shortened in this scenario.



Perspective for business case development

- **Local potato processors** source better quality potatoes, thus reducing processing costs and increasing competitiveness.
- **Seed potato producers** provide new potato varieties and high quality seeds to be tested on their performance in a 120 days growing season.
- Increased demand for **processing equipment** if the potato industry in Bangladesh gets a boost by sourcing better quality potatoes.
- Better **storage and logistics solutions** needed to process year-round high quality potatoes.
- Last but not least, **local farmers** are interested to participate to extend the potato growing season but need proper incentives such as training, secured pricing, and rapid pay-out after harvesting.



Knowledge questions in business case

- For early planting: Identify pilot areas with low vulnerability to drainage problems due to late *Aman* rainfall.
- For late harvesting: Identify pilot areas that are not affected by surrounding flooded *Boro* rice fields.
- Test different planting dates on potato yield and quality, not only dry matter but also possible other defects affecting processing efficiency.
- Test (new) potato varieties that have the potential to deliver the desired quality characteristics after 120 days growing period.
- Validate net return calculations of a longer potato growing season considering potential effects on *Aman* and *Boro* rice.
- Train farmers to secure a good crop health after 90 days growing period.
- Analyse processing quality & efficiency of potatoes with higher dry matter content.



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