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The Impact of Agricultural Mechanisation on Poverty Alleviation in a Seasonal Environment: a project evaluation from northern Bangladesh

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**IEE
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Sebastian Zug

**The Impact of Agricultural Mechanisation on
Poverty Alleviation in a Seasonal Environment**

**A Project Evaluation from
Northern Bangladesh**

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Sebastian Zug

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A Project Evaluation from Northern Bangladesh

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Abbreviations

BADC	Bangladesh Agricultural Development Board
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
bn	basic needs
BR	Bangladesh rice
BRI	Bangladesh Rice Research Institute
CBA	cost-benefit analysis
DAE	Department of Agricultural Extension
DAM	Department of Agricultural Marketing
FAO	Food and Agricultural Organization
HYV	high-yielding variety
IRRI	International Rice Research Institute
NGO	non-governmental organisation
NPV	net present value
PRS	poverty reduction strategy
PRSP	poverty reduction strategy paper
PTODS	power-tiller operated dry-seeder
RDRS	Rangpur Dinajpur Rural Service
RIB	Research Initiatives, Bangladesh
tp	rate of time preference
UN	United Nations
VGF	vulnerable group feeding

Glossary

amon	rice cultivated during the monsoon (<i>kharif II</i> season)
boro	paddy transplanted in January which is optimal time (definition relates to the context of Pabitra Jhar, only)
BR11	long-duration <i>amon</i> rice variety released by BIRRI in 1980
BR2	<i>amon</i> rice variety released in 1971
BR33	short-duration <i>amon</i> rice variety released by BIRRI in 1997, also referred to as 'BIRRI dhan-33'
contract-labour	people are paid for the amount of work they did
day-labour	people are paid for the time worked
dhon	local unit for measuring land size
greater Dinajpur	consists of the districts Dinajpur, Panchagarh, and Thakurgaon
greater Rangpur	consists of the districts Gaibandha, Lalmonirhat, Kurigram, Nilphamari and Rangpur
highland	land which is never flooded under normal climatic conditions
Jamuna	river, which is called Brahmaputra, before entering Bangladesh
Joya	<i>amon</i> rice variety from India
kharif I season	premonsoon season. (March to July)
kharif II season	monsoon and immediately post-monsoon season (July to December)
large farmer	household cultivating more than 34.08 dhon
late boro	is used here for <i>boro</i> rice, which is not transplanted in optimal time, but later (February-March)
lowland	land, which is normally flooded between 180 and 300 cm during the floods
madrasah	Islamic school, which is acknowledged as an alternative to government education
mauza	subdivision of <i>unions</i> , mainly for statistical purposes. A <i>mauza</i> consists of one or several villages or settlement clusters.
medium farmer	household cultivating between 11.36 and 34.08 dhon
medium highland	land, which is normally flooded up to 90cm during the floods

medium lowland	land, which is normally flooded between 90cm and 180 cm during the floods
monga	popular term for the food insecure period in Northern Bangladesh
non-farm household	household cultivating less than 0.22 dhon
power-tiller	a small two-wheeled tractor mainly used for ploughing
rabi season	winter season (November-April)
small farmer	household cultivating between 0.22 and 11.35 dhon
taka	currency of Bangladesh
union	administrative unit below <i>upazila</i> level
union parishad	elected local government on <i>union</i> level
upazila	administrative unit below district level
upazila nirbahi officer	highest government representative in an <i>upazila</i>
van	three-wheeled bicycle for transporting goods

Conversions

1 dhon	=	890 m ² = 22 decimal = 0.22 acre = 0.089 ha
1 t/ha	=	89.0 kg/dhon
1 USD	=	69.52 taka (1.10.2007)
1 Euro	=	99.22 taka (1.10.2007)

1 Introduction

Agricultural mechanisation is a controversial issue. Replacing the production factor labour with capital can have a severe impact on the livelihoods of those living from agricultural employment. However, if the labourers are compensated for the loss of employment, while the profit of the farmers increases, promoting agricultural mechanisation through poverty-oriented institutions is justifiable.

In this evaluation a project will be analysed, which exactly aims on the above described constellation. The *non-governmental organisation* (NGO) *Rangpur Dinajpur Rural Service* (RDRS) started a project in which a machine for seeding paddy will replace manual labour in Northern Bangladesh. In combination with a specific seeding date and a fast maturing rice variety, the cropping period will be significantly shortened and harvest will take place several weeks earlier. The project will have a different impact on farmers and labourers. The economics of agricultural production will differ in the respective season. Farmers will experience a change in cultivation costs and in yields. Shortening of the season will also allow optimising the following crops in the cropping pattern and will hence impact the farmers' profit. The project planners also expect a positive project impact on the labourers, which is related to seasonality. Seasonal food insecurity is a persisting problem in Northern Bangladesh. From October to November mainly labourers cannot afford to buy basic food, since agriculture is hardly diversified in that season, which leads to a distinct lean season. The earlier harvest will provide employment during the current lean season, hence smoothening seasonality of employment. However, mechanisation will also lead to a reduction of overall employment, which will negatively affect the labourers' social welfare. A second project alternative is additionally discussed, which will also shorten the rice cultivation with impacts on labourers and farmers, but will only use the short-duration rice variety without promoting mechanisation.

The objective of this evaluation is to determine whether the project alternatives will really lead to a 'win-win situation' as the project planners expect. The information generated should support the decision-making of the project officials on whether the project should be implemented large scale or not. The evaluation might therefore provide a justification of the project alternatives. A detailed analysis of the changes induced by the project on farmers and labourers will be carried out guided by the following research question:

What is the project's impact on poverty alleviation and on seasonal food security for farmers and labourers?

In the following chapter a review of various literature on food security, seasonality and agricultural mechanisation will present the relevant theoretical debates, which are related to the project conception. The third chapter gives an overview on the project. In the fourth chapter the theoretical framework to evaluate the project is discussed, followed by a detailed description of the

evaluation methodology. The case study is presented in the sixth chapter. In chapter seven the results of the evaluation will be discussed and linked back to the theoretical considerations of the first chapters.

2 Literature Review

2.1 Food Security

Food security has developed to one of the central concerns of development activities. It is directly reflected in the first of the *United Nation's* (UN) millennium development goals *eradicate extreme poverty and hunger* and indirectly contributing to many of the others goals.

The concept of food security was developed in the 1970s with the primary focus on the supply side. Food security was thought to be achieved if the availability of food was ensured and the prices were stable to a certain degree.¹ Increasing the food production, however, does not necessarily lead to a reduction of food insecurity on the micro level. "A person's ability to command food – indeed, to command any commodity he wishes to acquire or retain – depends on the entitlement relations that govern possession and use in that society. It depends on what he owns, what exchange possibilities are offered to him, what is given to him free, and what is taken away from him."² The work of Amartya Sen on entitlement in the late seventies³, highly acknowledged after publishing his book *Poverty and Famines* in 1981, introduced the *access to food* as a relevant aspect to food security. This debate further concretised the concept through multidisciplinary contributions and included aspects such as vulnerability and sustainability.⁴

The current definition of the UN's *Food and Agricultural Organization* (FAO) reflects the various aspects, which have been incorporated into the concept: "Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."⁵

Beyond availability and access this definition includes the aspects of utilization, which "refers to the ability of the human body to take food and convert it into [...] energy, which is either used to undertake daily activities or is stored"⁶ and the temporal aspect of stability. Food insecurity, which is the state in which food security cannot be maintained, does not necessarily have to be a perpetual situation of the individual. Most of the current literature distinguishes between chronic and transitory food insecurity.⁷ Barrett subdivides transitory food insecurity into periodic, regular and conjunctural food insecurity.⁸ Periodic food insecurity implies a regular pattern in which food secure periods alternate with food insecure periods. Seasonality caused by climatic and agricultural patterns is the most typical periodic food insecurity. This cycle is known and people have

1 cf. Clay 2002, p. 1

2 Sen 1981, pp. 154-155

3 Sen 1977

4 Cf. Weingärtner 2005, p. 5

5 FAO 2000, p. 26

6 Weingärtner 2005, p. 6

7 cf. Hoddinott 1999, p. 3

8 cf. Barrett 2002 pp. 2114-2115

a high ability to predict it. Regular food insecurity is also a recurring event, but it is hardly predictable. Floods or droughts can be the catalyst, which people expect, but there is uncertainty if it will appear in a specific year. Conjunctural food insecurity requires an additional irregular event, such as a war, which aggravates the situation in a specific year. In the course of this evaluation seasonal and chronic aspects of food security and poverty will be analysed. In the following chapter the link between seasonality and poverty will be clarified further.

2.2 Seasonality

Seasonality in developing countries was mainly looked at from the perspectives of single disciplines. The first authors started to analyse the "interactions of multiple seasonal adversities (medical, nutritional, agricultural, family, economic, social and so on)"⁹ in the mid of the 1970s. Robert Chambers along with Richard Longhurst and Arnold Pacey made this multidisciplinary approach to understand seasonality popular by publishing the book *Seasonal Dimensions to Rural Poverty* in 1981. Starting from Chambers work, seasonality began to be looked at as an aspect of the poverty problem.¹⁰ The book's impetus on the seasonality debate is comparable to the impact of Sen's entitlement approach on the debate on food security. However, the debate on seasonality was by far not fought as intense as the one on food security. Only David E. Sahn's *Variability in Third World Agriculture* (1989) and Gerhard J. Gill's *Seasonality and Agriculture in the Developing World* (1991) contributed to the theoretical debate. Some empirical studies on seasonality have been published since then, but the theoretical concept has not been developed further.

Seasonality in agriculture is a result of climatic, ecologic and human factors.¹¹ The variation of rainfall and temperature along with the ecology of the environment determines the agricultural conditions at different times in a year. Since every crop has specific cultivation requirements, it can neither be planted everywhere nor always. The farmer's cropping system has to take these limitations into consideration when planting. If there is a unimodal climate with only one rainy season with no substantial cultivation during the dry season, agricultural activities peak once a year. A bimodal climate normally tends to be less seasonal, since rain is available twice a year. The farmer has to cope with the conditions determined by climate and ecology. However, he can have significant influence in changing these natural patterns by developing crops that are for example drought or flood resistant or by introducing irrigation, which allows cultivation during the dry season.

9 Chambers, et al. 1981, p. 2

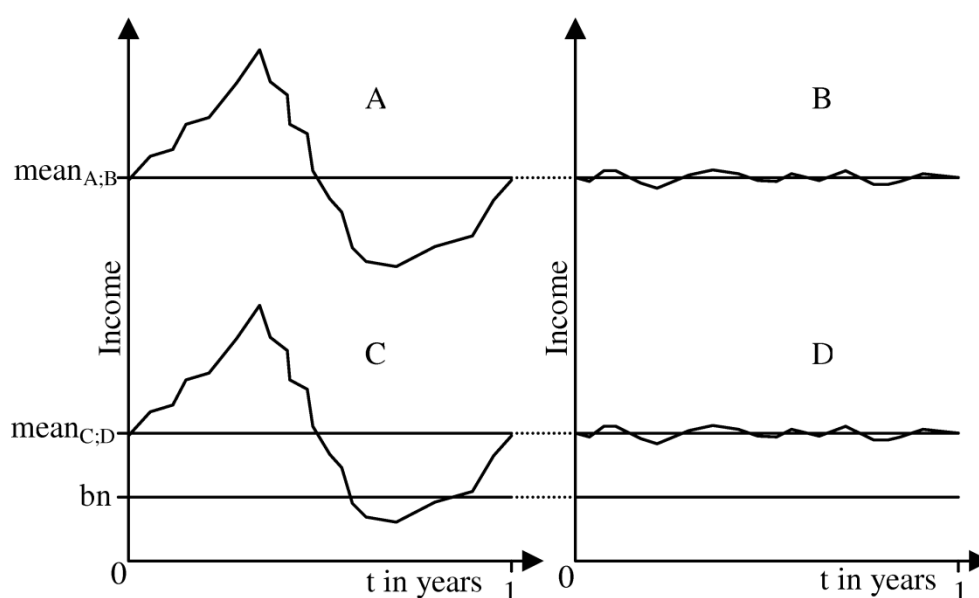
10 Gill 1991, p. 2

11 Chambers, et al. 1981, p. 9

2.2.1 Seasonality and Poverty

The permanent income hypothesis by Friedman states that if income changes because of predictable (seasonal) patterns, consumption will not reflect the seasonal pattern of income, because people will save money when income peaks to retain the level of consumption in the slack season.¹² From this theory it could be concluded, that seasonality does not have an impact on poverty and that despite seasonal patterns of income, seasonal food security would be non-existent. Later literature, however, assumes a significant relationship between seasonality and poverty. A model developed by Gill¹³ helps to explain this relationship. The model is comparing the mean and the variance of a household's annual income. Figure 1 shows the annual distribution of four households. A and C have high fluctuations in their income, as it is typical for day-labourers in a unimodal agricultural setting. However A's income is on a higher level than C's. B and D have a relatively stable income on different levels. They might generate their major income from jobs with a fixed salary.

Figure 1: mean-variance model on income (seasonal/non-seasonal; high income/low income)



(Source: Gill 1991, p. 9; adjusted)

We assume that all households need a certain amount of income to ensure their *basic needs* (bn) to be food secure.¹⁴ For the moment we also assume a

12 cf. Alderman and Sahn 1989, pp. 98 (based on Friedman, Milton (1957). *A Theory of the Consumption Function*. Princeton: Princeton University Press.

13 The following description of the model is based on Gill 1991, pp. 8-10.

14 In the original model, Gill uses a *critical level of consumption* (Gill 1991, p. 8) instead of bn. The concept of basic needs will be explained in more detail in chapter 4.2.

household to finance its consumption exclusively from current income. The probability of temporary food insecurity increases with a falling mean and an increasing level of seasonal variation in income. In this example C is seasonal food insecure, because its income in certain periods is not sufficient to cover basic needs. By increasing its mean income (like A) or by smoothing the income pattern (like D) the household could fulfil its basic needs all around the year. If the mean is very low even a household with a stable income can become food insecure. In this case we would speak of chronic food insecurity.

We now relax the previous assumption and take into consideration that a household can save and borrow money and goods. Therefore, current consumption can be financed from past, current, and future income. The rational behind saving is quite strong, because the risk of future shortages can be anticipated due to its regular pattern. C could prevent being food insecure either by building up savings during the first six months of the year, when income peaks, or by borrowing during the food insecure period. However, these processes bring costs for the people, which reduce their ability to consume.¹⁵

For understanding how saving reduces consumption, the model of time preference – a persons preference between current and future consumption – can be used.¹⁶ Normally it is assumed that a person prefers current consumption to future consumption. A person would only save if he is compensated for shifting present to future consumption. This compensation is reflected in the financial market by the interest rate on deposits. To make a person save, the rate of compensation must be higher than his *rate of time preference* (tp)¹⁷. A household, which is expecting a situation of seasonal food insecurity to come, however, would give future consumption a higher relevance than present consumption. His tp would therefore turn negative.

In the case of a developed financial system, the money would be saved on a bank account with a positive interest despite the negative tp. Total consumption would therefore increase by the realised interest. However, a majority of those affected by seasonal food insecurity, the rural poor, do not have access to the formal banking sector. They can consequently only hoard their money or kinds without realising interest.¹⁸ Physical storage of food is mostly associated with a natural storage loss and saving money at home is risky because of theft.¹⁹ Saved assets like livestock might deteriorate in price, since too many people want to sell these assets during food insecure periods.²⁰ The loss in money and assets that results from saving reduces consumption. All methods to shift consumption in time imply costs; these costs will be called the 'cost of seasonality'.

15 Gill 1991, p.10

16 The explanation of the model on time preference is based on Gill 1991, pp. 10-11

17 The rate of time preference is defined as $tp = (I_f - I_p)/I_p$ with I_p = the amount of a given income and I_f = the amount of future income that must be received in order to persuade an individual to save I_p

18 cf. Gill 1991, p. 11

19 cf. Ibid., p. 11

20 e.g. Zug 2006a, p. 7

The cost of seasonality for borrowing money is the interest, which has to be paid to the creditor. During the slack season, the preference for current consumption is high, which leads to a high *tp*. Without access to the financial services with low market imperfections, where interest rates are mainly determined by supply and demand, poor households can often only borrow from informal money lenders. Maximising their profits, money lenders can adjust the interest rates up to *tp*.²¹

The higher the income variation between peak and slack season the higher is the variation in the *tp*, which leads to the acceptance of storing and saving conditions with a high loss and loans with a very high interest rate. "Hence, seasonality *in itself* implies an increase in the degree of poverty, other things being equal."²²

People in a seasonal environment therefore face a trade-off. Increasing consumption in the slack season does not only lead to a loss in consumption in other seasons, but also to a decrease in overall consumption. Reduced financial market imperfections, which would allow the poor to save money and to access credit with low interest, would reduce their costs of disconnecting seasonal consumption patterns from seasonal income patterns.²³ Improved storage capacities have a similar effect.²⁴

The poorer the household is the bigger are its difficulties to save. Despite a higher income during the peak season, there is the possibility that the household is unable to reduce current consumption significantly in favour of future consumption, without suffering extreme consequences already in the peak season such as malnutrition.²⁵ This problem is even aggravated if the household peak season income is reduced from paying back the previous season's debts.

Chambers and Gill are strongly arguing that "the regular occurrence of bad seasons in itself is poverty reinforcing and helps to hold the victims of poverty entrapped"²⁶. Indebtedness is a major reason for this poverty trap. Knowing that a bad season will occur, the poor always have to keep up good relationships with their patrons, who might provide them with a credit or work during the critical period. "They are thus screwed down seasonally into subordinate and dependant relationships in which they are open to exploitation. Sometimes the screw becomes a ratchet, an irreversible downward movement into deeper poverty as assets are mortgaged or sold without hope of recovery."²⁷

In all considerations it should be borne in mind that, depending on the setting, the ability to predict seasonality of income differs. Climatic shocks or other

21 cf. Gill 1991, p. 12

22 Ibid., p.11

23 Alderman and Sahn 1989, p. 99

24 cf. Raiks 1981, p. 69

25 cf. Alderman and Sahn 1989, p. 98

26 Gill 1991, p. 218

27 Chambers, et al. 1981, p. 5

externalities in a specific year can highly influence the characteristics of a season.

2.2.2 Seasonality and Prices

The household's consumption during the slack season is mainly based on the amount of food stored and its ability to buy food from current income, loans or savings. The market price of a good determines the amount that can be bought with the available money. Since market prices are fluctuating in time, they have to be included into the consideration. "If movements in prices and incomes are procyclical, purchasing power remains stable from one season to the next".²⁸ However this is not the case in many agricultural seasonal environments. The typical pattern for prices is a drop after harvest, when supply is high and gradually recovering prices until the next harvest.²⁹ In many agricultural settings this period coincides with the period of low income. High fluctuations in food prices can therefore further reduce access to food during periods of food insecurity.

2.2.3 Seasonality, Employment and Income

Seasonality in agriculture has mainly effects on the farmer's and labourer's income. This research will focus on those two groups only, nevertheless acknowledging that a multitude of other groups is indirectly affected by agricultural production, ranging from traders and producers of agricultural inputs to beggars, whose income often depends on the financial situation of those directly involved into agricultural production.

The impact of agricultural patterns on the seasonal income of farmers and labourers differs. Farmers are compensated for their continuous inputs on the fields by the yield. The money or stocks in kind that have been accumulated can be used to finance the next season's cultivation and consumption. The labourers' income, however, is not restricted to the harvest, but to the farmers demand in agricultural labour. This pattern of demand is determined by the seasonal requirements of each crop planted, the diversity of crops with different patterns, and the timing of cultivation.

The agricultural cropping pattern in a region therefore determines how much labour is needed during which time of the year. If this demand is volatile, one or several peak and slack seasons in labour demand will characterise the labourers' annual income opportunities. If wages are determined by the market, they will be low during the slack season and high during the peak season. The days when the labourers can find work are less in the lean season. If they find work, the wage rate is below the annual average. Since these two effects occur

28 Sahn 1989, p. 10

29 Gill 1991, p. 161

in combination, the total negative impact of seasonality on the labourers' income is high.

In a setting, in which farmers and their families work on their own fields, the seasonality of income of the labourers is even extended.³⁰ The farmers tend to employ external labour only after household labour is fully employed. That means that the proportion of work done by labourers from the total work available is less in the slack season and more in the peak season. Gill deduces, that "income of labourers can expected to be [...] more seasonal than that of farmers"³¹. This conclusion is not entirely true. The degree of seasonality of income of the labourers is extended. However, seasonality in the farmers' income can still be expected to be more distinct. Although the farmers might have a lower seasonality in working days, their income remains highly seasonal since they receive it only after harvest. The labourers, however, have at least a little income whenever they find employment. Since the landless labourers tend to be poorer than farm households, seasonality can still create a more serious problem for them.

Several macroeconomic theories from the 1950s such as Lewis' dual sector model did not take the aspect of seasonality into account.³² Lewis assumed the marginal productivity of labour in rural areas to be zero. Labour could therefore be released for the development of other sectors until the excess supply of labour was reduced in the countryside. Seasonality is a significant shortcoming of this theory.

Availability of labour is naturally restricted by the total number of labourers, assuming that no labour migration takes place. Although the marginal product of labour might be zero most times of the year, a natural labour shortage during the peak season can be expected in a seasonal environment. This leads to a high marginal product of labour in that specific season. If labour would be withdrawn from the rural areas to be employed in the urban industries, the intensified labour bottleneck in the peak season would be a significant limitation to agricultural growth. In many African contexts where land is no limiting factor, not having enough labour in the peak season would reduce the area cultivated.³³ However, Bangladesh is densely populated and land is scarce. Nevertheless the problem of labour bottlenecks in agriculture can have an effect on the cropping intensity and the intensity of cultivation. Because of seasonality, withdrawing labour from the agricultural sector can lead to a decrease in production despite high underemployment in the rural area. Accordingly, the possibility to increase production through labour intensification is limited.

The labour bottleneck during the peak season has a positive effect on the labourers' income. Since demand in labour is very high, while supply is limited,

30 cf. Alderman and Sahn 1989, p. 90

31 Gill 1991, p. 13

32 cf. Ibid., p.6 (refers to Lewis, W. A. (1954). "Economic development with unlimited supplies of labour". *The Manchester School*, 22:2.)

33 cf. Moris 1989, p. 223

the wage rates are normally far above the average. "The farmers' labour constraint is the labourers' golden opportunity, perhaps the only time, when they can earn enough to see them through the next slack season."³⁴

2.2.4 Strategies to Influence Seasonality

Seasonality is only predetermined by climate and natural conditions to a certain degree. Men always had counter-seasonal strategies to disconnect consumption from these seasonal patterns, such as storage of food. Additionally they applied strategies, such as breeding and irrigation, to allow cultivation in periods or under conditions, in which cultivation was not possible before.

In the field of agricultural research influencing agricultural seasonality through breeding of varieties and adopting new cultivation technologies is an important aspect, which contributes to increase overall production. In the course of this evaluation, such an intervention will be analysed. The aspect of mechanisation will be elaborated on in the next chapter. Other factors, which can influence seasonality, are shortly summarised³⁵ here.

The income of a household does not entirely have to be based on agricultural income. Livelihood diversification is a core strategy to smoothen income patterns. Besides generating income from non-agricultural work, migration to regions with a different seasonal pattern is a relevant option for alternative income during the lean season. In several countries, the government directly tries to smoothen consumption by distributing relief and providing cash-or food-for-work programmes, which provide counter-seasonal employment opportunities.

The importance of price fluctuations on consumption was explained above. Some governments directly stabilise the prices by different means or indirectly by establishing functioning markets. Equally important is the performance of the financial market, which can provide services to those, who are facing seasonality.

Coming back to Gill's model on seasonality (Chapter 2.2.1.): Reducing the effects of seasonality on the livelihoods of the poor can be achieved by reducing the seasonal fluctuations of income. The strategies described above aim on such a change. The second option is to lift the mean income in relation to basic needs. Chambers demands that the issue of seasonality "should not divert attention from more basic issues. [...] The most counter-seasonal measure is to remove extreme poverty"³⁶.

34 Gill 1991, p. 183

35 The summary is based on Alderman and Sahn 1989, Sahn and Delgado 1989 and Gill 1991, pp. 104-131

36 Chambers and Maxwell 1981, p. 238

2.3 Agricultural Mechanisation

Technological innovations in agriculture change the previous modes of cultivation and can highly influence the total production but also the factor productivity of labour and hence labour demand. We can roughly differentiate between two types of technical innovations: mechanical and biological technologies. In the course of this evaluation especially mechanisation of agriculture is analysed with its impacts on different groups of society, both from a seasonal and a non-seasonal perspective. Mechanisation is defined as a process of introducing technical equipment, which reduces physical work irregardless of its energy source. Hence, human powered tools are included under the definition. In this chapter some theoretical considerations on agricultural mechanisation will be presented.

The impact of introducing agricultural machinery can have two diverse impacts on labour demand. Gill differentiates between labour displacing and labour augmenting technologies.³⁷ The prime example for an augmenting technology is irrigation, which allows cultivation on fields that had to lie fallow before.³⁸ In the case of Bangladesh the introduction of irrigation on large scale through shallow and deep tube wells since the early 1960s³⁹ made cultivation of different crops during the dry winter season possible on plots, which could not be cultivated in the dry season in the past. Hossain⁴⁰ conducted an empirical study comparing villages, which differed in the degree of participation in green revolution technologies including irrigation. He found all sizes of farms and the labourer households to be better off in the villages where modernisation already took place. He concluded that the landless benefited because of a higher demand in labour and higher wage rates.

However, if machines reduce the labour demand for one or several steps of cultivation, the technology is in most cases labour displacing. A very drastic example is the introduction of combine harvesters, which rape, thresh and separate grain from chaff within one operation. Gill cites a case study from India, where combine harvesters reduced harvest employment by 95% without increasing the productivity and cropping intensity.⁴¹

Under certain conditions a technology can be labour displacing for specific steps in the production circle, but labour augmenting when taking the whole cycle into consideration. This is the case for technologies, which reduce a labour bottleneck and therefore allow expansion of production.

For the labourers a trade-off exists if seasonality is smoothened by removing a labour bottleneck. On the one hand labourers have an interest in stable income patterns. Dependency created by the labourers' need to bridge times of short-

37 cf. Gill 1991, pp. 183-184

38 cf. Alderman and Sahn 1989, p. 91

39 Alauddin and Hossain 2001, pp. 38-39

40 Hossain 1988

41 Laxminarayan H. et al (1981). *Impact of Harvest Combiners on Labour Use, Crop Pattern and Productivity*. Dehli, Agricole Publishing Academy (cited in Gill 1991, p. 178)

ages by loans leads to a loss in overall income. On the other hand, removing a bottleneck of labour also removes the favourable income opportunities in the peak season. Even if the overall demand of manpower remains the same, wage-labour might be replaced by the farm households' own working power. If the labour, which was done by the labourers in the peak season, is shifted to the lean season, the farmer might have enough capacity to do it by himself.⁴² Under certain circumstance the existence of a labour bottleneck can even stabilise the labourers' income pattern. Alderman and Sahn⁴³ argue, that the more difficult the peak season recruitment the higher the probability that the farmers will give long-term contracts to the labourers, which bind them during the peak season, but also give them a stable income throughout the year.

If a technology is labour displacing like in the Indian example, the result for the labourers can be devastating and lead to the loss of social welfare of the labourer even without being balanced by an equal increase in social welfare of other groups in society. To understand why machines are introduced despite a net decrease in social welfare, we have to look on how decisions are made. The farmers are the ones, who normally decide to invest in a technology or not. The labourers have hardly any influence on the decision-making process, unless their interests are protected by government regulations.⁴⁴ The farmers' prime objective is the improvement of their own social welfare. If replacing labour by capital improves their profit, they would normally implement that option despite the decrease in social welfare of the labourers. In some cases the rational behind investment in machines is not profit. Farmers can improve their social status by owning modern technical equipment, and they might buy it even without increasing profit.⁴⁵ Despite expecting higher profits some farmers might also not change because of habits and uncertainty of the new technology.

From a seasonal viewpoint mechanisation does not necessarily remove bottlenecks in agriculture, but might just replace one bottleneck with another. Much of the technical equipment, like a harvesting machine, is only needed in a short seasonal period.⁴⁶ Technical equipment is often expensive. Hence, a lot of area has to be cultivated to use it efficiently. Since periods for certain steps of cultivation are short, technical equipment can also lead to a timeliness problem as the restriction in labour does.⁴⁷

To determine whether a certain type of mechanisation of agriculture is *good* for the society as a whole and the labourers in particular a variety of effects has to be analysed. It should however not be forgotten to take a long-term perspective into consideration. If mechanisation leads to lower costs of production and/or increase in production, the rural poor, which include the labourers, can access food cheaper and hence profit. If labour displacing mechanisation is

42 cf. Gill 1991, pp. 182-183

43 cf. Alderman and Sahn 1989, p.86

44 cf. Gill 1991, p. 189

45 cf. Ibid., p. 181

46 cf. Ibid., p. 128

47 cf. Ibid., p. 187

combined with generation of employment in non-agricultural sectors, the loss of employment can be balanced.

3 The Project in its Context

3.1 The Setting

The majority of Bangladesh's rural population – especially in the economically low diversified northern part of the country – is heavily dependent on agriculture, either by cultivating own land or by working as wage-labour on the fields of others.

Agricultural patterns and therefore the income of a large proportion of the rural population are strongly influenced by seasonality. Bangladesh's agriculture is characterised by a unimodal climate with heavy rainfall during the monsoon. Since the spread of the technical innovation of irrigation up to three harvests per year are possible on a single plot. During the *rabi* season in winter, irrigation is used while agriculture is mainly rain-feed during *kharif I* and *kharif II*. The cropping systems in these seasons differ significantly. While during *rabi* and *kharif I* various crops are planted, *kharif II* is hardly diversified. Nearly all agricultural activities during *kharif II* are focussing on *amon* production, which is the paddy of that season. The farmers' and the labourers' income patterns are therefore highly seasonal. Farmers cannot generate income in-between plantation and harvest of paddy since no other crops are cultivated

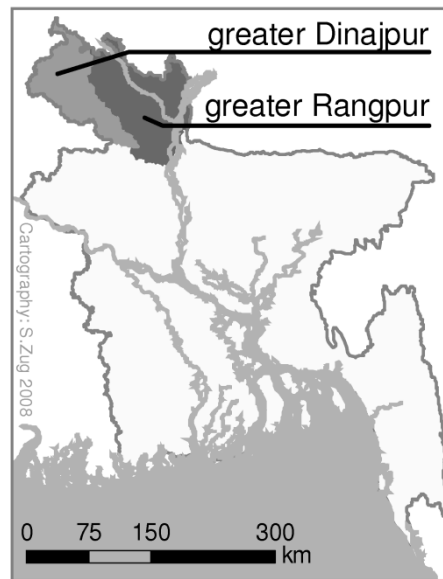
The labourers' income is determined by the requirements of *amon* cultivation, which is nearly exclusively cultivated through transplantation. After seeding paddy on a very small plot, the seedlings are manually removed and planted with a specific spacing on a large field. Some farmers practice so-called double transplantation, where the seedlings are planted in an intermediate field before final transplantation. The process of transplantation is very labour intensive. However, after paddy is planted on the main field, only a limited amount of labour is needed for intercultural activities, which include weeding and the application of fertiliser and pesticides.

Alternative non-agricultural working opportunities such as in the construction sector and on the brickfields are rare, because the rains are still ongoing. Small trade activities are also reduced, since hardly any agricultural products are traded⁴⁸ and people do not have money to buy clothes, cutlery etc. The low availability of non-agricultural employment aggravates the seasonality of income for the labourers.

The underemployment of the labourers and the waiting of the farmers for the harvest lead to a depleting purchasing power and a reduction in food stocks. Accelerated by rising rice prices towards the harvest, a situation of seasonal food insecurity for a significant part of the population arises.

48 People are involved in agricultural trade, especially during and shortly after paddy is harvested. The food insecure months also coincide with the off-season of vegetables.

Map 1: Bangladesh



This phenomenon of seasonal food insecurity is widely discussed in the Bangladesh media, in politics and increasingly among scientists. Seasonality is a characteristic of all agriculture practised in Bangladesh. However, in some regions it has a more significant impact on the people's livelihoods than in others. In the current debate the five Northern Districts Gaibandha, Lalmonirhat, Kurigram, Nilphamari and Rangpur, which are also called greater Rangpur are said to be most severely affected.⁴⁹ Discussions on greater Dinajpur consisting of Dinajpur, Panchagarh and Thakurgaon decreased in the past few years.

The lower diversification of agriculture and comparatively few non-agricultural income opportunities are two major reasons, why seasonality of income is more severe in greater Rangpur than in other regions. A higher share of chronic poor people⁵⁰, who tend to be more vulnerable to seasonal fluctuations in income, aggravates the problem of seasonal food insecurity in the region.

The poorly defined term '*monga*' has emerged from this debate, describing a situation where the lean season of *amon* cultivation leads to a decreasing food intake of a significant proportion of the population in these northern districts.

Severity within the districts differs strongly. The aspect of ecological vulnerability makes some areas more affected. The Jamuna (Brahmaputra) and its biggest contributor Teesta have a big impact on the livelihoods of those living on the islands and on the banks. The annual flooding and land erosion significantly

49 cf. Zug 2006b, pp. 7-9

50 Recently two poverty mappings were published, which both clearly indicate a higher proportion of households below the poverty line in greater Rangpur compared to most of the other regions in Bangladesh. (Bangladesh Planning Commission and WFP 2005, p. 12 and Bread for the World and RDRS 2005, p. 33)

increases chronic poverty. These areas have become a refuge for the poorest, since those, who can afford, including landlords, settle on mainland areas, which are not affected by floods and erosion. The higher degree of chronic poverty makes people more vulnerable to seasonal food insecurity, too. Another accelerating factor is that the floods precede *monga*. People's livelihoods are already weakened when the lean season begins.

As shown in the previous chapters, changes in the agricultural system can have a significant impact on the farmers' and labourers' income patterns and on their overall income. A relatively new project in Northern Bangladesh is aiming at optimising agricultural cropping patterns and technologies to reduce seasonality of food security and to increase the farmers' profit.

3.2 The Project to be Evaluated

Monga is a widely discussed phenomenon among policy makers. Ideas for sustainable solutions were rare so far. Only a few small activities went beyond distribution of relief. In the past years the idea developed to solve *monga* by addressing seasonality of agricultural patterns, which can be seen as the root cause of *monga*. Diversification of agriculture by the introduction of alternative crops into the predominant rice cultivation during *amon* season is hardly possible, because of climatic preconditions. Rice cultivation itself, however, allows adjustments in the timing of cultivation. Pattern of labour demand can be changed and hence seasonality of the labourers' income.

Rangpur Dinajpur Rural Service (RDRS) and the public *Bangladesh Rice Research Institute* (BRRI) developed or adopted several methods to harvest *amon* some weeks earlier, providing employment and income for the labourers during *monga*. There are three parameters, which can be used to shift *amon* harvest: seeding date, variety and cultivation technology.

Setting an earlier seeding date results in an earlier harvest, but this method is restricted, since paddy yield is depending on the optimal planting time and planting time on the harvest date of the previous crop.

The parameter variety affects the harvest date, since rice varieties have different growth durations. The predominantly planted variety BR11 takes 145 days from seed to harvest.⁵¹ Other varieties have a significant lower growth duration. BR33 is the currently promoted variety by the project. It was released in 1997 and takes only 118 days to mature.⁵²

Amon cultivation is mainly done by transplantation. Paddy is seeded very densely on a very small field. After some time, depending on the seedling age and the weather conditions, paddy seedlings are removed and replanted with a specific spacing on the main field. Removing the seedlings from the seedbed

51 BRRI 2004, p. 8 (This figure refers to cultivation by single transplantation)

52 Ibid., p. 9

leads to root injury and leaf loss.⁵³ This is a shock for the plant, which has an impact on the growth duration. One project alternative is shortening rice cultivation by changing the parameter cultivation technology. Paddy is directly seeded on the main field instead of being transplanted. Growth duration shortens by about 10-18 days⁵⁴. BR33 can therefore be cultivated as short as 100 days.⁵⁵

Different technologies for direct-seeding are currently discussed and some are already being introduced. The most prominent technology is direct-wet-seeding by a drum-seeder (called drum-seeding), which was developed by the *International Rice Research Institute* (IRRI). The drum-seeder is rather low cost plastic equipment that currently costs 2,500 taka in Bangladesh which is about 25 euro. It consists of several perforated drums, in which the seeds are filled. When it is pulled, every drum releases one line of seeds, which drops into the wet soil. Water management is very crucial in drum-seeding. The soil has to be wet, but the seeds are not allowed to be covered with standing water. This requires a properly levelled surface which is achieved by extra ploughing and levelling.

Alternatively, paddy can be sown directly into the dry soil. Different than in drum-seeding, the seeds have to be covered with some soil in direct-dry-seeding. Three steps are needed. A furrow has to be created, the seeds have to be put into the furrow and it finally has to be covered with soil. The power-tiller operated dry-seeder (PTODS) performs all three steps in one operation. This equipment is rather expensive and difficult to promote. In October 2007 RDRS presented an optimised drum-seeder to the public, which performs farrowing and seeding. Only covering with soil has to be done in a separate step. BRRI is promoting the lithao, which is a simple device to create a furrow. Seeding and covering has to be done separately.

RDRS and BRRI's Regional Station Rangpur are the main actors in developing or adapting the above described technologies to the context of greater Rangpur. Additionally, they are the key players in extending these technologies to the local farmers. What seemed to be a close cooperation of these two actors under the roof of the 'Focal Area Forum Northwest Region', developed into a competition. There is a big dispute about who developed which technology and who should get the credit for it. The big political and media interest in the project aggravates this conflict. However, this problem will not be dealt with in this evaluation.

53 cf. Salam, et al. 2001, p. 69

54 Husain and Abedin 2004, p. 55, Mazid and Johnson 2007, p. 2, Neogi unpublished

55 Some farmers transplant twice, which is called double-transplantation. With that cultivation technology crop duration is additionally prolonged.

Figure 2: paddy seeding with a drum-seeder



In 2006 RDRS firstly introduced early rice cultivation through farmer field schools on 1,271 ha, which is 0.14%⁵⁶ of the total area cultivated with *amon* in greater Rangpur and Dinajpur. 25 Partner NGOs and about 10,000 farmers were involved in the process.⁵⁷ In the beginning the major objective was to introduce drum-seeding technology as the only project option. 64% of the area was cultivated with drum-seeded BR33 and BR11. The remaining 36% of the area were cultivated with transplanted BR33, mainly because not enough drum-seeders were available. RDRS encountered some resistance towards using the drum-seeder from the farmers' side and changed its policy in 2007. The farmers were now given different options to choose from. The overall project area slightly increased to 1414 ha. The disagreement of farmers with drum-seeding technology is significant. Only 10% of the area was cultivated with that technology while 89% was cultivated with transplanted BR33,⁵⁸ when farmers were given the option to choose. On some minor areas direct-dry-seeding with PTODS and the modified drum-seeder was implemented. In 2007 BRRI also started to establish an NGO network like RDRS and provided training to 202 farmers.⁵⁹

This evaluation will not consider all the methods, which are currently promoted and tested. Only transplanted BR33 and drum-seeded BR33, which are the most important ones, will be taken into consideration and compared with the current practice. It will be assumed here that the technologies are technically feasible and that the farmers are willing to apply them. The evaluation will only focus on the economic rather than the technical aspects.

56 In 2003 in greater Rangpur and greater Dinajpur, where the project is implemented, 934,000 ha were cultivated with *amon* (Bangladesh Bureau of Statistics 2005b)

57 cf. RDRS Bangladesh 2007, p. 23

58 based on RDRS internal monitoring data.

59 cf. Mazid and Johnson 2007, p. 2

3.3 The Expected Outcome

Changing agriculture in the project's intended way will have a different impact on labourers and farmers. The implementing organisations expect significant relief from seasonal food insecurity or even the final solution of the problem. They promote the project in the public as a counter-seasonal intervention. The rationale behind this expectation is that labourers will have a more evenly distributed employment pattern. Earlier harvest would provide a significant demand in labour and hence income for the labourers during the food insecure period. However the new technologies will also have an impact on the total availability of employment, which is not discussed in public. It has to be analysed what impact the project will have on the annual income of the labourers taking both, the benefits of reduced seasonality and the possible loss of employment opportunities, into account.

Changing the rice cultivation system during the *kharif II* season makes adjustments in the annual cropping pattern possible. Since harvest of paddy takes place much earlier, subsequent crops can also be planted earlier. Potato and wheat in greater Rangpur are currently planted too late, which leads to a loss in profit. In 2006/2007 the total area of these crops amounted to 16.7%⁶⁰ of the area, which was cultivated with *amon* in the previous season. Having an earlier harvest of *amon* will allow planting potato and wheat in optimal time and will therefore increase yield and generate additional profit for the farmers. RDRS is aiming to implement early rice cultivation on the majority of the area, which is currently planted with potato and wheat during *rabi* season.⁶¹

Subsequently the third crop in the cropping pattern can be planted earlier, which is in case of some crops also expected to have a positive impact on yield and therefore on the farmers' income.

60 Additional Director, DAE (unpublished data)

61 RDRS Bangladesh 2007, p. 24

4 Theoretical Framework

In the previous chapter the characteristics of the project have been outlined. The project activities can only propose a new cultivation system. The investment decision for or against a new system are taken by the farmers. Their decision will mainly be based on the system's potential to increase their profit. The sustainability of the project therefore depends on the profitability of the system for the farmers. The labourers are excluded from this decision, but they are the major defined beneficiary group of the project. A core project objective is to improve their food security, since they are much more affected from food insecurity than the farmers. To be successful, the project has to improve the social welfare of the farmers and the labourers. Hence, both groups are analysed separately.

Despite the fact that the project already started in 2006, an ex-ante evaluation is applied. At the current stage of the project an ex-post evaluation would strongly be influenced by the pilot character of the project and would not reveal a reliable result because of various aspects.

- The project is expected to have an impact on seasonality of labour. This impact is only measurable, if a significant area is cultivated with the new technology.
- Most farmers only cultivate a very small area with drum-seeding technology as a trial. Cultivation costs can be expected to differ between a farmer who is cultivating a significant share of his lands and a farmer who is doing a trial on minimal scale.
- The project is currently providing services to the farmers. Drum-seeders are rented out for free, which reduces the farmer's production costs.
- The process of learning the new technology requires time and is especially in the beginning also characterised by mistakes. Maintaining an optimal moisture content, which is required for drum-seeding will be one of the challenges in the first years, which can lead to crop losses for the inexperienced farmers.

Because of these limitations the evaluation will only look at the setting without the project and model a situation with the project. The evaluation will therefore take place in a sub-district (*upazila*) where the project is not being implemented, yet. For analysing the overall impact of the project on the people's social welfare, a *cost-benefit analysis* (CBA) will be chosen.

4.1 Cost-Benefit Analysis⁶²

A CBA is a widely used method to evaluate public interventions. Its objective is to represent the affected people's perspective on the project rather than a political or an expert view. Impacts of the project that either have no conse-

62 The description of the CBA is based on Bergen, et al. 2002, pp. 413-446 if not indicated differently.

quence on the people's lives or that people do not attach importance to are not taken into consideration. To determine a project's overall value, costs and benefits of one or several investment alternatives are analysed. From the costs and benefits the *net present value* (NPV) of each alternative can be calculated. Hence, the NPV expresses the economic value of an investment in comparison to non-investment. If the NPV is positive the project should be implemented, since the social welfare with the project will be higher than without.

This evaluation does not focus on an exclusively public intervention but on a project mainly implemented through NGOs. Nevertheless, the perspective taken is quite similar to analysing a public intervention. The aim of the evaluation is not to determine the profit which derives from the project for the NGO, as it would be done in evaluating the investment activities of a private company, but whether the project fulfils its objective to increase social welfare or not.

In contrast to most CBAs of public interventions, the cost for the implementing organisation will not be taken into consideration here. The analysis focuses on the social welfare change of those directly affected by the project, only. Since they do not pay for the implementation, as a taxpayer does for most government projects, the implementation costs do not have any effect on their social welfare. The project is mainly financed through donor money. Hence, implementation costs impact on the social welfare of foreigners, only.

If implementation costs are taken into consideration, normally high costs occur in the initial phase of a project. Expenses for technical equipment are one example for an investment which is often done in the first year, but used for several years. In the beginning the social welfare change might be negative, since the benefits cannot balance the costs. However, in the following years, it can be used and only maintenance costs have to be covered. Benefits might then be higher than costs. To determine the total value of a project the whole project duration or even the time beyond has to be taken into consideration. In a classical CBA discounting is applied to express future costs and benefits from today's perspective resulting in a NPV.

Costs and benefits in the context of this project are mainly the same every year. The farmers have to cover input costs, labour costs, and achieve yield, which does not significantly differ from one year to another (assuming no degradation of soils, stable prices and no other externalities). The only equipment that is used for several years is the drum-seeder, which however only leads to insignificant capital costs. Determining a NPV through discounting the social welfare change for several years does therefore not provide any additional information. The result of this evaluation will therefore be expressed by the welfare change between one year of cultivation without the project and with the project.

Monetarising all costs and benefits distinguishes CBA from most other evaluation methods. However, not all aspects that have an influence on the society's change in social welfare are given in monetary units. Various methods have been developed to assess the value of those aspects, which are not mone-

tarised from the people's perspective. Examples are the value of biodiversity or of a healthy environment. Despite the existence of different approaches to monetarise these aspects, they are contested and applying them is complex. The big advantage of this evaluation is that most of the costs and benefits expected from the project are related to changes in income, which is comparatively easy measurable in monetary terms.

Income from agricultural activities in the case of the farmers equals the profit from cultivation, which is the excess of returns over cultivation cost. Labour costs are one part of the farmers' cultivation costs and are at the same time the income of the labourers. For working a certain time or doing a certain task the farmer pays a wage to the labourer. This wage does not necessarily have to be paid with money. In the case of the study group, labourers sometimes receive their income partly in cash and partly in form of a meal. The value of the meal has to be monetarised and added to the wage to determine the labourers' income and the farmers' labour cost. Additional ancillary wage costs are not expected in the context of the agricultural economy in Bangladesh.

The project will bring about a change in the technology the farmers are using for cultivation. The production function for paddy will change and therewith the farmers' production costs and the returns from cultivation. Hence, the farmers' income will be affected. Changes in the farmers' production costs will also impact on labour costs. The demand for labour will change impacting on the labourer's income.

A project with a positive welfare change allows the conclusion that the project benefits the society and that it benefits society more, than a project with a lower welfare change. However, a positive welfare change does not necessarily mean that everybody gains. The CBA is based on the Kaldor-Hicks principle, under which a project is acceptable if the gainers' change in social welfare is sufficient to compensate the losers. Whether this compensation actually takes place or not is not relevant.⁶³ Robert H. Frank tries to defend CBA: "Rich and poor alike have an interest in making the economic pie as large as possible. Any policy that passes the cost-benefit test makes the economic pie larger. And when the pie is larger, everyone can have a larger slice."⁶⁴ He is right that everybody *can* have a larger slice, but it can also happen that the piece of those, who are already in need, will become smaller, despite the total growth of the total cake.

Under the normative guidelines of the implementing institutions it would not be acceptable if economic development would be achieved on the cost of a resource poor group in society. The two key players in the project RDRS and the Government of Bangladesh stress their orientation towards poverty reduction. RDRS commits it work to the rural poor. "RDRS has never lost sight of its primary function and raison d'être - to support the emergence of, to give voice to,

63 cf. Sen 2000, pp. 947-948

64 Frank 2000, pp. p. 917

and to empower the rural poor of the north. All actions must be assessed according to this fundamental principle.”⁶⁵

The Government of Bangladesh is involved in the project through BRRRI. They stressed their poverty oriented perspective in their *poverty reduction strategy paper* (PRSP) published in 2005.⁶⁶ Pro-poor growth is the central message of the PRSP.

The concept of pro-poor growth is highly debated and different definitions co-exist.⁶⁷ Definitions vary on the extent the poor have to profit from growth in order to label growth “pro-poor”. The main three groups of definitions are presented here. The minimal definition is absolute pro-poor growth, which requires a reduction of absolute poverty of the poor irrespectively of distributional issues. Relative pro-poor growth sets the economic development of the poor and the non-poor into relation. Relative pro-poor growth is achieved, if the growth rate of the poor is higher than that of the average population. Thus, relative inequality is reduced. The most radical group of definitions demands that absolute inequality has to be reduced through pro-poor growth. This would require that the absolute increase of an average poor person’s income has to be bigger than an average person’s increase in income.

The *poverty reduction strategy* (PRS) of the Bangladesh Government is aiming on relative pro-poor growth. Income opportunities from agriculture, which is the central topic of this evaluation, is given a big weight in the PRS because of its importance for food security, income for the rural poor and exports.⁶⁸ Within agriculture the labourers are seen as a central group, which has to be promoted. “The future growth process must generate employment opportunities for the poorer sections of the population and the returns from employment, both self and wage/salary employment, must generate adequate earnings for them so that they can break out of poverty.”⁶⁹

In this evaluation the group of agricultural labourers and the farmers are analysed. Looking from a pro-poor growth perspective requires classifying the groups according to their poverty status. The labourers belong to the resource poorest households in Bangladesh. Incomes are low and affectedness from poverty and seasonal food insecurity is high. The farmers are a diverse group, which ranges between rich landowners with vast agricultural lands and marginal farmers, who have to obtain part of their income from labour, too. Hence, a certain part of the farmers struggles with similar problems as the labourers. Nevertheless it can be assumed that the majority of those poor farmers is still less poor and that they have more capabilities to ensure food security all-around the year than the labourers since they have access to the most important rural asset – land. The evaluation will hence compare the development

65 RDRS Bangladesh 2001

66 Government of the People’s Republic of Bangladesh 2005

67 different perspectives are described in detail in Lopez 2004 and Klasen 2004

68 cf. Government of the People’s Republic of Bangladesh 2005, p. 87

69 Ibid., p. 76

impacts of the project of the labourers, who are assumed to be poor and the farmers, who range between less poor and rich. Under the proclaimed governmental goal of relative pro-poor growth the project is successful if the labourers' income is increasing stronger than the income of the farmers.

Taking distributional issues into consideration leads to two distinct figures for the change in social welfare: one for the farmers and one for the labourers. A conventional CBA resulting in a single value for the welfare change allows a clear statement on the desirability of a project. Having two separate values for both groups' demands a normative discussion based on principles such as pro-poor growth.

For calculating the welfare change of both groups, labour costs are central. The change of the labourers' income, which equals the change in the farmers' labour costs, is derived from the difference in labour requirements of the analysed cultivation technologies.

For calculating the welfare change of the farmers a financial analysis is being applied. Project impacts on labour costs, capital costs, yields and paddy prices are taken into account to check if the necessary conditions for the project's success will be fulfilled. Primary data will be supplemented by some secondary data to analyse *kharif II* season, whereas the measurement of the change in *rabi* and *kharif I* season will completely rely on secondary data.

Beside the change in total labour income, the labourers' social welfare will be affected by the adjustment of planting seasons. Integrating this seasonal impact is the most complex component in the changes of social welfare of the labourers, which are to be recorded to see whether the project fulfils its objectives. The method to monetarise the change in seasonality will be described in the following chapter.

4.2 Measuring the Cost of Seasonality

The labourers' welfare change related to seasonality is closely linked to seasonal food security. Gill's mean-variance model on income showed that in a seasonal environment with a low mean income, households cannot fulfil their basic needs in the lean season, assuming that present consumption is financed by present income. Food security in the lean season can be achieved through borrowing, saving or selling of assets. All these methods involve some costs, the 'cost of seasonality'.

In the course of this evaluation the cost of seasonality will be calculated by the interest rate on informal loans, which are the only short-term loans available for the rural poor in the area. It is assumed, that selling assets in the lean season has a similar negative effect. Prices for assets during *monga* tend to decrease. One of the most important assets, which are easily transferable to money, is livestock. Interviews on the local market revealed, that the price of poultry

during *monga* is significantly lower. The price difference of poultry is quite similar to the interest rate on loans in this time of the year.⁷⁰ In an environment, which is less seasonal, the cost of seasonality will be lower or nonexistent. The project aims on reducing seasonality. Hence, the cost of seasonality is expected to be reduced, leading to an increase in social welfare. In form of the cost of seasonality, seasonality in income can be monetarised and included in the CBA.

This approach has to be seen as a rough approximation of the benefit from changing seasonality, but it includes some limitations. It assumes that everybody can access the services of the capital market and use the opportunity to shift consumption in time. This is often not true for the poorest strata of society, who will not receive loans because of their high risk of default and because they have no assets to sell or ability to save. They can have a higher profit from the project than expressed by the interest rate, because for them food insecurity cannot be prevented through shifting consumption by the cost of the interest rate. They will suffer from seasonal food insecurity with all the negative consequences on their livelihoods, including a weakened health status and decreasing capabilities, which are leading to setbacks in their development process.

The second limitation is to determine when people's present income is below their basic needs. A profit of a reduced cost of seasonality can only be achieved if income is shifted to a period, when people cannot fulfil their basic needs with current income. If the basic needs of a household are known, a comparison with its income in one moment in time allows concluding whether the household is subject to the cost of seasonality or not. If the project increases income to the same level than basic needs, the cost of seasonality is zero in this specific moment in time and increases the social welfare by the previously existing cost of seasonality. However, if income in one period is lifted beyond the basic needs through shifting employment from another period, no additional social welfare is generated, since the cost of seasonality is already zero.

It is complex to determine the basic needs line, which is required here to capture the benefits from reducing seasonality. Basic needs are defined in different ways. However, they normally refer to those needs, which are most essential for human life, comprising especially food intake, but also of clothing and housing etc. The income needed to ensure these basic needs can be interpreted as a poverty line. One method to determine this line is the *cost to basic needs method*, which computes the poverty line by a food basket enabling households to meet nutritional requirements and adding an allowance for non-food con-

70 The interest on informal loans is about 10.8% (figure will be discussed in chapter 6.5.1). The price for poultry is 130 taka per kg in the *monga* season and is expected to rise to 150 to 160 taka. Assuming a period of two to three months reveals a monthly interest rate between 5 and 12%. Data was taken from interviews conducted on the weekly market in Pabitra Jhar with customers and traders of livestock, who explained the price fall with an excess supply due to distressed sales.

sumption.⁷¹ Instead of using a basic needs line, which was generated from external experts, information was gathered about the people's perception on how much income they need to sustain basic needs and on the times, in which they are not able to do so. There were some major limitations in generating the basic needs line. Since people had expectations to personally benefit from the research activities, it is assumed that they gave too high figures for basic needs. Additionally, it was difficult for them to calculate their basic daily needs, since they do the major shopping twice a week during market days.

Since the explanatory power of the basic needs line, which was generated through the questionnaire is contested, only the people's perception on the times when they suffer from food insecurity was used for determining the period, in which a shift of income reduces the cost of seasonality. From the people's perception and the average monthly income, a range of the basic needs line was calculated. The upper limit is determined by the month with the lowest average income, in which all people state not to be food insecure. The lower line is determined by the food insecure month with the highest average income, respectively. A profit through a reduced cost of seasonality is expected as long as the new income in a food secure month does not exceed the monthly basic needs. The range of this line has to be seen as a very rough estimation.

4.3 Hypothesis and Justification of the Evaluation

As described above, the evaluation will analyse the impact of the project on the overall income of the farmer and the labourer households which are affected by the project. Only if the farmers profit economically, the project can be sustainable. If not, they will change to another cultivation practice. This leads to the following hypothesis:

Hypothesis 1: If the project is implemented, the overall social welfare of the farmers will increase.

The labourers, as the main declared beneficiary group will experience an impact on their social welfare through the total change in income opportunities and the change in the cost of seasonality. The justification of the project mainly depends on whether the following hypothesis is supported or not.

Hypothesis 2: If the project is implemented, the overall social welfare of the labourers will increase.

71 cf. Wodon 1997, pp. 66-67

The aim of an ex-ante evaluation is to give a suggestion to the decision makers, enabling them to decide whether the project should be implemented or not. The methodology of this evaluation is ex-ante. However, project implementation already started. Nevertheless, since the project still has a pilot character, the result of the evaluation can provide an important justification of the project. It can show advantages and disadvantages of different project alternatives and highlight the losers of the project, if there are any. Compensational activities could then be taken into consideration.

There are three major possible outcomes of the project. If the first hypothesis is wrong, the project will not go beyond the pilot stage, because the farmers will not use the new technology, if their social welfare does not increase. In this case the second hypothesis is not relevant, because it has no impact on the farmer's decision.

If the both hypotheses are supported, the project increases overall social welfare. The evaluation can conclude in such a case, that a project is a contribution to poverty reduction, at least under the absolute definition of pro-poor growth. If the labourers lose while the farmers profit from the project, the project cannot be justified under any definition of pro-poor growth. A justification of the project then has to be based on other normative concepts or the project has to be rejected.

5 Methodology and Preparation of the Field Survey

The aim of this evaluation is to compare three states of the world:

1. The currently practiced agriculture (without situation)
2. Agriculture with transplanted BR33 (project alternative A)
3. Agriculture with drum-seeded BR33 (project alternative B)

Since an ex-ante evaluation is being applied, only the without situation can be analysed in the field. A detailed empirical study was conducted to generate a model on currently practiced agriculture with a focus on employment opportunities. This model is used as a basis for modelling the situations for the two project alternatives. The value of each alternative is being determined by comparing it with the without situation.

The model reflects the situation in the study village. Aspects such as agricultural cropping patterns, agricultural practices and alternative employment opportunities differ within the project area. Hence, the model cannot be exactly translated to the whole study area.

For deciding on the whole project it is important to generalise conclusions to the whole project area. Some careful generalisations will be drawn, bearing the heterogeneity of the region and the special characteristics of the study area in mind. Explanatory power of this evaluation for the whole project area will be much weaker than for the study village, only.

5.1 Site Selection

For the study Pirgachha Upazila, one of the eight *upazilas* of Rangpur District, was selected. This selection was made, because the technologies have so far not been extended in this *upazila*, which is a precondition for creating a model for the without situation.

Secondly, Pirgachha contains some villages along the Teesta River. Because of a higher degree of chronic poverty and the impacts of flooding on the people's livelihood, seasonal food insecurity is more severe on the islands and the banks of the two big rivers in the northern districts Jamuna and Teesta than away from the rivers.⁷² It was planned to select two villages differing in their vulnerability towards food insecurity, which seemed to be quite feasible in the context of Pirgachha.

72 Zug 2006b, pp.14-16; The *upazila nirbahi officer* supported this theory, and attached to the highest affectedness of seasonal food insecurity in his upazila to the two unions, which are located alongside Teesta.

In the course of the evaluation some problems occurred in selecting a study area with a high degree of affectedness. Flooding in 2007 was more severe than usual. When the study started the villages along Teesta River were hardly accessible. It was therefore pragmatically decided to conduct the survey away from the river first. When the area was accessible again, it was tried to select a suitable area. Two field visits were made partly accompanied by the *union parishad* chairman, the elected head of the local government, and two sub-assistant agriculture officers, the field staff of the *Department of Agricultural Extension* (DAE). In the last 10 years the river significantly changed its bed and most of the river is now flowing in the neighbouring district Kurigram. The physical setting, which was left behind is very heterogeneous. Soil types and land elevation alternate on small scale. Hence, agricultural patterns are much diversified. While one village is dominated by double-cropped paddy, the neighbouring village cultivates a third of the area with banana and another village is cropping about 80% potato in the *rabi* season. By surveying a study village in this setting, conclusions can only be drawn about the income of the farmers in this specific village but not for the labourers. According to the labourers of one village, labour is very flexible. About half of the labourers, who cultivate the fields in the village come from other villages, while labourers from the village frequently work in the surrounding villages. Analysing the employment pattern for the labourers in one village would therefore require an analysis of agriculture in all the surrounding villages, which was not possible due to time constraints. Additionally, the severe flood had a huge impact on that year's *amon* crop. Analysing this crop would not allow drawing conclusions on the general agricultural patterns.

Because of these constraints no second study area in the flood affected area was selected and more effort was put on the area not affected by floods. Selecting only one village is not a severe limitation of the study, since the used models do not depend on having two villages. Selection of a second village would mainly have allowed a cross-check of results.

In the selected study area Pabitra Jhar the problem of agricultural heterogeneity is negligible. In different group interviews it was stated that labourers are hardly flexible. The major reason is that cropping patterns in the neighbouring villages are very similar to the study village. Hence, employment peaks and depressions in labour demand occur simultaneous in the whole area, resulting in the same patterns of labour demand.

The study area was purposely selected. Data from the agricultural census 1996 was used to find a study area, which reflects a similar land ownership pattern and a similar share of agricultural labour households than whole Rangpur.⁷³ The *mauza* Pabitra Jhar fulfilled these criteria and was selected after an initial field visit.

73 Data can be found in table 1

5.2 Information Sources

5.2.1 Questionnaire Survey

The major tool for data collection was a standardised questionnaire survey in Pabitra Jhar with a sample size of 200 households, which is about 17% of the total population. One questionnaire was applied for all groups of society containing sets of separate questions, which only had to be filled for those families having income from farming, agricultural labourer, seasonal migrants and non-agricultural occupations.

The questionnaire was developed before the field research started. It was intensively discussed and adjusted with Dr. Korban Ali⁷⁴, who later translated it into Bangla. Dr. Samsuzzaman revised the questionnaire before it was pre-tested twice.

Two research assistants were employed for one month to conduct the survey and to enter the answers into Microsoft Access. Despite holding a master's degree in agricultural extension, the research assistants had to be trained, supervised and monitored intensively, because they were lacking field experience. They were supported by a local guide, who helped them to find respondents and who motivated the respondents to join the interview and to take enough time.

The survey was conducted during the lean season. The low workload of most villagers increased their willingness to participate. It were mainly male household heads, who were interviewed. Women were only asked in female headed households or if the husbands were seasonally migrated. If the weather conditions allowed, interviews were conducted in front of the houses or on the paths. Since these places are mainly open to the public, other people listened to the interviews, which might have had some impact on the response behaviour.

The process of sampling is a crucial issue in every quantitative empirical research. Covering all households of one village is hardly possible. Some people might not be there and some might not be willing to be interviewed. The same problem occurs if a random sample is conducted. Random sampling is difficult, since household units are not directly visible because of the settlement structure. It is not clear how many families are living in one homestead. Intensive preparations would have been needed to generate a household list, since no official lists are accessible. Despite the limitations of a non-random sample, a quota sampling was used here as the only feasible possibility considering time and resource constraints. Since the sample size of 17% is rather high and no obvious selection biases existed, results will be generalised on whole Pabitra Jhar, despite of the sample not being random.

74 Dr. Korban Ali is Director of Research of *Research Initiatives, Bangladesh* (RIB). RIB has an advisory function in the project, but is not directly involved in the activities.

Two overlapping criteria were used for the quota sample. Households should be represented in the sample according to the amount of land they cultivate⁷⁵ and whether their 'major source of income during the preceding year was obtained by agricultural labour'⁷⁶.

The censuses conducted by the Bangladesh Bureau of Statistics (BBS) provide information on *mauza* level, which is the lowest available unit, containing of one or several small settlements. This data was used for determining the quotas for the different groups. The latest population census was conducted in 2001, but does not provide enough detailed information. Sufficient information can only be found in the last agricultural census. However, this census was conducted in 1996 and the data is rather outdated. The number of households in Rangpur district increased by 50.7% between 1996 and 2005⁷⁷. This increase significantly impacts on the ownership patterns.

The BBS conducted an agricultural sample survey in Rangpur in 2005, in which they generated the same data as in an agricultural census, but only for a sample of 10% of the villages. Figures are compiled on district level, only. From the agricultural census 1996 and the agricultural sample survey 2005 change rates for all farm sizes between 1996 and 2007 for whole Rangpur were predicted for this study.⁷⁸

Table 1: Sampling

table 1: sampling

		all house- holds	non-farm house- holds	farm households			total area cultivated in dhon	agricultural labour households
				small	medium	large		
Rangpur	1996	436,464	161,322	221,954	47,562	5,626	1,811,836	151,742
		100%	36.96%	50.85%	10.90%	1.29%		34.77%
	2005	657,752	306,658	313,446	34,413	3,235	1,843,186	268,210
		100%	46.62%	47.65%	5.23%	0.49%		40.78%
	relative change 1996-2005	50.70%	90.09%	41.22%	-27.65%	-42.50%	1.73%	76.75%
	1996-2007	61.97%	110.11%	50.38%	-33.79%	-51.94%	2.11%	93.81%
Pabitra Jhar	1996	712	274	347	70	11	2,650	287
		100%	38.48%	48.74%	9.83%	1.54%		40.31%
	2007	1,153	576	522	46	5	2,706	556
		100%	49.92%	45.25%	4.02%	0.46%		48.23%
	Proposed Sample	200	99.8	90.5	8.0	0.9	469.3	96.5
	Achieved Sample	200	100	91	8	1	476.1	90

Source: Bangladesh Bureau of Statistics 2003a; Bangladesh Bureau of Statistics 2006a

75 Households are differentiated by the amount of land they operate: non-farm: < 0.22 dhon; small farms: 0.22-11.35 dhon; medium farms 11.36-34.08 dhon; large farms: > 34.08 dhon.

76 Definition of agricultural labour household based on Bangladesh Bureau of Statistics 2003a, p.8. Those households were counted as agricultural labour households, who realised at least 50% of their income from agricultural labour.

77 Bangladesh Bureau of Statistics 2006a

78 It was assumed that the annual change rate between 2005 and 2007 was the same than between 1996 and 2005.

In 1996 Pabitra Jhar was mainly reflecting the district's average distribution of landownership only with slight deviations. It was assumed that the ownership patterns and the share of agricultural labour households in the Pabitra Jhar developed equivalent to the whole district. Based on the household data in Pabitra Jhar and the change rate in Rangpur between 1996 and 2007, the current household distribution in Pirgachha was approximated.

Detailed information on the village structure, such as a map, was not available. Nevertheless it was tried to conduct the survey in all parts of Pabitra Jhar. However, this spatial selection was not done in a systematic way. Respondents were accidentally selected depending on their availability at home and their willingness to contribute. The quotas were continuously analysed and after 150 questionnaires directions were given to the assistants to select those groups, which were so far underrepresented in the sample.

Data analysis supported the quota on the size of the farmer's cultivated area. The farmers of the sample cultivated 476.1 dhon (42.4 ha) of land. Data based on the Agricultural Census 1996 projected for 2007 assumed that 200 Households should cultivate 469.3 dhon, which is only 1.4 % less than the sample data.

Representing the actual share of agricultural labour households was more problematic. The research assistants already while conducting the survey reported that they felt the quota of 48.2 % to be too high and did not complete the whole quota. Data analysis supported their impression. Comparing the labourers' realised income with the farmers' labour costs revealed that the farmers spent about one third less than the labourers earned.⁷⁹ To allow a comparison between farmers' expenditure and labourers' income the labourers' data was manipulated by reducing the labourers' figures by 32.4%, which equals a reduction of the labour households' share to 30.4% of all households and equates the labourers' income with the farmers' labour cost. Linking the farmers' data with the labourers data will allow to draw conclusions about the impact of the change of farmers' cultivation practice on the income of an average labour household. This manipulation will be used for some graphic representations and some minor comparisons, but will not impact the overall calculations of the CBA.

Analysis of data was done with Microsoft Access in combination with Microsoft Excel. Analysis was complicated by the aspect of seasonality, which adds an additional dimension to most of the data, compared to most other studies.

5.2.2 Group Interviews

After the questionnaire survey nine group interviews were conducted in different spots all over the study area. Some farmers were selected, who were thought to be disproportionately high experienced and others were just selected

79 farmers' expenditures: 366,188 taka; labourers' income: 517,180 taka.

accidentally. Because the interviews were conducted in public places other people spontaneously joined resulting in a group sizes between four and more than 30 people. The group interviews were conducted in cooperation with a retired NGO worker, who was highly experienced and sensitive for the local context. The major aim of the group interviews was to generate a cropping calendar for all relevant crops cultivated in the area. A special format was used, which is attached in annex III. Additionally, information on labour demand of other crops than *amon* was collected, information from the questionnaire survey was cross-checked and some general questions were discussed.

Some very informal group interviews were made in the beginning of the study to cross-check the site selection and to inform the people about the study. Two groups of migrant labourers and one group of bus ticket vendors were interviewed about seasonality of migration.

5.2.3 Local Expert and Elite Interviews in Pirgachha

In the study *upazila* government officials on various levels were interviewed. Socializing with the *upazila nirbahi officer*, the appointed representative of the *upazila*, and the *union parishad* chairman, the elected leader of the local government, was of fundamental importance for being able to conduct the study. Additionally, general information about the study area and especially their perception of spatial exposure to seasonal food insecurity was gathered. Many interviews were made with different officials of the *Department of Agricultural Extension* (DAE). Much time was spent to obtain statistical data from the Department on cropping patterns, land ownership etc. The reliability of the data in general was very insufficient and could not be used for the study. A field visit was made with the shortly retired sub-assistant agriculture officer, who was responsible for Pabitra Jhar. He was forced out of office by the local farmers because of a very low performance, and could also not provide reliable information. Additionally, an interview was made with the *upazila* chief engineer about seasonality of construction work and on food- and cash-for-work schemes.

Several short interviews were conducted with seed dealers, fertiliser dealers, pesticide dealers, rice mill operators and traders of livestock.

5.2.4 Scientific Expert Interviews

In this evaluation it was of major importance to get a very detailed picture on the project conception. The author of this evaluation cooperated closely with Mr. M.G. Neogi, who is the agriculture coordinator of RDRS, and the main initiator of the project. He is writing a PhD on the technical aspects of the project. With him all aspects of the project were intensively elaborated. Additionally, discussions took place with other project related staff and the Director of Livelihoods Dr. S. Samsuzzaman. Dr A. Majid the Head of BRRI's regional station in Rangpur was interviewed for incorporating the perspective of the second key

player in the project. Meetings mainly for obtaining secondary data but also for discussing the project from a distant perspective were scheduled with two regional stations of the *Bangladesh Agricultural Research Institute* (BARI) and the BARI and BRRI head offices in Gazipur.

5.2.5 Secondary Information

Data on the project was only very insufficiently available. RDRS is doing some monitoring on the project, but the information is not kept systematically. Since the project is financed from RDRS general budget, no reports have to be submitted to funding agencies. Reports, which are produced by RDRS, and articles from BRRI are mainly meant to promote the project in public, which leads to a very uncritically reflected way of writing without including most important details. Documents related to the PhD thesis of Neogi are not available yet but some raw data could be used.

Dr. Korban Ali did a survey from a social science perspective for *Research Initiatives, Bangladesh* (RIB)⁸⁰ and compared project farmers with non-project farmers. Discussions with him gave important impetus, but his research results could not be considered, since his report is only available in an early draft version.

Especially for analysing the project's impact on yield, secondary information had to be used. Neogi's technical research on the project is central. He did field experiments on the yield of the different technologies in *amon* cultivation and on different planting times of potato. For *boro* rice, which is the most important third crop influenced by the project, research data from BRRI was used. All yield data is rather weak, since it is all based on a single year. Because other research findings, especially of BRRI, were not accessible, the data could not be cross-checked. Data on price fluctuations of relevant commodities was provided by the District Marketing Office of the *Department of Agricultural Marketing* (DAM) and data on cultivated area was gathered from the Rangpur office of the *Department of Agricultural Extension* (DAE).

5.3 Generating a Model for the Without Situation

For developing a model of current agriculture in Pabitra Jhar a mix of different information sources had to be used. The questionnaire survey provided detailed information for establishing a model on currently practiced cropping patterns in the study area.

Secondly, a temporal model on labour demand was developed. In the questionnaire farmers were asked about labour requirements of different *amon* varieties and labourers were asked about their working days and the respective wage rates for every step of *amon* cultivation. To set the labour costs in a temporal

80 Ali forthcoming

perspective, farmers were asked in the group discussions about the timing of all cultivation steps on a weekly basis.⁸¹ Combining this temporal data with the information on labour costs per cultivation step allowed generating a model on the labour costs for every week in *amon* cultivation for a period of seven months. This model was extended by including all other relevant crops, which are cultivated in Pabitra Jhar. Figures on the other crops are less accurate, since they are only based on the group interviews. The respondents were not only asked about the timing of those crops, but also about the labour costs involved in each step. The income of many labourers is not exclusively obtained from agricultural labour. Some of the alternative income sources, such as migration, off-farm employment and small businesses are also subject to seasonality. Local off-farm employment has been integrated in the model, while other income types have been discussed separately.

5.4 Predicting the With Situation

The annual cropping patterns and the labour model from the without situation are the starting points for generating models for the two project alternatives. The project can only be implemented if the land fulfils specific physical preconditions. In the project area only those fields are suitable, which are currently cropped with potato in *rabi* season. Having the information on the present cropping patterns allows drawing conclusion on how the cropping pattern will look like if the new technologies are implemented on those fields, on which they are technically feasible.

Cultivation technologies can differ in various aspects such as herbicide and fertiliser requirements, intensity of ploughing and irrigation, use of technical equipment, labour demand, timing and yield. These different aspects were analysed in detail by using different information sources. RDRS published an information sheet⁸² on the two analysed technologies, which they use for extension work. This sheet reflects the projects recommendations for the farmers on how they should apply the new technologies. However, this information is not detailed enough to predict all changes. Interviews and discussions with RDRS and BRRI clarified the conception of the project.

From this information assumptions were made on how agriculture will change if the project is implemented. Models for the project alternatives could be generated through manipulating the model of the without situation based on the assumptions. From comparing the three models the social welfare change of the two project alternatives could be calculated for the farmers and the labourers.

81 The farmers subdivide a month into four weeks. For calculations it was therefore assumed, that a week has 7.5 days.

82 RDRS Bangladesh 2007

5.5 Limitations and Problems Encountered in the Field

5.5.1 Problems in the Empirical Research

The field research took place in the Muslim month of Ramadan, which has a high importance in Bangladesh. In the Pabitra Jhar exclusively Muslims⁸³ are living of whom a significant share was fasting. A widely used method to determine seasonality of nutrition is to compare the numbers of meals taken per day in different periods of the year. During Ramadan, when people only take meals between sunset and sunrise this rough measurement can not be used, since it is not comparable to other months in the year. Ramadan also has an impact on the people's expenditure patterns. People tend to consume some special food and for Eid-ul-Fitr, the celebrations of the End of Ramadan, they buy presents for their families. Availability of people at home is different than in other months. Interviews therefore had to be timed according to the prayer times.

A common research problem is the difference between the purpose of the study and the expectations of the respondents. Despite the explanation of the research purpose prior to every interview, people still had wrong expectations. They wanted the result of the research to be a project, which distributes assets or relief. The local guide was visited by many people trying to convince him to be included in the study. Other people directly expressed to be poor, hoping for immediate help. In one part of Pabitra Jhar the rumour spread, that it will be tried to convert people to Christianity and people were claiming back their questionnaires from the research assistants. The situation calmed down, when the research purpose was again clarified with some suspicious people in the respective area.

5.5.2 Limitations

Gender

Gender is an important topic in rural economic development in Bangladesh. In the course of micro credit programmes and also in other projects, NGOs are promoting employment especially for women. Female employment in agriculture is strongly differing within a small distance. There are some cultural and religious reservations against women working outside of the homestead. In some areas women are therefore not at all working in the fields. In rice cultivation in the study area, female participation in agricultural activities exists, but to a rather small degree. In total *amon* cultivation women's work amounts to 8.1% of the total working days. Women are working exclusively in weeding and post harvest activities such as threshing. In *boro* cultivation female participation can be expected to be more relevant, since drying of straw (which is not required in *amon* cultivation because of climatic reason) generates a lot of employment, which is predominantly done by women.

83 Bangladesh Bureau of Statistics 2005a

Payment strongly differs by gender. While males earn in average 83.2 taka per day females only receive a bit more half of that (45.1 taka). Because of the lower wage rate the female contribution to the income generated by agricultural labour is only 4.5%. Since the share of female contribution to agricultural income is insignificant, gender was excluded from the considerations.

Simplifications of Income Categories and Ownership Patterns

Farmers and Labourers are being treated as two distinct groups in this evaluation. This is a simplification since the two categories are overlapping. 36.4% of the labourers are involved into own cultivation. Their income hence depends on both agricultural labour and own cultivation.

A similar simplification was made for land ownership patterns. 78% of the land is owned by the cultivating farmers and 15% is operated under mortgage. In both cases all cultivation costs have to be covered by the farmer, but he also keeps the total returns. The remaining 7% of land are operated through share-cropping. The cultivator has to give around 50% of the harvest to the landowner. The income of a share-cropper is therefore significantly lower than the income of a farmer, who operates own or mortgaged land. However, the additional money remains in the area, since the landowner earns money without cultivating. Share-cropping is mainly done by small farmers. 95% of the share-cropped area is cultivated by households, who also do agricultural labour. Hence, the average income of farmers, who are also involved in agricultural labour, is lower than for farmers, who are not working as agricultural labourers. The impact of the project on these farmers is therefore also less.

Analysing the project's impact on these different groups with different ownership patterns is not possible with the small sample size of 200 respondents.

Labour Arrangements

In the study region two different types of employment of agricultural labourers exist. Day-labour is a system where labourers are paid for a specific working time, mainly for one day.⁸⁴ For contract-labour the time needed by the labourers is not relevant. Groups of labourers negotiate with the farmer a price for performing a specific step, such as harvesting a certain amount of land. The relevance of contract-labour differs in different steps of cultivation, which is related to incentive structures. A day-labourer has no benefit if he works fast. Contract-labour is performance based. If a group of labourers performs a certain task faster, they can start a second job and hence increase their income. Farmers expressed that they assume the labourers to work more carefully in

84 In the day-labour system workers sometimes receive one small meal per day, consisting of some bread, rice or puffed rice and lentils or vegetables. The average value of such a meal is assumed to be 7 taka, based on group interviews. Whenever the labourers received a meal, 7 taka was added to their wage rate. For contract-labour meals are never provided.

day-labour arrangements, since the time pressure is lower. Some farmers complained for example that contract-labourers tend to transplant with higher spacing to save working time, which has a negative impact on yield.

Contract-labour is mainly done, when labour is scarce and when a large number of labourers are required to perform a task. 89% of hired labour in the second transplanting and 88% in harvest is done by contract labourers, whereas fertiliser and pesticide application is exclusively done by day-labour. In all other steps the share of contract-labour is between 25% and 35%.

Having these two systems side by side, makes the analysis a bit more complicated. Contract-labour cannot be expressed in labour days and wage rates. Hence, all day-labour was transformed into labour costs and summed up with contract-labour resulting in the total labour costs. Thus, information on labour days was lost.

Analysing the project's impact on the wage rate, which is an important factor in determining the overall profit of working, could not be done. All conclusions about wage rates drawn from a labour model, in which some steps are mainly based on contract-labour, are very vague since contract-labour is not expressed in relation to labour days and wage rates. It was therefore assumed that wage rates remain the same for specific working steps, despite some changes, which might occur as a result of changing labour demand.

Not all agricultural work is done by labourers, only. Farmers also perform some tasks on their own fields. The share of the farmers' household labour is strongly correlated with the amount of land cultivated. While household members of the only large farmer in the sample do less than 1% of the work required, family labour amounts to 16% for the medium farmers, 28% for the upper part of the small farmers (>2 dhon land cultivated) and even 52% for the lower part of the small farmers.⁸⁵ The aspect of household labourers will sometimes be touched in the analysis, but the main focus will be put on wage-labour.

Technical Aspects of the Project

The technical innovations themselves are contested. Not all scientists are convinced especially about the feasibility of drum-seeding technology in the *amon* season. When the technology was explained in the study village, farmers always reacted very sceptically and stressed the necessity of transplantation. During implementation RDRS experienced some resistance towards the technology and is now also experimenting with other technologies. There are different problems in the discussion such as birds eating the seeds from the field, strong rains washing away the seeds and destroyed seedlings, if the field is standing too long under water. Even if the technology itself would be feasible it is still not certain whether the farmers can be convinced on the one hand and

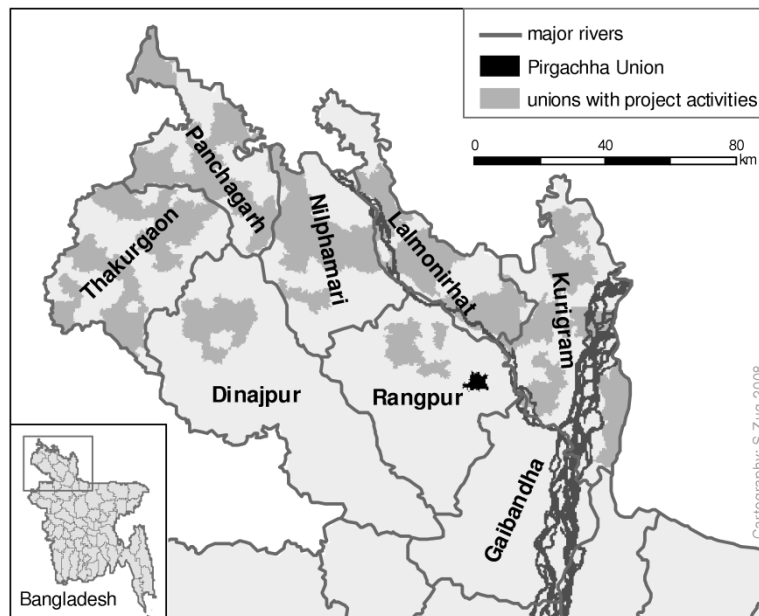
85 It was assumed that the value of family labour per day equals the wage rate for labourers. From the value of family labour and the labour costs the share of family labour was calculated.

can sufficiently be trained on the other hand. This evaluation is only looking at the economic aspects of the project. It will be assumed, that it is technically feasible and extension work is done successfully. For drawing overall conclusions on the project additional evaluations have to be made at least on extension and on the technical feasibility, which will be partly covered by the forthcoming dissertation of Neogi.

6 Case Study

6.1 The Study Area

Map 2: project and research area (2007/2008)



Source (project area): RDRS unpublished monitoring data

Pabitra Jhar is a *mauza*, which is the lowest administrative unit in Bangladesh, on which statistical data is generated by Bangladesh Bureau of Statistics (BBS). It is one of thirteen *mauzas* in Pargachha Union under Pargachha Upazila. About 50% of the 1,150 households are practicing farmers, who cultivate 2,706 dhon (241 ha) of land, and 30% of the households have income from working as agricultural labourers.⁸⁶ Pabitra Jhar is located some three kilometres north of Pargachha municipal area. The Municipality, as the administrative headquarter of Pargachha Upazila, is offering the typical social, economic and physical infrastructure of a rural centre. Bus and train services are available to Dhaka, which is especially important for seasonal migrants. A daily market provides most required goods including food items, agricultural inputs and equipment, drugs and clothing. Some basic private and governmental health services are available. Besides some rice mills and some workshops, no major processing industries provide employment opportunities. Nevertheless some inhabitants of Pabitra Jhar profit from employment in the municipality.

Pabitra Jhar is connected with the municipality via an unpaved road, allowing road communication with rickshaws. Despite some tea-stalls and a few small shops, market infrastructure is hardly developed, since most people buy their

⁸⁶ see table 1

goods in the municipality. A *madrasah* and a governmental school provide primary education. Secondary education is available in the municipality. Literacy rate in Pabitra Jhar was 38.5% in 2001, which is slightly below the average in Pirgachha (39.2%) and the national average (46.2%).⁸⁷ Some NGOs are working in the area, mainly in the micro finance sector.

6.1.1 Agriculture

Since construction of houses is mainly possible on highland, the settlement structure in many parts of Bangladesh is closely related to land elevation. Pabitra Jhar contains several dispersed highland areas, which results in several settlement clusters. Highland in this case means land, which is never flooded under normal climatic conditions. Most of the highland is used for settlements and only a small share for cultivation of vegetables and annual crops. The main paddy-based agriculture is practiced between the settlement areas on medium highland, which is seasonally flooded up to 90 cm.⁸⁸

The land elevation determines the cropping intensity. The lower parts of the medium highland are mainly double-cropped since flood water is standing too long in the field delaying plantation in *rabi* season. The higher parts of the medium highland are triple-cropped.

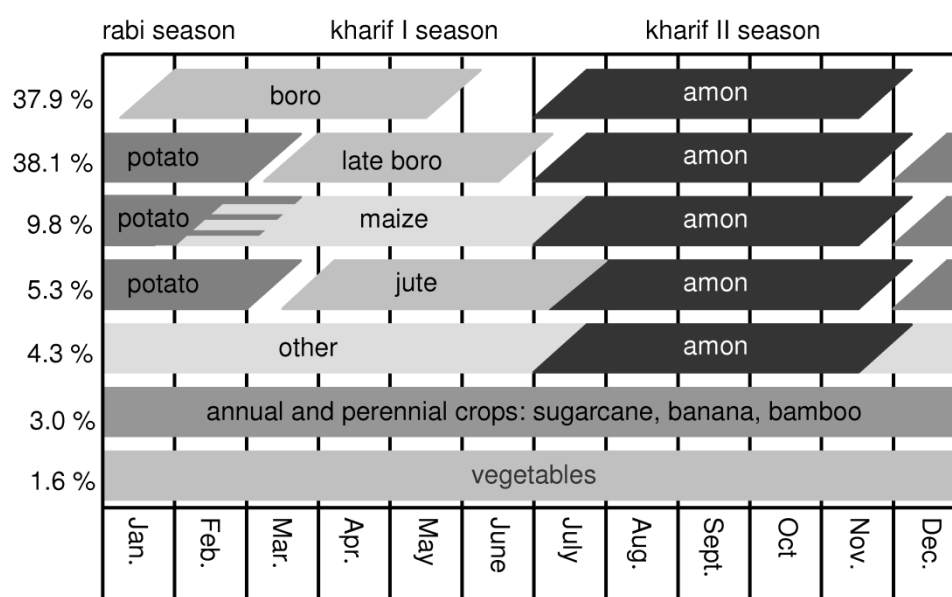
The chart on the cropping patterns shows a rather diverse picture of different crops being cultivated throughout the whole year with the exception of the *kharif II* season. *Amon* paddy is heavily dominating this season amounting to 95.4% of the totally cropped area. The predominant *amon* variety BR11 (85.7 %) is graphically represented in the chart. With the intend to simplify the other varieties were left out of the chart. BR2 (3.2 %) and Joya⁸⁹ (7.5 %) are the currently cultivated early varieties, but the shares of these varieties are far below the project objective for BR33 and the harvest date is not as early. BR2 is harvested in the last week of October and Joya in the first week of November. Additionally, some local varieties (3.6 %) are planted, which are mainly cultivated for own consumption of wealthy farm households. These varieties take until end of December to mature. BR11, BR2 and Joya cultivation in Pabitra Jhar and all over Pirgachha is exclusively done by double-transplantation, regardless of the land elevation of the field. Since in most regions of Northern Bangladesh double-transplantation is not practiced on the medium high land, double-transplantation is an exceptional feature of agricultural practices in Pirgachha.

87 based on a population census in 2001 (literacy rate for population aged 7 years and more) (Bangladesh Bureau of Statistics 2003b and Bangladesh Bureau of Statistics 2005a)

88 Details on the classification can be found in Brammer 2000, p.16

89 Joya is an Indian variety, which was not formally introduced by the government of Bangladesh.

Figure 3: cropping patterns in Pabitra Jhar



Source: own data

Soils and climatic conditions in Pabitra Jhar are suitable for potato cultivation in the *rabi* season. However, planting potato is only possible on the higher laying parts of the medium highland, since potato requires a low moisture content in the soil. On the lower parts the flood water remains too long, and the soil cannot dry in time. Since potato cultivation is not possible on the low laying fields, farmers cultivate *boro* directly after *amon* (37.9%).

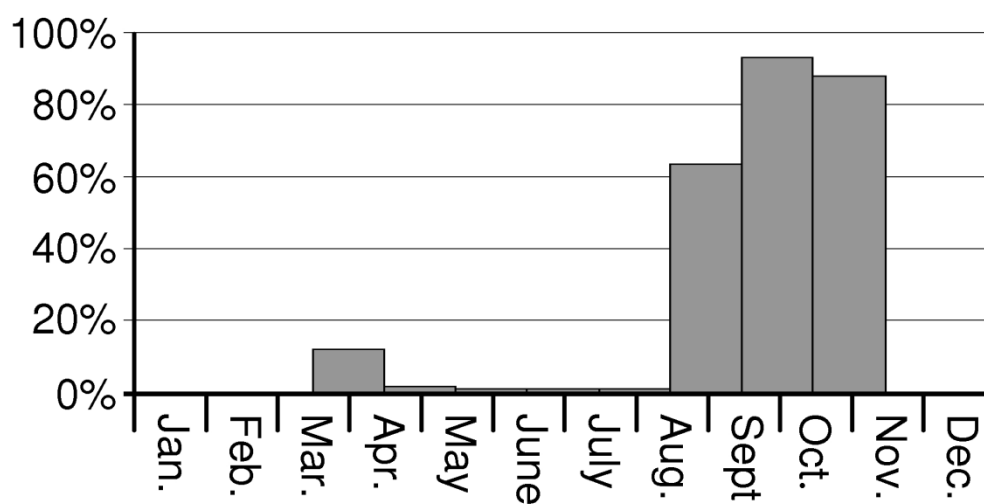
Ten days after the harvest of *amon*, when the soil has dried in the open sun, potato can be planted on the higher laying areas (53.2%). On those areas where BR2 and Joya was planted during *kharif II* season, potato can be planted some weeks earlier than indicated in the chart. Potato only requires 90 days until harvest, which allows cultivating a third crop. The third major crop in the *amon*-potato cropping pattern is *late boro*⁹⁰, which is cultivated on 71.6% of the previous potato fields. Additionally, maize (18.4%) and jute (10.0%) are planted. Maize is planted as a relay crop. 30 days before potato is harvested, maize is seeded in-between the potato lines.

90 In general paddy, which is transplanted before 15th of March, is called '*boro*' and after 15th March '*aus*'. This paddy is planted around the 15th March. It was chosen to call it '*late boro*', since it is counted in official DAE statistics as '*boro*'. It could also be called 'early aus' and even the merged form 'braus' is used.

6.1.2 Seasonality

Food insecurity in Pabitra Jhar follows a clear seasonal pattern. Households, who are working as labourers, were asked, in which month of the year they are not able to purchase enough food for their families. Figure 4 shows that households only perceive food insecurity in two periods.⁹¹

Figure 4: share of households, involved in agricultural labour, stating that they do not have enough money to buy sufficient food in specific months



Source: own data

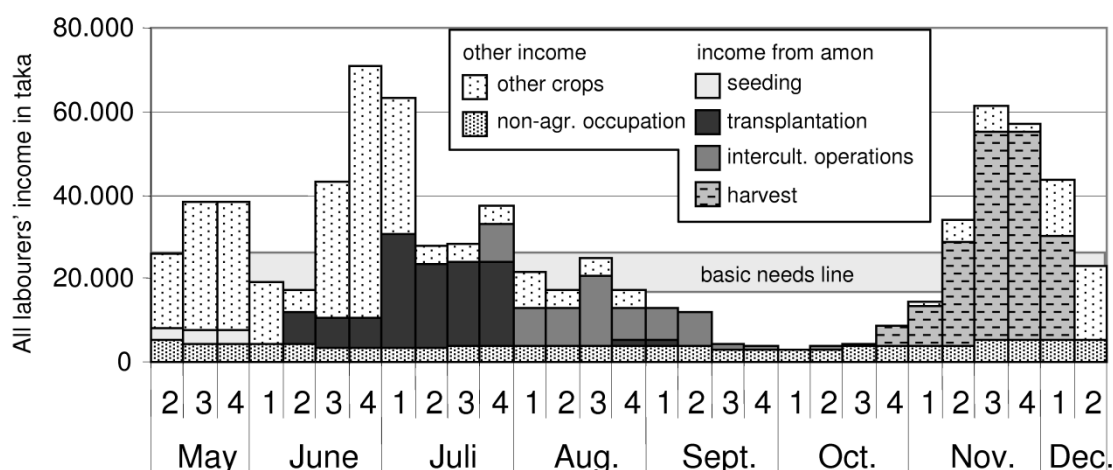
A very small proportion is suffering from mid March to mid April. This period is linked to the lean season of *boro* cultivation. Since other crops are cultivated, too this lean season phenomenon is rather small. Differently the lean season, which is linked to *amon* cultivation: A very high proportion of respondents stated to be food insecure from mid August to mid November. This period highly correlates with the commonly called *monga* months Aswin and Khartik (mid September to mid November).

Figure 5 adds up the income of those households in the sample, who are at least partly engaged in agricultural labour. This diagram is a simplification, since the complete income could not be recorded. It is here restricted to the income, which is generated in and around Pabitra Jhar by working as agricultural labourers and in non-agricultural occupations. Only the months from May to December are included in the model, containing the whole *amon* cultivation

91 The percentages that are given in the chart have to be seen critically. It has already been explained that a tendency of the respondents might have existed to suggest that they are more exposed to food insecurity. The real figures might therefore be lower. Here we are interested in the periods of food insecurity, rather than the exact shares of affected households.

period, which is required for the analysis. Data for the remaining months was not generated and is not needed for the analysis.

Figure 5: income opportunities of all labourers in the sample



Only looking at agricultural labour reveals a high degree of seasonality. *Amon* is seeded on a small field and double-transplanted.⁹² In June and beginning of July, *amon* is transplanted into an intermediate field before it is finally transplanted in July. The second transplantation is very labour intensive. When the small seedlings have been transplanted into the main field, some inter-cultural activities are required. On most fields weeding is currently applied twice. Some few farmers even do a third weeding. Herbicides can be applied to reduce labour requirements, but in Pabitra Jhar chemical weed management is currently only used in *boro* cultivation. Topdressing with fertiliser is normally applied twice and some farmers spray pesticides. However, weeding is the only inter-cultural operation generating significant employment. After the last weeding is finished in the second week of September, hardly any labour is needed until harvest starts with BR2 in the last week of October, Joya in the first week of November, and finally BR11 from the second week of November on.

Since *amon* cultivation is strongly dominating the *kharif II* season, hardly any employment is generated by the cultivation of other crops. Only in the beginning of the cultivation, harvest of *boro*, maize and jute is overlapping with the first and the second transplantation of *amon*. Some limited employment is

92 Double transplantation is in most areas applied in lowland paddy cultivation, only. The rational behind double transplantation: seedlings have a big size and a high age, when planted in the lowland. The risk of destruction is minimised. Pirgachha is an exception. Farmers are doing double transplantation for all *amon*. Why farmers in Pirgachha are convinced about the need for double transplantation even on highlands would require a detailed research.

available from post harvest activities in jute production until end of August. During the lean season of *amon*, all work, which is connected to previous crops is already completed. When employment opportunities peak again during harvest, the starting potato cultivation and seedbed preparation of *boro* has an aggravating effect on the labour demand.

The temporal labour demand is highly correlating with the people's perception on food insecurity. Income is lowest in the period from mid August to mid November, when people state to be food insecure. Mid July to mid August is the month among the non-food-insecure months, where the labourers' income is lowest. It can be assumed that whenever the labourers' monthly income is at least as high as the monthly income from mid July to mid August, no seasonal food insecurity problem will arise. Accordingly, if the monthly income is lower than the income from mid August to mid September (the month with the highest income among the food insecure months), food insecurity will occur. The range between these two values is shown as the basic needs line in the graph. The exact basic needs line is expected to be within that range.

The non-agricultural income opportunities also show a seasonal fluctuation, which is less volatile, but follows the same pattern as agricultural occupations. The lowest income opportunities are available during the lean season of *amon*. The agricultural patterns have a high influence on small businesses. Trade with agricultural products strongly decreases during the *amon* lean season, since most trade of the previously harvested paddy is over and it is off-season for vegetable production. Some locals are seasonally trading with other products, such as textiles, cutlery, or cheap jewellery. Their income is lower during the lean season since the purchasing power of the rural people is low. Additionally, employment for earth works, such as road construction and maintenance is not possible during the lean season of *amon* because the soils are still wet and partly flooded. Earth works start end of November, when *amon* is harvested. The only counter seasonal income opportunity existing, is fishing, which peaks when the floods remove.⁹³

Seasonal migration is an important strategy of the rural poor to mitigate the income short-comings during the lean season. However, this migration is mainly restricted to destinations with non-agricultural employment, hence nearly exclusively rickshaw pulling in the big cities. In the lean season, agricultural employment in other districts is not available, because the lean season roughly takes place during the same period all over Bangladesh. A significant number of labourers migrate to other districts, when harvest starts, because wages there are much higher than in greater Rangpur. More detailed research would be required to determine the seasonality of income generated by migration. Here, it will be assumed that overall income from migration is not seasonal, since seasonal agricultural migration alternates with migration to the cities.

93 detailed information about the seasonality of different types of occupations can be found in Annex I.c.

6.2 The Project's Impact on Cropping Patterns

Implementation of both project alternatives – drum-seeded BR33 and transplanted BR33 – will have an impact on seasonality, which was described for the whole project idea in chapter 3.3. The context of every locality is different. In Pabitra Jhar the fields, where currently potato is cultivated, fit to the project conception.

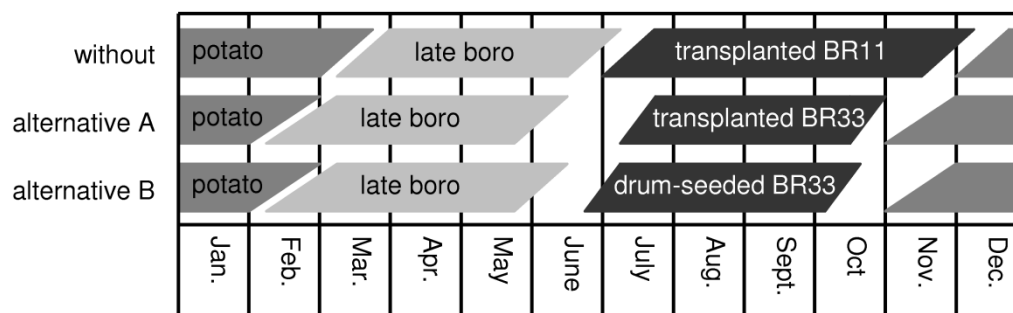
It will be assumed that the farmers will not change the shares of the cropping patterns and that they will only use the new technologies on those fields, which are currently cultivated with *amon-potato-late boro*. *Amon-potato-maize* and *amon-potato-jute* will not be taken into consideration. Excluding these two cropping patterns is a simplification, since they constitute only 15.1% of the totally cropped area, while *amon-potato-late boro* amounts to 38.1%. But there is also some rational behind.

The benefits from the project for the farmers depend on the change in all three crops in the cropping cycle. A significant share of the profit is determined by the third crop after *amon* and potato: *late boro*, jute or maize. Having an earlier planting time has different impact on the profitability of the three crops. No profit is expected for jute, since jute is currently already planted in optimal time. The profit for maize is difficult to determine, there might be higher yields, because maize would not have to be cropped as a relay crop, but cultivation costs would increase because high residual effects are involved in the relay system. A detailed agricultural analysis would be needed to draw conclusions. This analysis is not available so far. Profit is expected for shifting *late boro*, which makes the project much more attractive for the *amon-potato-late boro* pattern than for *amon-potato-jute* and *amon-potato-maize*.

Figure 6 shows how the timing of *amon-potato-late boro* cropping pattern will change.⁹⁴ Both project alternatives allow an earlier harvest of *amon*, project alternative A about four weeks and alternative B about six weeks ahead of conventionally cultivated BR11. Harvest will hence take place during October, which correlates with the period of highest seasonal food insecurity and the period of the currently lowest demand in labour.

94 In the case of the without situation and project alternative B transplantation is applied. In the chart only the time, when the crop is standing in the main field is indicated. The period before transplantation is not visualised here. This is not required when analysing the annual cropping pattern, since seedling raising only consumes a very small area.

Figure 6: *amon*-potato-*late boro* cropping pattern under different project alternatives



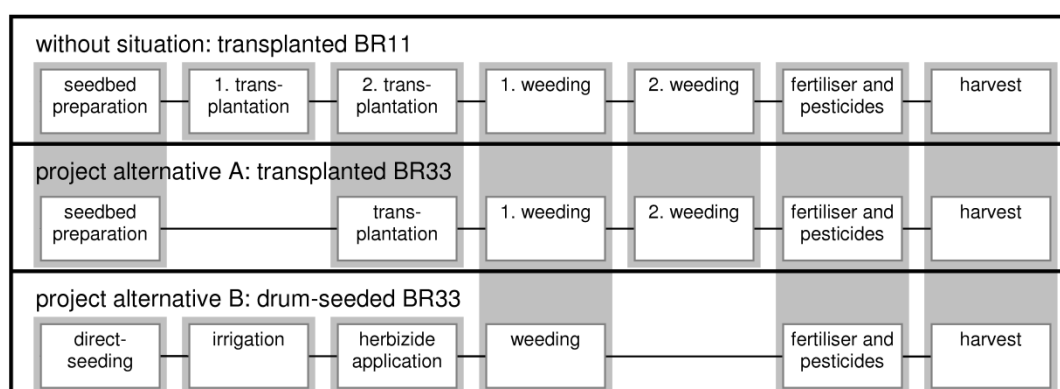
For the farmers, spill-over effects for the other two crops in the cropping pattern can be achieved. Potato can be planted in November instead of December and *late boro* in February instead of March.

6.3 The Project's Impact on Labour Costs and Employment Opportunities

The project's impact on labour intensiveness is both relevant for farmers and for labourers. The farmers' benefits of reduced labour costs will be recorded as costs for the labourers, who lose income. Thus, the same figure will be included in the calculation of the overall changes in social welfare for both groups. Figure 7 visualises the different steps required in the three cultivation methods. Table 2 presents the quantitative change in demand from externally employed labour and the farmers' own household labour for every step of cultivation. Both, the chart and the table will be explained in detail in the following two sub-chapters.

The analysis will be done on the basis of one dhon (0.089 ha), which is the locally used land unit. The unit dhon was also used in the questionnaire survey and the group discussions. Currently a farmer's labour cost for cultivating one dhon with transplanted BR11 amounts to 831.2 taka (8.38 euro). This equals about 10 labour days assuming the average daily income of 83.2 taka based on the labourers' questionnaire. Additionally, a farmer spends 3.4 days himself working on the field.

Figure 7: labour steps required for different amon cultivation technologies



6.3.1 Transplanted BR33

Promotion of transplanted BR33 is a rather uncomplicated issue. Besides changing the planting dates and the seeds, no major adjustments in cultivation practices are required in most parts of Northern Bangladesh. Farmers will easily be able to adopt the new cultivation practice if they can be convinced of the profitability.

In Pabitra Jhar double transplantation is applied, which significantly prolongs crop duration. To maintain the benefit of early harvest, farmers have to change to single transplantation. Not transplanting into the intermediate field saves the farmers 67.0 taka labour costs. Land preparation for the intermediate field is not needed. Ploughing and levelling of the soil is nowadays mainly done by power-tillers and most bullock driven ploughs have been replaced. Power-tillers are very capital intensive and hardly generate any labour. Costs for power-tillers were therefore recorded as capital costs of the farmers and not as labour costs. 3.8 taka in labour costs for animal driven ploughing is reduced. Very few farmers apply three times weeding in BR11. BR33 is standing a shorter period in the field, which will require maximum two times weeding reducing the labour cost by 1.7 taka per dhon.

The implementation of transplanted BR33 will reduce labour costs by 72.5 taka (0.73 euro) per dhon or 8.7%. Since the farmers use a lot of own labour for the intermediate transplantation, own labour days reduce more significantly by 16.7 %.

Table 2: labour costs and family labour in different *amon* cultivation technologies (per dhon)

step of cultivation	labour costs (taka)			family labour (days)		
	trans-planted BR11	trans-planted BR33	drum-seeded BR33	trans-planted BR11	trans-planted BR33	drum-seeded BR33
seedbed	20.15	20.15		0.71	0.71	
1. transplantation						
ploughing animal	3.84	0.08				
transplanting	66.97	0.38				
final transplantation / drum-seeding						
ploughing animal	1.23	1.23	1.23	0.10	0.10	0.10
transplantation	188.15	188.15		0.27	0.27	
drum-seeding		14.73	0.08			
irrigation		35.36	0.14			
Intercultural activities						
herbicide application		3.77	0.12			
1. weeding	85.68	85.68	85.68	0.52	0.52	0.52
2. weeding	73.71	73.71		0.51	0.51	
3. weeding	1.66	0.11				
1. fertiliser application	2.18	2.18	2.18	0.09	0.09	0.09
2. fertiliser application	2.18	2.18	2.18	0.09	0.09	0.09
insecticide application	3.96	3.96	3.96	0.08	0.08	0.08
harvest	381.82	381.82	381.82	0.42	0.42	0.42
total	831.53	759.06	530.91	3.36	2.79	1.64
change in labour costs		-72.47	-300.62		-0.57	-1.72
	100%	91.3%	63.9%	100%	83.0%	48.8%

Source: own data

6.3.2 Drum-seeded BR33

Introducing drum-seeded BR33 is much more complex than introducing transplanted BR33. A lot of technical innovations come along with the new system: various cultivation steps are replaced, and others are being changed. Intensive training and motivation of the farmers is crucial.

Direct-seeding by drum-seeder replaces all activities, which were previously connected to seedling raising. No seedbed and intermediate field has to be prepared and no seedlings have to be transplanted. This reduces labour costs by 280.3 taka. Drum-seeding is a cultivation step, which is not very labour intensive. Two persons are needed to operate one drum-seeder. One person is pulling the drum-seeder and the second one is only needed to help turning the drum-seeder, after one line has been seeded. It is estimated that eight dhon

can be cultivated by one drum-seeder per day, resulting in labour cost of 14.7 taka and 0.08 own labour days of the farmer.⁹⁵

Drum-seeding requires very good water management in the beginning of cultivation, which is not required for transplanted paddy. Soil has to be wet, but water should not be standing in the field, since too much water would damage the small paddy. Careful irrigation is therefore needed. It is assumed, that irrigation is required 2.5 times on average, which brings labour costs of 35.4 taka.⁹⁶

Weed growth is a major obstacle in applying drum-seeding technology. Weeds and crops are competing with paddy and high weed infestation leads to yield losses. Weed growth mainly depends on the access to sunlight. In the late stage of rice cultivation, weed growth is insignificant, since hardly any sunlight reaches the soil. In conventional transplantation systems paddy seedlings are planted in the main field. These seedlings have already a certain height and hence an advantage in competing against weeds. It is sufficient for most farmers to apply weeding twice. Direct-seeded paddy plants in drum-seeding technology have to compete with weeds from the seed stage and weed growth is much stronger. At least four times weeding is required for weed control. The project is promoting herbicide application shortly after seeding as the solution for weed growth. Weed infestation is strongly reduced and only one time weeding is necessary. This leads to a reduction in labour costs by 75.3 taka. Applying the herbicide is done by spraying, which is assumed to require the same amount of labour than pesticide application (3.8 taka). Application of fertilisers and pesticides as well as the process of harvest are not expected to change. Labour requirements will therefore remain the same.

The replacement of seedling raising and the second weeding are the two major factors, which lead to a total decrease of labour demand by 36.1% or 300.6 taka per dhon. Family labour is even reduced by 51.1%.

6.4 Economic Analysis of the Changes in Farmer's Income

The farmers' total change in social welfare depends on the sum of the changes in all three relevant crops: *amon*, potato and *late boro*. The analysis will be

95 So far no system of ownership of drum-seeders has been developed, since the drum-seeder is still lent out for free by the NGOs and the DAE. It has been assumed here that one person will buy a drum-seeder and offer the services to other people, while the second person is provided by the farmer. Share of family labour and household labour is assumed to be equal as for fertiliser application, since both steps are relatively easy and require only limited time.

96 It is assumed, that 30 minutes are required for one time careful irrigating. One operator is needed, who is assumed to work 8 hours per day. Additionally, labour is needed for channelling and maintaining the irrigation system. One labourer can manage 6 dhon per day. The share of family labour is assumed to be the same as for weeding, since both are manual activities. The average wage rate has been applied. (Operator: 13.0 taka, additional labour: 22.36 taka)

done on the basis of one dhon. For all three seasons the change in the farmers' profit will be determined through an incomplete financial analysis. Only those aspects are taken into consideration, which are changed through the project. It will therefore not be possible to give a statement about the total profit from each of the three cultivation technologies. It will only be possible to determine the change in profit between current practice and the two project alternatives. For *amon* cultivation the project's impact on the income of farmers differs between the two project alternatives. Potato and *late boro* cultivation experience the same shift in plantation dates for both alternatives and technology remains the same for both alternatives. Hence, only in the analysis of the project impacts on *amon* of both project alternatives have to be dealt with separately.

6.4.1 *Amon Cultivation*

The technical innovations will be implemented in the *amon* season. Hence, impacts in this seasons are more complex than in the other seasons. A major cost factor in *amon* cultivation are labour costs, which have been analysed in chapter 6.3. The change in labour costs between current agriculture and the project alternatives will be taken from this analysis. All other capital based expenditures will be analysed separately.

For transplanted BR33 the cultivation costs hardly differ. The slight decrease in labour costs results from shifting from double-transplantation to single-transplantation. Hence, preparation of an intermediate field is not necessary anymore. Currently farmers spend 35.8 taka for ploughing by power-tiller, which is saved if they cultivate single-transplanted BR33.

In the case of drum-seeded BR33, capital costs will differ more. Ploughing of the intermediate field will not be needed but preparation of the main field has to be done much more carefully. In normal transplantation systems fields are ploughed three to four times followed by levelling through a leader, which is pulled by the power-tiller. Costs for one dhon are currently 324.9 taka, which has to be paid to the power-tiller operator. In transplantation systems the plants have already a certain size, when they are planted on the main field. Hence, it is not very important whether the field is exactly levelled and one plant is several cm deeper under water than another. In drum-seeding technology the seeds are seeded directly and the germinating seeds get destroyed, if they are completely covered with water. It is therefore very important that the field is totally plane without any puddles. It is assumed that farmers have to plough two more times and to do a second or even a third levelling to ensure the required conditions. This will cost them additional 215 taka.⁹⁷ For the careful

97 According to the group discussions, one time ploughing is 80-90 taka (two times ploughing =170 taka) and levelling 30 taka per dhon (1.5 times levelling =45 taka).

irrigation, which is linked exactly to the same problem, farmers have to expend additional 55.8 taka.⁹⁸

Table 3: change of farmers' expenditures in the amon cultivation (in taka; per dhon)

	trans-planted BR33	drum-seeded BR33
Δ seeds		-20.00
Δ power-tiller		
intermediate field	-35.8	-35.8
main field		215.0
Δ drum-seeder		4.9
Δ irrigation		55.8
Δ herbicide		132.2
Δ labour costs	-72.5	-300.7
total Δ expenditures	-108.3	51.4

source: own data

The introduction of the drum-seeder, the new technical equipment, leads to additional costs. The drum-seeder does not have a long tradition in Bangladesh. Mainly the *Bangladesh Rice Research Institute* BRRI started with some initiatives and imported the first drum-seeders a few years back. The drum-seeder is now produced in Bangladesh and sold for 2,500 taka. Since the technology is newly introduced, hardly any experience about the running costs and the lifetime exist. For determining the capital cost of using a drum-seeder to seed one dhon of land, this information is required. From rather weak assumptions a cost of 4.9 taka per dhon was calculated.⁹⁹ Nevertheless, even if the assumptions are weak, the cost is in a dimension, which does not significantly impact the overall result.

Cultivating with drum-seeding technology allows a more efficient use of seeds. About 25% less seeds than in the transplanting system are needed, which

98 One hour of irrigation including the operator costs 50 to 60 taka per hour (55 taka was used for the calculation). 2-3 times irrigation (2.5 was used for calculation) of 30 minutes each are needed. Total costs for irrigation amount to 68.8 taka. 13 taka for the operator where included under labour costs. 55.8 taka will be included under irrigation costs.

99 A drum-seeder has a lifetime of about 5 years (International Institute of Rural Reconstruction 1990). With one drum-seeder an area of 12 dhon can be operated per day. The seeding period of BR33 is 15 days long. If the equipment is only used in that period, allowing 20% unsuitable days, 96 dhon could be cultivated with one drum-seeder per year or 480 dhon over the drum-seeders lifetime of 5 years. 1,000 taka maintenance costs over the total lifetime were added to the initial investment of 2,500 taka. Disregarding discounting, a capital cost of 4.9 taka is needed for cultivating one dhon.

saves about 20 taka per dhon.¹⁰⁰ For weed control RDRS is promoting the herbicide Ronstar (Bayer), which should be applied with 176 ml per dhon by spraying. Ronstar is a comparatively expensive herbicide. Other herbicides are available for less than half of that price. RDRS made some experiments and now recommends to apply only halve the dose (88 ml) per dhon, which costs 132.2 taka.

Other required investments in cultivation such as pesticides, fungicides, and threshing machines are expected to be equal for all three cultivation technologies.

In total, cultivation costs of transplanted BR33 decrease by 108 taka while cultivation costs of drum-seeded BR33 increase by 54 taka. In the case of drum-seeded BR33 labour intensity of *amon* production is replaced by capital intensity. The labour based expenditures are reduced by 300 taka, whereas the capital-based expenditures increase by 352 taka.

Table 4: yield of different paddy varieties by different sources (in t/ha)

	BR11 trans-planted		BR33 trans-planted	BR33 drum-seeded
RDRS	4.20 ^a		3.82 ^b	4.16 ^c
BRRI	6.50	4.50	no data	

^a seeding date: June 15th

^b seeding date: June 15th and June 30th (average)

^c seeding date: June 30th

Source: Neogi unpublished (experiment conducted in 2006);
BRRI 2004, p. 8-9

The revenue from rice cultivation depends on the yield and the market price. The yield is determined by three parameters, the plantation time, the cultivation technology and the variety, assuming that no annual variations take place and soil conditions are equal. Current agricultural research data is only accessible from Neogi's PhD project, which is carried out in close cooperation with RDRS. An experiment was conducted in 2006 with all three relevant cultivation alternatives, which are part of in this evaluation. The yield of drum-seeded BR33 is 9% higher than transplanted BR33. Since all other parameters have been equal, the difference in technology must be the reason for the variation in yield. Other

100 The price for BR11 seeds on the local market was 20 taka from the public Bangladesh Agricultural Development Corporation (BADC) and 28 taka from private companies. Since farmers use both seeds an average price of 24 has been used. The price for BR33 seeds is not expected to differ. Normally, farmers require 3.33 kg seeds for 1 dhon of transplanted *amon*. For drum-seeded paddy they need 0.83 kg less, which is worth 20 taka.

research data supports the conclusion that drum-seeded paddy yields higher than transplanted paddy.¹⁰¹

The yield difference between BR11 and BR33 is a contested issue. BR11 was released in 1980 by BRRI. Having a high yield potential of 6.5 t/ha, BR11 became the predominant *amon* variety.¹⁰² Because of genetic degradation and variety specific diseases, yield potential of modern rice varieties tends to decrease over time. Since BR11 is a rather out-dated variety, yield decreased far below its former potential.

BR33 was issued in 1997, with a yield potential of 4.5 t/ha. This short-duration variety was not meant to become a substitute for BR11, which is a long-duration variety. The use of short-duration varieties brings a temporal advantage, but in most cases yield has to be compromised. BR11 is still waiting to get replaced by a new long-duration variety, which has a comparable high yield. In the current situation two unequal opponents are competing. RDRS research data shows that BR11 is currently only yielding 10% more than BR33 if cultivated through transplantation. In this constellation BR33 is able to compete with the yield of the weakened BR11. By using drum-seeding technology in BR33, yields are nearly the same for both varieties.

If BR11 would still have its original yield potential of 6.5 t/ha, the difference between the two varieties, based on the yield data of BRRI, would be 69%. BRRI and other actors did not manage to release a comparable *amon* variety like BR11 in the last two decades. But if such a new variety enters the market, the outcome of the evaluation would be heavily changed, and the change of the farmers' social welfare derived from project activities would be negatively affected. This aspect has to be considered as a risk when thinking about the project in a long-term perspective. This risk for the project will be dealt with in chapter 6.6.2.

For further analysis yield data from the RDRS will be used. Hence, yield is 3.5 kg (1%) lower per dhon for drum-seeded BR33 than for transplanted BR11, which is rather insignificant. Yield of transplanted BR33 is 33 kg (9%) lower than BR11.

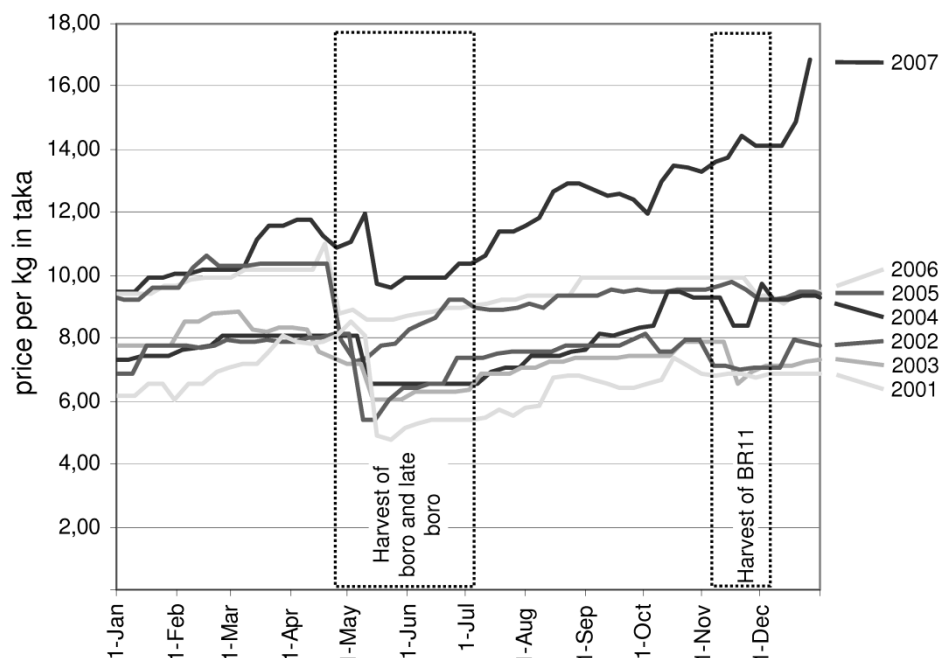
For analysing the price of *amon*, data was gathered from the Rangpur office of *Department of Agricultural Marketing* (DAM). A weekly bulletin, in which prices of different commodities from various major markets in Rangpur District are recorded, was compiled for the last seven years. The Department collects the agricultural wholesale prices from the weekly markets in Taragonj and Mithapu-

101 Husain and Abedin did a field experiment in *kharif II* season 2003 in several regions in Bangladesh and found drum-seeded paddy to yield 21% higher than transplanted paddy (cf. Husain and Abedin 2004, p.55); Mazid did a similar experiment with three *boro* varieties. Yield increased by 10.4%, 13.4% and 12.8% for BR28, BR29 and BR36, if drum-seeding technology was applied instead of transplantation. (cf. Mazid 2006, p.26)

102 cf. Hossain, et al. 2006, p. 157

kur Upazila. The data is not expected to differ significantly from the market in Pirgachha and was used to determine the farmers' rates in Pirgachha.¹⁰³

Figure 8: paddy (coarse) wholesale price in Rangpur District



With the exception of the 2007 data, the paddy price follows a very similar pattern every year. *Boro* has the biggest impact on the price of paddy. With its harvest the price significantly decreases and then increases until the next *boro* harvest. The impact of the *amon* harvest in-between has a much smaller impact on the price than *boro* harvest. It sometimes leads to a short-term decrease in the paddy price or a temporary stabilisation, but not to a significant decrease.

Some people argue that those farmers, who shift to cultivation of early varieties, will have a profit from a higher price in the market. There are two major arguments against this theory. As explained above, the paddy price is not significantly higher if harvest takes place earlier. Secondly, the project is aiming on shifting a big part of the area cultivated with *amon* earlier in greater Rangpur and greater Dinajpur. Earlier harvest would also lead to an earlier decrease of the paddy price. The price of a future early harvested BR33 is therefore expected to be equal than the price for currently harvested BR11.

2007 was an exceptional year. Prices increased much stronger than usual, which is mainly a result of natural hazards. The floods around July and the cyclone in November significantly reduced yields of *amon*, leading to a national food deficit and therefore to strongly increasing prices. Using the average

¹⁰³ It is neglected here, that the farmers sometimes trade via middlemen and that transport costs arise.

paddy price of the 2007 *amon* harvest period (14.1 taka) for the calculations would not be appropriate, since it reflects this special circumstances of the year. In 2006 the paddy price was significantly lower at 9.7 taka per kg.

Table 5: change in the farmers' revenue from *amon* cultivation (per dhon)

	BR11 trans-planted	BR33 trans-planted	BR33 drum-seeded
yield (kg/dhon)	374	340	370
(t/ha)	4.2	3.82	4.16
price (taka/kg)	10.2	10.2	10.2
revenue (taka)	3814	3468	3774
Δ revenue (taka)	-	-346	-40

source: own data

For the calculation therefore a paddy price of 10.2 taka was used, assuming the same annual increase in price between 2006 and 2007 than for the period from 2001 to 2006. From the paddy price and the yield data the change of the revenues from *amon* cultivation was calculated.

Table 6: change of farmers' profit in the *amon* season (in taka; per dhon)

	trans-planted BR33	drum-seeded BR33
Δ revenue	-346	-40
- Δ expenditures	-108	51
Δ profit	-238	-91

source: own data

The change in profit in *amon* cultivation is negative, but not very significant for both technologies. Profit is decreasing by 238 taka (2.40 euro) for transplanted BR33 and 91 taka (0.92 euro) for drum-seeded BR33.

6.4.2 Potato Cultivation

In potato cultivation no new technology will be introduced, and the way of cultivation and hence the labour and capital costs remain the same. The only change, which will result from the project, is a temporal one, which has impact on the yield.

Potato cultivation is rather complicated in Bangladesh, because of moisture and temperature regimes. Hence, potato cultivation is only possible in the winter season. A major problem is the late blight disease (*Phytophthora infestans*), which is a fungicide infection, leading to decreasing yields. Foggy weather accelerates crop losses caused by the fungicide. Potatoes planted in December are more subject to foggy weather in the critical period than potatoes planted in November. This is one of the major reasons, why yield of potatoes planted in November is significantly higher than in December.

Table 7: yield of potato (in t/ha)

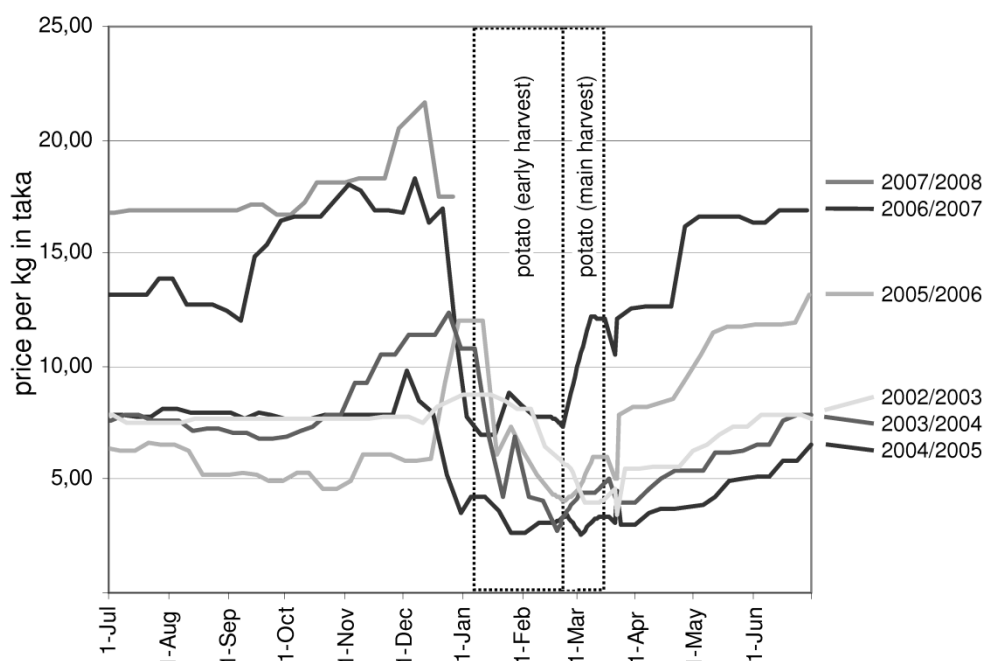
variety/ planting date	Diamond	Cardinal	average
7. November	18.55	22.71	20.63
22. November	18.82	22.32	20.57
07. December	14.61	19.65	17.13

Source: Neogi unpublished (experiment conducted in 2006-2007)

Neogi did some experiments on the planting time of potato and the respective yield in winter 2006/2007. He compared the yield of the varieties Diamond and Cardinal for three planting dates. The yield of each variety for the two dates in November is not differing much. Yield on 7th of December, however, is significantly reduced by 21.8% for Diamond and 12.7% for Cardinal. Averaging both varieties results in a crop loss of 3.47 t/ha or 16.8%, if potato is planted in December.

In the past years farmers of Pabitra Jhar cultivated a significant area with Diamond and Cardinal. In 2006/2007 however, most farmers planted Granola. The shifting between varieties mainly depends on the availability of seed potatoes and hence, international imports and the seed preservation by local cold stores. It is mainly the market, which determines the farmer's choice in variety. No yield data for Granola is available and the possibility that farmers will shift to another variety or one of the previously planted varieties is high. The average data for Diamond and Cardinal will be used for calculations, assuming that potato yield in general is affected similarly by the change in the plantation date. If the farmers shift the plantation from November to December, they can harvest 309 kg potato more per dhon.

Figure 9: potato (HYV) wholesale price in Rangpur District



Source: Department of Agricultural Marketing 2001-2007

Potato prices are highly seasonal. The potato market follows a typical seasonal pattern for an annual harvested crop. In order not to spoil, potatoes have to be stored in cold storages, leading to high costs and hence a big difference between the annual peak and the minimum price. The price is low during harvest, when supply is high and potatoes can be directly sold on the market without being cooled. It is increasing towards the next harvest. The potato market is very risky¹⁰⁴, which is related to the big price differential. In the centre of the speculations is the question on how high the price will increase and when it will drop again. If stocks are low, prices can shoot up prior to harvest as it was the case in 2005/2006, leading to high profits for those selling late. If stocks are too high, those people speculating for high prices might have a high loss. During the period when prices were peaking in 2005/2006, prices already reached the minimum in 2004/2005. Because of the nature of potato, farmers planting early potatoes can speculate, too. Other than paddy, crop duration of potato is not defined. From a certain moment the tuber formation process starts. If harvest takes place in an early stage, yield is lower than after the optimal time of 90 days, but possible. Since prices are sometimes very high some two months after potatoes are planted, farmers can realise a high profit by sacrificing yield for high prices. The majority of potatoes is planted after BR11 is harvested and the tuber formation starts too late for these kinds of speculations. Hence, harvest takes place when the price already reached its minimum.

104 cf. Moazzem and Fujita 2004

The project will shift all harvest to the month of February. The price for the earlier harvested potatoes is assumed to equal the minimum price, which is currently achieved, since the new main harvest will again take place in the period when nearly all potatoes are harvested.

Table 8: change in the farmers' revenue from potato cultivation (per dhon)

	without- situation	with- situation
yield (kg/dhon)	1525	1834
(t/ha)	17.13	20.6
price (taka/kg)	5.9	5.9
revenue (taka)	8996	10821
Δ revenue = Δ profit (taka)	-	1824

source: own data

In 2007 the price of potato decreased less and increased earlier than usual, which might have been a result of a low harvest due to a high incidence of late blight disease in Rangpur¹⁰⁵ and a resulting excess demand from the cold storage operators for potatoes. Hence, for the calculations a price of 5.9 taka was used which more reflects the price during the earlier years. It was projected for 2007 from the change in potato price between 2002 and 2006. If the project was implemented, the farmers' profit from potato cultivation increases by 1824 taka (18.38 euro) per dhon cultivated.

6.4.3 Late boro Cultivation

The third crop in the cropping pattern – *late boro* – has a similar impact on the farmers' social welfare than potato. Earlier plantation of *late boro* increases their profit, since yields increase and cultivation costs are assumed to remain equal. *Boro* cultivation is much more diversified with different varieties than *amon* cultivation. Mainly BR28, BR29 and a hybrid variety, called Hira by the farmers, are planted. Different field experiments have been conducted for each of these varieties under different management practices. However, hardly any research is available on the impact of the planting date on yield in the context of greater Rangpur.

105 e.g. The Daily Star 14.1.2007

Table 9: yield of BR28 by transplantation date (Rangpur; in t/ha)

transplanting date	yield
15. January	5.02
15. February	4.06
15. March	2.69

Source: BRRRI 1999, p.XXVI/7
(experiment conducted in
1999)

Research data covering all relevant planting dates could only be found from BRRRI and only for BR28. It will be assumed, that the data of BR28 reflects the change in yield of all varieties.

Transplantation of BR28 is optimal in January. In the study village *boro* is planted in optimal time as part of the *amon-boro* cropping pattern, allowing a yield of 5.02 t/ha. In the analysed cropping pattern the intermediate crop potato does currently only allow planting of '*late*' *boro* in March resulting in yield reduced by 46%. From an economic perspective this lower yield is compensated by the profit from potato cultivation.

The project makes it possible to transplant *late boro* already in February, which is one month ahead of the current planting date, but still late and not in optimal time. Yield is still about 19% below the optimum, but 1.37 t/ha higher than currently. Transformed to local units, a farmer can harvest 122 kg or 51% more paddy per dhon.

Table 10: change in the farmers' revenue from *late boro* cultivation (per dhon)

	without situation	with- situation
yield (kg/dhon)	240	362
(t/ha)	2.69	4.06
price (taka/kg)	8.9	8.9
revenue	2,136	3,221
Δ revenue = Δ profit	-	1,085

source: own data

It is not expected, that if *late boro* is harvested earlier, the price, which can be achieved for selling paddy, decreases. Harvest time will be shifted from end of June to beginning of June. In this period the prices are relatively stable on a low level. For calculating the price of the untypical year 2007 the same method was used than shown for the *amon* cultivation. The price for 2007 was predicted based on the change in price between 2002 and 2006 resulting in a price of 8.9 taka for the period of the third week of June to the first week of July, where currently *late boro* is harvested. Having an earlier harvest of *late boro*

increases revenue by 1085 taka (10.94 euro) per dhon. The increase in revenue equals the increase in the farmer's profit, since cultivation costs are not assumed to change.

6.4.4 Total Change in the Farmer's Social Welfare

The core activities of the project take place during *amon* cultivation. Impacts on the two following seasons, which tend to be seen only as 'side-effects' of the project, are the main benefits for the farmers.

Table 11: farmer's change in social welfare (per dhon)

	transplanted BR33	drum-seeded BR33
amon cultivation	-238	-91
potato cultivation	1824	1824
late boro cultivation	1085	1085
total Δ social welfare	2671	2818

source: own data

In *amon* cultivation the farmers' profit slightly decreases for both project alternatives. Despite reduced cultivation costs, yield losses lead to 238 taka less profit per dhon in transplanted BR33. For drum-seeded BR33 yield losses are far lower, but cultivation costs increase, leading in total to a decrease of 91 taka.

In potato and *late boro* cultivation high benefits for the farmers arise, if one of the two project alternatives is implemented. The loss, which the farmers experience in *amon* cultivation, is highly compensated by potato and *late boro*. The increase in profit by 1824 taka per dhon for potato and 1085 taka for *late boro* cultivation is in both seasons based on higher yield due to an optimisation of the planting date. In total the project alternatives lead to a positive change in the farmers' social welfare. The profit of drum-seeded BR33 is 2818 taka per dhon, which is 5.5% higher than for transplanted BR33. Assuming profit maximisation, the farmers would change their technology in *amon* cultivation to drum-seeding.

6.4.5 Discussion of Other Project Impacts

The project has a significant impact on the farmers' own labour requirements in *amon* cultivation. In contrast to the labourers, a reduction in these requirements has a positive effect on the farmers. Household labours' income is not negatively affected, if their amount of labour reduces, since they are unpaid anyway. Instead, the household benefits by saving time, which can be used for

other purposes. If the household members find an alternative income source, they could generate additional income for the household during that time. However, alternative employment and income opportunities are hardly available. Hence, it was decided not to include the reduced household labour as a benefit for the farmers in the evaluation.

The projects impact on straw is a second aspect, which will not be included in the calculations, but is part of the current debate on the project. When people suffer from seasonal food insecurity prior to *amon* harvest, cattle is suffering from similar problems. The major storages of straw, which is the prime fodder for cows, are built up after *amon* harvest. A lot of harvest of *boro* can not be used, because rains are damaging the straw. Towards the next harvest of *amon* the availability of straw decreases, which leads to a scarcity and to very high straw prices. In October selling of straw is a big business, which is generating a lot of income for some farmers, while some cattle owners have high expenses.

It is argued, that an earlier harvest of BR33 would provide fresh new at a time where the stocks are currently running out and, hence, increase the social welfare of those, who are raising cattle. However, there are several arguments, which oppose this argumentation. Overall availability of fodder might reduce, since herbicides reduce the availability of weed based fodder and short-duration varieties like BR33 are expected to produce less straw than long-duration varieties. High prices do not necessarily have a negative impact on the social welfare of the local community as long as those, who sell the straw are also part of this community. This is not necessarily the case, since a part of the traded straw is also imported from other regions. To draw final conclusions about the impact of earlier straw availability on the social welfare of farmers and livestock keepers would require a detailed analysis, which has not been done so far.

6.5 Economic Analysis of the Changes in the Labourer's Income

Both project alternatives have mainly two impacts on the social welfare of labourers: an employment change from a non-seasonal perspective and a change in the cost of seasonality, which is related to the food insecure period during *amon* cultivation.

The non-seasonal perspective describes the overall change in employment throughout the whole year. It was assumed that no change in labour demand will occur during potato and *late boro* cultivation, since only the timing is changed, but not the technology. Hence, only the change in *amon* cultivation impacts on the labourers' social welfare. For every dhon cultivated with transplanted BR33 or drum-seeded BR33, the labourers will have a loss in income of 72.5 taka or 300.6 taka, respectively.

6.5.1 Aspects of Seasonality

The cost of seasonality has to be analysed in a more complex model than the non-seasonal changes. Seasonality requires an inclusion of the temporal aspects and therefore adds an additional dimension to the considerations. Figure 10 visualises how seasonal patterns of employment opportunities for the labourers will change if the project is introduced.

The first graph shows the current situation. It is followed by a scenario with introduced transplanted BR33 and the change in employment opportunities between the scenario and the without situation. For the situation with drum-seeded BR33 two graphs are presented, respectively.

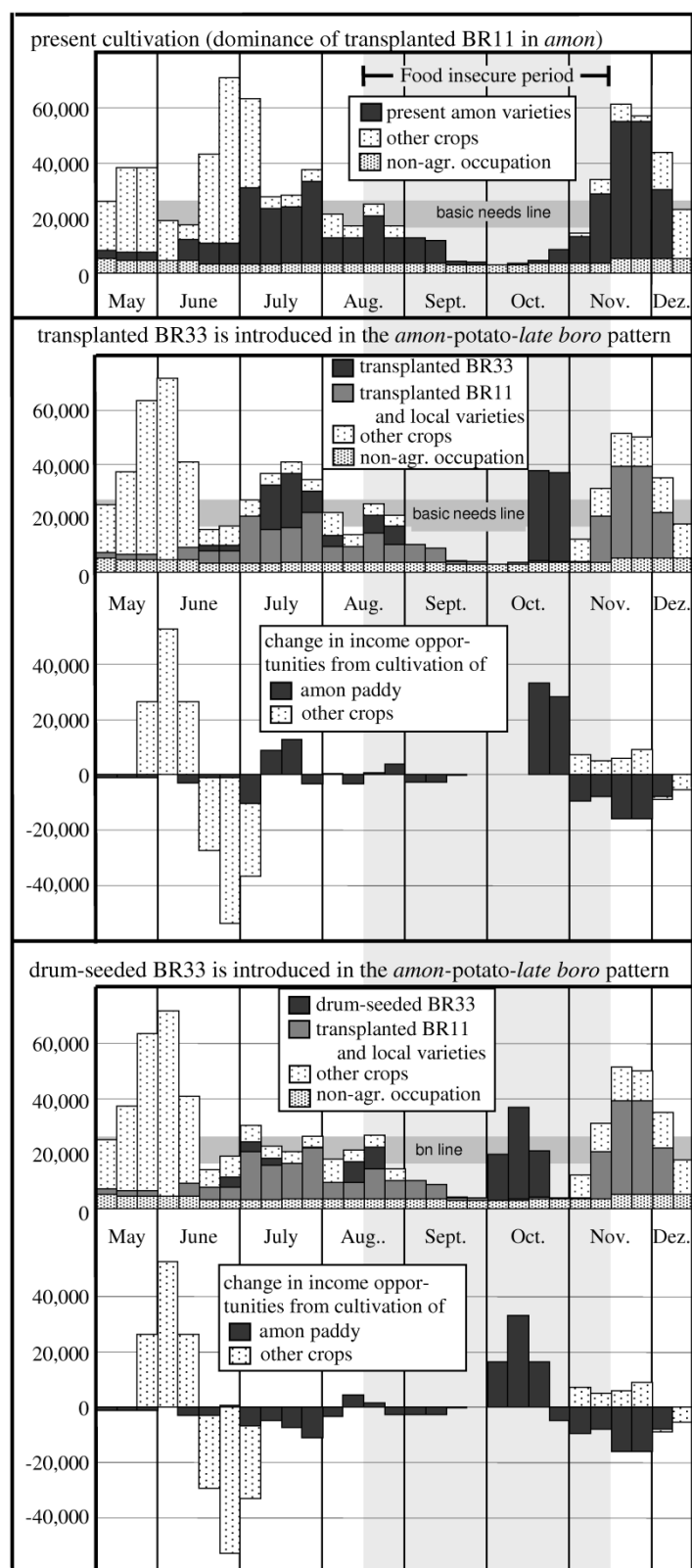
For the moment it is assumed that the farmers completely convert agricultural production on all the fields, which are currently operated under an *amon*-potato-*late boro* pattern (38.1%/174 dhon), to one of the two project alternatives. Current early varieties (BR2 and Joya) and a share of BR11 are assumed to be replaced by BR33. Local varieties are not expected to be replaced, since these crops are mainly planted on the low laying parts, which are not suitable for potato cultivation.

Looking at *amon* cultivation only, shows two periods with different project impacts. In the period of May to September, which covers all cultivation steps from seeding to intercultural activities, no distinct temporal changes occur. Especially for drum-seeded BR33 an overall decrease in income opportunities is visible. This decrease is already reflected in the figure for the overall decline in employment opportunities, mainly explained by replacing transplantation by drum-seeding and weeding by herbicides.

Employment opportunities do not change for the step of harvest. The farmers need the same labour force to carry out this step regardless of the technology and variety they use. The project's impact is a temporal shift of harvest from November/December to late October for transplanted BR33 and to early to mid October for drum-seeded BR33, respectively. Employment will be available during the food insecure period but will decrease by the same amount during the current harvest period. In the graph the period of food insecurity, which is based on the people's perception, is marked in the background. This benefit for the labourers will be measured by the concept of cost of seasonality.

Harvest of BR11 starts in the second week of November. Income from this week on is above the basic needs line and hence sufficient to cover daily expenses. Benefit for the labourers will arise, if employment opportunities are shifted prior to the second week of November. For calculating the change in the cost of seasonality the time duration between the 2nd week of November and the new harvest dates, the amount of employment shifted and an interest rate was used.

Figure 10: seasonal labour model for all project alternatives (y-axis: all labourer's income in taka/week)



Source: own data

The interest rate is based on the questionnaire. 63% of the labour households took at least one loan during the last three years from an informal money-lender. On 85% of these loans 10% monthly interest was charged. Since a few families paid more interest, the average interest rate is slightly higher at 10.8%¹⁰⁶.

Because of technical reasons, transplanted BR33 is harvested later than drum-seeded BR33, resulting in different changes in the cost of seasonality. In the case of drum-seeded BR33 the harvest period is shifted right into the middle of the food insecure period. In the second week of October the new income is clearly above the basic needs line. However, it can be expected, that this higher income will be used by the labourers end of October, when income opportunities are low again. It is expected for drum-seeded BR33 that the total increased income in the food insecure period leads to a profit in a reduced cost of seasonality. A total seasonal profit of 6,657 taka can be achieved by all labourers of the sample if the total area cropped with *amon*-potato-*late boro* is brought under the new technology. For the average labour household, this profit has the value of about 1.3 labour days.¹⁰⁷

The case is different for transplanted BR33. The harvest is only shifted less. Shortly after the new harvest the current *amon* harvest takes place. There is only one week in-between (first week of November) when the income opportunities are slightly below the basic needs line. Averaging the income of the third week of October to the first week of November results in an average income, which is above the basic needs line. Hence, only a share of the shifted income (71%)¹⁰⁸ contributes to a reduced cost of seasonality, which amounts to 2,767 taka (about 0.5 labour days per average labour household).

6.5.2 The Labourers' Total Welfare Change

The calculation of the total change in the labourers' social welfare is only based on the projects' impacts on employment opportunities in *amon* cultivation and the cost of seasonality from shifting the harvest. Other aspects will be discussed in the next chapter. In table 12 the change in the cost of seasonality is shown as calculated above.

106 The cost of seasonality was calculated on a weekly (7.5 days) basis with an interest rate of 2.6%.

107 Assuming 60.8 labour households in the sample and the average wage rate of 83.2 taka.

108 From the third week of October to the first week of November, the labourers have a total income of 86,747 taka (A) compared to 9,226 taka (B) without the project. They only need 64,185 taka (C*) to cover basic needs for the three weeks. Only 54,959 taka (D=C-B) of the additional income in the period of 77,512 taka (E=A-C) contributes to the reduced cost of seasonality. Hence only 71% (D/E) of the shifted income has a seasonality effect. *the arithmetic mean of the maximum and minimum expected basic needs line was used for the calculation (21,395 taka/week).

Table 12: labourers' change in social welfare in taka
(all *amon*-potato-*late boro* fields are cultivated with one project alternative (174 dhon; in taka)

	transplanted BR33	drum-seeded BR33
Δ employment opportunities	-12,589	-52,221
Δ cost of seasonality	2,764	6,657
total Δ social Welfare	-9,825	-45,564

Source: own data

The labour income was so far discussed on the basis of one dhon. For determining the whole change in social welfare it was multiplied by the whole cultivated area. Summing up both effects leads to a negative change in social welfare for the labourers. Comparing the two project alternatives shows that the negative welfare change for drum-seeded BR33 (45,564 taka) is five times higher than for transplanted BR33 (9,825 taka).

The project only has an impact on employment, which is related to the *amon*-potato-*late boro* cropping pattern. Employment is reduced in transplanted BR33 by 8.7% and in drum-seeded BR33 by 36.1%. However 61.9% of the area cultivated with *amon* remains unchanged¹⁰⁹, which reduces the overall relative impact of the project on the labourers' income. Including the benefit from reduced seasonality the labourers lose 2.7% of income in *amon* cultivation, if transplanted BR33 is implemented and 12.4% for drum-seeded BR33, respectively.

To visualise the project's impact on the labourers it is tried here to give a figure for a single labour household. This figure has to be seen as a very rough value, since it brings together the farmers' and the labourers' data. It is assumed that 60.8 households live fully or partly from the employment generated by all farmers in the sample. An average household's social welfare reduces by 162 taka for transplanted BR33 and by 749 taka for drum-seeded BR33. Labourers would require alternative employment for 1.9 days (transplanted BR33) or 9.0 days (drum-seeded BR33) to be compensated for the loss derived from the agricultural change.

Assuming a price of 17.7 taka¹¹⁰ per kg, a household can purchase 9.2 kg (transplanted BR33) or 42.3 kg (drum-seeded BR33) less rice. From September to December 2007 the local government in Pirgachha Union distributed four

109 This area contains of *amon*-potato-maize, *amon*-potato-jute and *amon*-*boro*

110 based on Department of Agricultural Marketing 2001-2007. The average retail price for HYV coarse rice in Rangpur District from 15.8-15.11.2008 was 20.7 taka. In 2007 the paddy and the rice price increased stronger than in other years. Hence, a rice price for 2007 was predicted on the change in rice price between 2003 and 2006. The rice price used is therefore lower at 17.7 taka/kg. (A detailed explanation can be found in chapter 6.4.1, where the paddy price is discussed)

times 10 kg rice to 15 %¹¹¹ of the households under the *vulnerable group feeding* (VGF) programme, which is mainly meant to help the vulnerable to bridge the food insecure gap. An average labour household's loss of purchasing power through introducing drum-seeding technology equals this relief.

6.5.3 Discussion of Other Project Impacts

Beside changes in the seasonality during the *amon* lean season, also some seasonal changes take place in other periods of the year, since the project is impacting on *amon*, potato and *late boro* cultivation, hence, on the total annual cropping pattern. It would be worthwhile to analyse all these changes based on the total year. Here only some limited conclusions can be drawn for the period from March to December, which was included in the model.

A significant change in labour demand will take place because of shifting *late boro*. Harvest will take place three weeks earlier, which will shift the peak season of *boro* cultivation from end June to the beginning of June.¹¹² The duration between the employment peaks (harvest of *boro* and harvest of *amon*) will be prolonged by three weeks. The period with no agricultural employment will be shortened, but especially in the case of drum-seeded BR33 where total employment heavily decreases, a long period with comparatively low employment opportunities will emerge. For nearly five months from the third week of June, labour income will be hardly above the basic needs level. Currently, this period starts in the first week of August and takes only a bit more than three months.

Whether a short period of nearly no income, or a long period with income opportunities on low level is more problematic for the local community would require more detailed analysis. This aspect will only be mentioned in this evaluation to stimulate further discussions, but cannot be included in the economic calculations.

6.6 The Projects' Impact on the Overall Social Welfare

Since the project has different impacts on the lives of farmers and labourers, both groups were analysed independently and the change in social welfare was determined for each of the groups. The labourers' welfare change was calculated on the basis of the total land, which is expected to be brought under one of the new cultivation technologies. For allowing a comparison between farmers and labourers, farmers' data on the welfare change per dhon was multiplied by the total area cultivated with *amon*-potato-*late boro* (174 dhon). By adding up

111 According to the Union Parishad Chairman, VGF was distributed to 2500 households in the total union, which had about 16,258 households in 2007 (10,038 households in 1996 (Bangladesh Bureau of Statistics 2003a); projected with the growth rate of Rangpur between 1996 and 2005 (Bangladesh Bureau of Statistics 2006a))

112 see figure 10

the farmers' and the labourers' figures, the overall change in social welfare for the local community could be calculated.

Table 13: overall social welfare change (for the whole sample; in taka)

	transplanted BR33	drum-seeded BR33
Δ social welfare (farmers)	463,988	489,543
Δ social welfare (labourers)	-9,825	-45,564
total Δ social welfare	454,163	443,979

source: own data

The result of the evaluation reveals, that the two groups analysed here have a completely different interest, of whether the project should be implemented or not. Farmers have high economic benefits, if one of the two project alternatives is implemented. They benefit a bit more (5.5 %), if drum-seeding technology is applied.

While the farmers are expected to be the winners of the project, the labourers will be the losers. The reduced cost of seasonality cannot balance the loss of overall employment. Hence, their social welfare will decrease, if one of the project alternatives is implemented. The decrease will be more than 4.6 times higher for drum-seeded BR33 than for transplanted BR33. The social welfare is highest for the labourers, if the project is not implemented at all.

Looking from the perspective of the whole society, the overall social welfare change brought by both project alternatives is positive, since the farmers' benefit is much higher than the labourers' loss. In case of transplanted BR33 farmers benefit is 47 times higher than the labourers' loss. In case of drum-seeded BR33 11 times, respectively. Benefits for the whole society from transplanted BR33 are slightly higher than for drum-seeded BR33 (2.3%).

There is a big conflict of interest between three perspectives. The farmers will opt for drum-seeded BR33. The total society will however profit most, if transplanted BR33 is introduced. The labourers have an interest that the farmers neither change cultivation technology to transplanted nor to drum-seeded BR33.

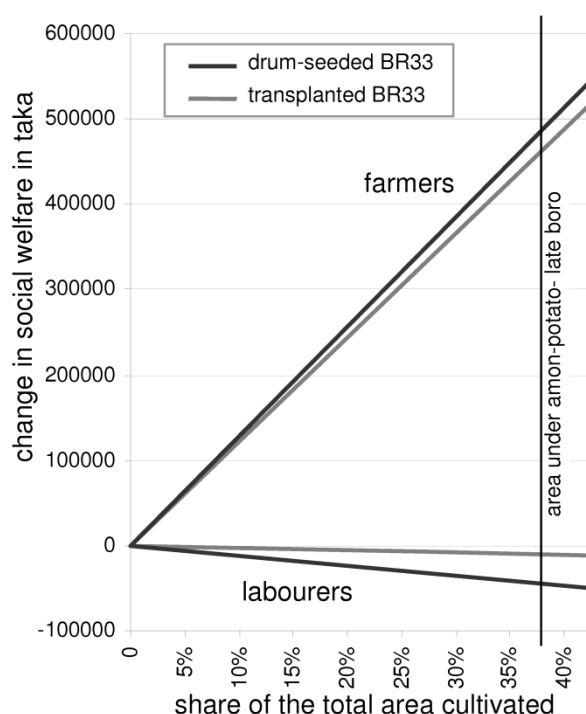
6.6.1 Impact of the Area Transformed on the Outcome

So far it was assumed that the farmers will change the total *amon-potato-late boro* cropping pattern to one of the project alternatives under the fulfilled precondition that profits are higher than with the currently practiced technologies. This assumption presupposes that the farmers' only decision criterion is profit maximisation. However, despite higher profits some farmers might be reluctant to use the new technology because of inability or unwillingness to use a new

technology or other reasons. These aspects can not be predicted by this evaluation. A detailed analysis of those farmers, who are currently practicing the technology, and those, who are refusing, would be required. What can be done here is to examine how the project's impact would change, if only a share of the possible areas is brought under the new cultivation technology. A sensitivity analysis was applied with 'area cultivated' as the independent variable.

The maximum area that can be cultivated under one of the new technologies is the total area, which is currently cultivated with *amon-potato-late boro* (38.1% of the total area).

Figure 11: change of social welfare of farmers and labourers by share of the total area cultivated with the new technology



Source: own data

Figure 11 shows that the farmers profit increases linear with the cultivated area. If a farmer cultivates two instead of one dhon with the new cultivation technology, he will realise a change twice as big in his welfare. This also holds true for the labourers' total employment opportunities, which are a part of the farmer's cultivation costs.

Only the cost of seasonality is not necessarily growing linear. Assuming that 100% of the total area will be shifted to the new technology (which is not possible), the labourers will have a high peak in employment in the currently food insecure period. The labourers can access far more income in that period than

required to fulfil their basic needs. Hence, the profit related to the cost of seasonality can only be counted up to that share of the income, which is required for the basic needs. Additionally, a new lean season might develop in another period, leading to a higher cost of seasonality in that period. If this new lean period is more distinct than the previous one, the cost in seasonality might even increase, leading to a loss in social welfare.

As discussed in chapter 6.2., if 38.1% of the total area is converted to drum-seeded BR33 all shifted employment will have a reducing effect on seasonality. This also holds true for any share below that. In the case of transplanted BR33 no additional benefit can be achieved after 27.1% of the area is converted. From that moment in time, additional income in the respective period is above basic needs, and the labourers' social welfare is stronger decreasing. This effect is not very big and not visible in figure 11, since the cost of seasonality only makes up a small share of the labourers' overall welfare change. The direction of the welfare change is not sensitive to the share of area cultivated with the new technologies. The farmers always realise a profit whereas the labourers always realise a loss. Hence, the desirability of the project is not affected by the size of area. The total welfare change is proportional to the area brought under cultivation, disregarding the insignificant deviation of the cost of seasonality for transplanted BR33.

6.6.2 Impact of the Introduction of a Substitute Variety for BR11

The project replaces the variety BR11 with BR33. As explained in chapter 6.4.1., the yield potential of BR11 has become very low compared to the 1980s when the variety was released. If a substitute long-duration variety with a higher yield potential will be developed and brought to the market, the farmers will cultivate that new variety instead of BR11. Hence, the yield of amon cultivation in the situation without the project would be higher, leading to a lower profit for the farmers for implementing one of the two project alternatives.

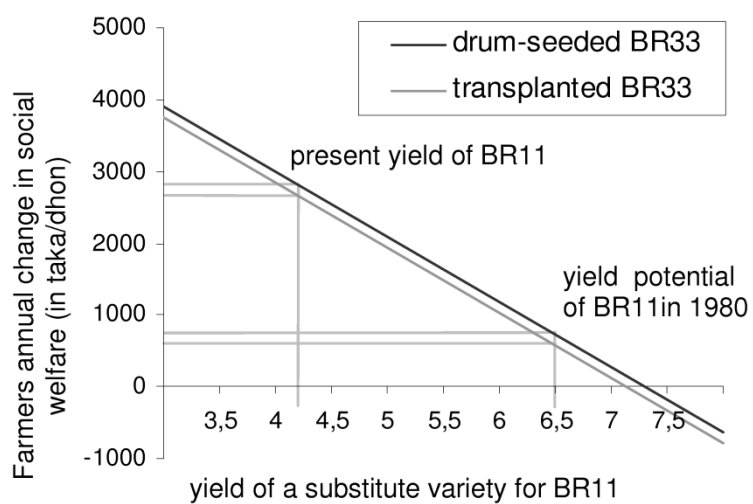
Figure 12 illustrates the sensitivity of the project outcome towards the yield of such a new variety. If the yield of the new variety surpasses 7.1 t/ha for transplanted BR33 and 7.3 t/ha for drum-seeded BR33, the farmers' profit from the project turns negative. Since a positive change in the farmers' profit is the necessary precondition for a shift in cultivation technology, the new technology would not be applied by the farmers. If farmers already cultivate with the new technology, they would shift back to the old one. The yield potential of BR11 is given with 6.5 t/ha¹¹³ by BRRRI, while currently only 4.16 t/ha¹¹⁴ are harvested. It is rather unlikely, that a variety can be developed, which yields more than 7 t/ha in amon season in the farmer's field. Hence, the project is expected to remain profitable, even if a new substitute long-duration variety will be intro-

¹¹³ BRRRI 2004, p.8

¹¹⁴ Neogi unpublished

duced. The projects impact on the social welfare of the farmers will however decrease significantly in case of a higher yielding substitute variety for BR11.

Figure 12: change of social welfare of farmers depending on the yield of a substitute variety for BR11



Source: own data

7 Discussion

7.1 The Project in the Context of Pabitra Jhar

Looking at the project from a utilitarian perspective, which aims on the "maximisation of the sum-total of the utilities of all people *taken together*"¹¹⁵, both project alternatives will be a success, since the sum of the welfare changes of farmers and labourers in Pabitra Jhar is positive. The project would hence fulfil the efficiency criterion under Kaldor-Hicks. However, applying the Kaldor-Hicks principle, only, for determining the value of the project, would ignore the difference in the project's impact on the social welfare of labourers and farmers.

If we include distributional aspects of the project and look at pareto-efficiency, both project alternatives fail, since one group in society loses, while another one benefits. Generalising that the labourers live below and the farmers above the poverty line allows drawing conclusion related to pro-poor growth. Under this assumption, the project does not fulfil any of the pro-poor growth definitions. Neither absolute pro-poor growth is achieved, since the labourers' income decreases, nor relative pro-poor growth, since the inequality between farmers and labourers increases. In the PRSP it is stated that "economic well being of the ordinary people cannot be improved without raising the total volume of employment"¹¹⁶. The project would lead to a reduction of employment of that group and should therefore be objected. The project would not increase absolute poverty of the labourers, if a certain amount of compensations from the farmers to the labourers took place. The farmers' benefit would be more than enough to directly compensate the labourers. Only one eleventh for drum-seeded BR33 and one 47th for transplanted BR33 of the farmers' additional profit would have to be sacrificed to the labourers in order to prevent them from losing social welfare. But without government interventions, the labourers will not be compensated in the cultural context of Bangladesh. There is no incentive for the farmers to share their profit. However, some indirect compensation might take place, having a positive impact on the livelihoods of the labourers.

In his analysis of the green revolution in Bangladesh, Hossain found an additional positive effect on the employment of labourers, than only the increased demand of labour due to the intensification of agriculture. Farm households that become richer through the impacts of the green revolution might "substitute leisure for labour and supply less labour in the market"¹¹⁷, resulting in a decrease in labour supply.

Higher income of the farmers can be expected to lead to higher consumption. If this higher consumption, e.g. in form of house construction, locally produced goods or employment of servants leads to higher income of those families living from agricultural labour, a certain compensation takes place. If the farmers use

115 Sen 1992, p. 13

116 Government of the People's Republic of Bangladesh 2005, p. 74

117 Hossain 1988, p. 12

some of their additional income to invest in non-agricultural businesses, labourers could profit from an increased demand in labour. However, using indirect compensations to justify a project, which is decreasing the income of the poor, requires a very detailed research to determine whether such trickle-down effects really take place.

Discouraging the project because it is not pro-poor is problematic, since the local society's overall benefit is much higher than the loss of the labourers. In a national comparison, the districts of greater Rangpur belong to the poorest in whole Bangladesh. Implementing the project would hence bridge the economic gap with the rest of Bangladesh. Additionally, benefits on national level arise, which were so far excluded from the discussion, since we were focussing on the project's costs and benefits from the local community's perspective, only. Bangladesh is struggling with self-sufficiency in food production.¹¹⁸ The country is extremely densely populated and all suitable lands are under cultivation. To guarantee the availability of food while the population is growing with 1.42% per year¹¹⁹ and agricultural land is transformed into settlement areas, food production has to be increased by higher yielding technologies, a higher cropping intensity on the existing area, or alternatively food imports or international food aid has to be increased. The project intensifies production in the *amon-potato-late boro* cropping pattern. On the respective fields in Pabitra Jhar, annual paddy production will increase by 12.6% for transplanted BR33 and 16.2% for drum-seeded BR33. Potato production increases by 16.8% for both project alternatives.¹²⁰

The project has to be discussed controversially by the policy makers, since it has an impact on different levels and on different groups with conflicting interests. If the maxim of pro-poor growth is taken as the only guiding principle, both project alternatives are not allowed to be implemented in Pabitra Jhar. If other aspects such as achieving self-sufficiency in food production and promotion of regional economic development of Northern Bangladesh are seen as the key issues, the project can be justified. The decision contains moral aspects and can not be rationally decided upon from a scientific perspective.

The discussion should not only centre around the question, if early varieties should be extended or not, but also on the choice of one of the two project alternatives. It was already discussed that the final decision for the implementa-

118 Dorosh, et al. 2004, p. 2 and pp. 14-22

119 SVRS Report (cited in Bangladesh Bureau of Statistics 2006b; figure refers to 2005)

120 Generalising the project for the whole area allows illustrating the project's overall impact on food availability on the national level. The project is aiming on transforming the majority of area currently cultivated with potato. Potato production increases by 3.47 ton/ha (16.8%). If we assume the total area cultivated in the northern districts with potato to be brought under one of the two project alternatives, national production would increase by 3.0%, having an impact on national self-sufficiency in food production.

(The data on the area cultivated dates from 2003/2004 (Bangladesh Bureau of Statistics. The Census of Agriculture 1996. Dhaka. cited in: Bangladesh Bureau of Statistics 2005b, p.221). For paddy no figure can be given, since the share of cropping patterns, which include *boro* or *late boro* is not known.)

tion of the agricultural change is taken by the farmers. In the context of Pabitra Jhar farmers would opt for drum-seeded BR33, since it improves their social welfare most. The labourers have no influence at all on the decision, but they have a conflicting interest from the farmers. They want to keep the status quo. In the present situation, where the farmers are not yet able to implement the technical change themselves, because technical knowledge is not sufficiently extended so far and drum-seeders are not available on the local markets, the interest of the labourers can be protected by the government and by RDRS. If the extension of drum-seeding is stopped now, instead of promoted further, negative employment impacts on the labourers can be prevented.

7.2 Generalisations of the Evaluation's Result on the Whole Project Area

The reflections on the project given above assume that the project decision is taken for Pabitra Jhar only. However this is not the case. The implementing organisations are aiming on a change in all districts of greater Rangpur and Dinajpur. In order to support the decision-making, conclusions must be drawn for the whole project area. The population of Pabitra Jhar only reflects 0.03%¹²¹ of the total population of all the districts. Analysing the technology in one village does only allow drawing limited conclusions on the project's impact on the overall area. As explained before, villages differ in cropping patterns, cropping technologies, alternative income sources, migration opportunities, exposure to flooding, access to markets, economic status etc.

Drawing conclusions on the overall economic benefits for the farmers is not possible at all, since their profit heavily depends on the crops cultivated after *amon*. In different locations, the project will influence different cropping patterns, which only have *amon* cultivation in common. In Pabitra Jhar potato and *late boro* were the successive crops. In the project conception, potato is interchangeable with wheat and *late boro* with a variety of other crops, resulting in a multitude of potential cropping patterns, which will differ in their economic benefits for the farmers. Whether all these other cropping patterns have a similar potential to increase the farmers' profit would require an economic analysis of each of these patterns.

Amon is the central crop of the project, which has an impact on the labourers' social welfare. It was assumed for Pabitra Jhar that the labour demand of potato and *late boro* is not affected by the project. It can also be expected for the second and the third crop in other cropping patterns that a shift in plantation date does not change labour demand, since the mode of cultivation remains the same. Hence, only the change in *amon* cultivation would have an impact on the social welfare of the labourers. In Pabitra Jhar *amon* cultivation has one major difference to most other regions: Double-transplanting is applied irregardless of

121 calculated from Bangladesh Bureau of Statistics 2003b and Bangladesh Bureau of Statistics 2005a

the land elevation. In most other regions *amon* is mainly single-transplanted. For both project alternatives, this step will have to be eliminated.

In the case of drum-seeded BR33 not doing the intermediate transplantation is only one aspect responsible for the reduction of labour demand among several others (no seedbed preparation, no final transplantation, less weeding). Hence, it can be assumed that a reduction in overall labour demand will also take place in regions, where currently already only single-transplantation is practiced. The total change in the labourers' social welfare might be a bit less in these regions, but it will still be negative.

The only difference in labour demand between transplanted BR33 and transplanted BR11 in Pabitra Jhar is the intermediate transplantation. In regions, where already now only single-transplantation is practiced on the respective fields, no loss in employment from implementing transplanted BR33 would occur. Assuming a positive effect from the cost of seasonality would even lead to a slight positive change in social welfare of the labourers, making the project a success according to the absolute pro-poor definition. However, this conclusion only holds true, if other regions really do not practice double-transplantation, and if no other factors play a role. An analysis of other areas would be required to support the assumption, that the project alternative 'transplanted BR33' can be pro-poor in a certain context.

If this assumption could be supported, transplanted BR33 would be the project alternative to go for, at least under the absolute pro-poor growth definition, since the social welfare of all groups would increase. Nevertheless the farmers might still decide for drum-seeding to maximise their profit, if this option is presented to them.

7.3 Seasonality, Poverty and Drum-Seeding Technology

Mitigating seasonality of the labourers' income is always stated to be the prime objective of introducing drum-seeding. In public the involved institutions present drum-seeding technology in *amon* season as the means to end *monga*. The institutions argue that employment is "provided"¹²², "created"¹²³ or "generated"¹²⁴ during *monga*. The cited documents and most of the newspaper articles imply that this employment is additional. The authors have the earlier harvest and post harvest activities in mind, which will take place during *monga*. However this employment is not additional it is merely shifted employment, resulting in an equal decrease in employment in the previous harvest period. The total labour requirement for the step of harvest remains the same, irregardless of the technology, which was used for cultivation.

122 Mazid and Johnson 2007, p. 3

123 RDRS Bangladesh 2007, p. 23

124 Bari 2007

What is never mentioned at all is the overall decrease of employment resulting from drum-seeding. Even if Pabitra Jhar is not representative for the whole study area, it is obvious that employment will decrease, since the labour intensive steps – seedbed preparation and transplantation – are replaced by drum-seeding, which hardly requires any labour.

Gil's basic model on seasonality presented in chapter 2.2.1 shows two different possibilities to reduce the negative effect of seasonality on covering basic needs.¹²⁵ A smoothening of the employment pattern reduces the time when a household's income is below being able to cover the basic needs.¹²⁶ Introducing drum-seeding leads to such an effect. The second possibility is to lift the average income. Drum-seeding reduces the average income and hence increases the possibility that a household becomes affected by seasonal poverty. Hence, the two effects on the people's exposure to food security are contrary.

Only looking at seasonality diverts our perspective from more fundamental issues. Seasonality has to be seen as one aspect of poverty among others. Combating seasonality cannot be a more important goal than reducing poverty. If poverty is increased as a result of combating seasonality of income, the hierarchy of development goals is turned upside down. The drum-seeder has exactly this effect. Not being exposed to the project would make the labourers less poor. Their total income would remain on a higher level, despite the need to pay the cost of seasonality to remove the negative effects of seasonality on their livelihoods.

In the current situation the northern districts still suffer from a high degree of underemployment. Economic development, especially in form of generation off-farm employment, is not significantly taking place so far. Mechanisation of agriculture by drum-seeding technology is labour displacing. Labour displacing technologies can be justified or are even necessary in a setting where labour is scarce. However, this is currently and in the near future not the case in Northern Bangladesh. Replacing labour intensity with capital intensity will have severe negative impacts on the livelihoods of the rural poor.

125 it is assumed here that present consumption is covered by present income.

126 assuming that the mean income is above basic needs.

8 Conclusions and Recommendations

There is a significant mismatch between the result of this evaluation and the rhetoric of those pushing the project in the public debate. I will restrict my explanations for the moment only to the project alternative drum-seeded BR33. The technology transfer is being presented in public with the labourers as the primary beneficiaries. Their relief from seasonal food insecurity is the major argument. However, if the economic impact of the project is somehow reflected by the results of the sample evaluation in Pabitra Jhar, the labourers' social welfare decreases. The reason for this discrepancy is that the perspective presented by the project supporters is a limited one. They only see the seasonal benefit of the technology, but do not take into consideration, that drum-seeding technology is labour displacing. That means they only look at a partial rather than the total impact of the project on the labourers.

The winners of introducing drum-seeding technology are the farmers. Especially in the two seasons following *amon* cultivation (potato and *late boro* in the case of Pabitra Jhar) the farmers' profit is significantly increased. This aspect has never been stressed in the debate. More than that, the farmers are often seen as a hindrance for project implementation. They have to be convinced to cultivate BR33 despite its lower yield than BR11 to relieve the labourers from seasonal food insecurity.¹²⁷

The project promoters are advised to reconsider the way of dealing with drum-seeding technology in public and in policy making. Drum-seeding has to be presented as a means to increase the farmers' profit from agricultural production and to increase the overall food production. These are two very strong arguments, which speak in favour of introducing drum-seeding. However it should not be neglected that the labourers are the ones, who are paying the cost for this development.

It is not the purpose of this evaluation to decide whether drum-seeding is *good* or *bad*. There are arguments in favour and against the technology. The aim is to provide information for the decision makers to decide upon this question. Different normative concepts will lead to different results about this question. The normative concepts applied have to be decided upon by the respective policy makers. However, if any type of pro-poor growth is the basis for decision-making, promoting drum-seeding technology has to be abandoned.

The negative effect of the introduction of transplanted BR33 on the labourers of Pabitra Jhar is much less than of drum-seeded BR33. In chapter 7.2. it was discussed that in settings where no double-transplantation is applied, the project might even have a positive impact on the labourers' social welfare. It would be important to do more intensive research on the change in social welfare related to the introduction of transplanted BR33 in different settings in the project region. If these assumptions hold true, transplanted BR33 would have the potential to absolutely increase the social welfare of all groups. Profits of farmers

127 RDRS Bangladesh 2007, p. 25

and the increase in the national food production, however, would be a bit lower than for drum-seeded BR33.¹²⁸

Hence, transplanted BR33 might be a compromise, which would still make the farmers' the big winners of the project, the national food security would still increase and the labourers' social welfare would at least not deteriorate significantly or would even slightly increase. To facilitate a type of development in Pabitra Jhar and in the project area, which would meet the criterion of the relative definition of pro-poor growth as demanded in the PRSP, supplementary projects have to be launched. Generation of non-agricultural employment for the rural poor is highly needed. Motivating the farmers to invest their additional income to build up such employment would make the labourers benefit indirectly from the project.

128 since transplanted BR33 is yielding a bit less than drum-seeded BR33.

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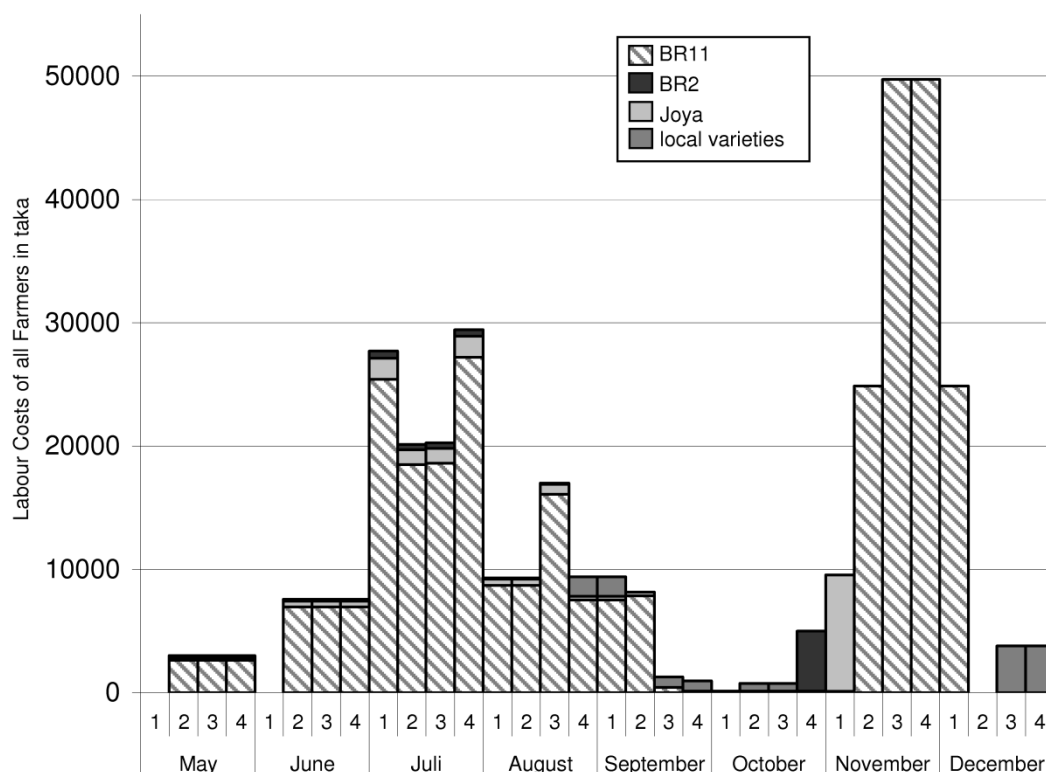
Annex

Annex I: Details on the Labour Model

The labour model is mainly based on the questionnaires and on the group discussions. It cannot be expected, that farmers are able to give the exact timing for every step of cultivation of all crops they cultivate. The timing given from different groups had variations of up to one month. Based on the overall result, assumptions were drawn on the timing of steps. Results were partly discussed with expert or cross-checked with available secondary data. The same was done with the amount of labour needed. In this annex all assumptions made, will be presented. The first graph refers to different *amon* varieties while the second shows all other crops of the without situation. Additionally, non-farm occupations are shown in a separate graph.

Annex I.a: Amon Cultivation

Figure 13: details about the labour model: amon cultivation



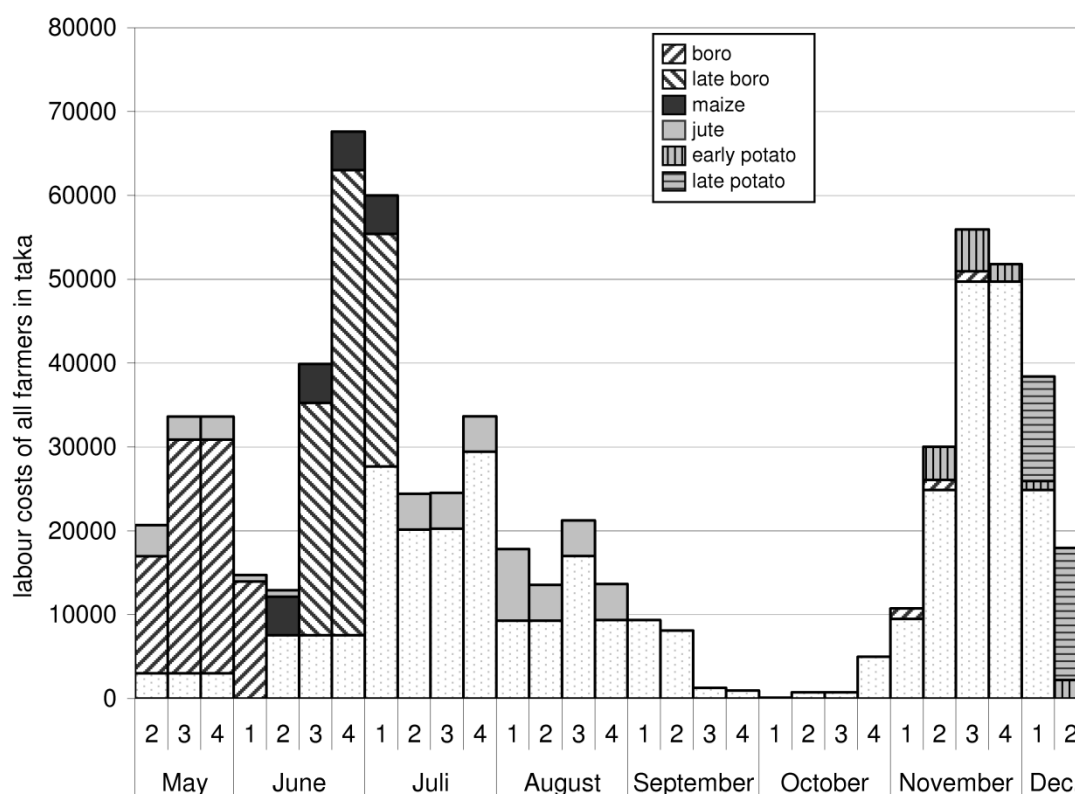
The labour costs were recorded separately for every *amon* variety in the questionnaire survey. The timing is based on the qualitative interviews

The timing of all steps in BR11, BR2 and Joya cultivation besides the harvest is the same. BR2 is harvested in the last week of October, Joya in the first week of November and BR11 between the second week of November and the first week of December.

The cultivation of local varieties differs significantly. Crop duration is much longer. Seeding takes place at the same time than for the other varieties. All other steps are delayed and harvest takes place in the last two weeks of December.

Annex I.b: Other Crops than Amon

Figure 14: details about the labour model: cultivation of other crops than *amon*



Source: own data

The timing and the labour demand for all other crops was derived from the group interviews. Much more assumptions had to be made, which will be described in the following table. Only those steps are explained here, which take place in the period between the second week of May and the second week of December. Other periods were not analysed.

Table 14: assumptions of the labour model: other crops than *amon*

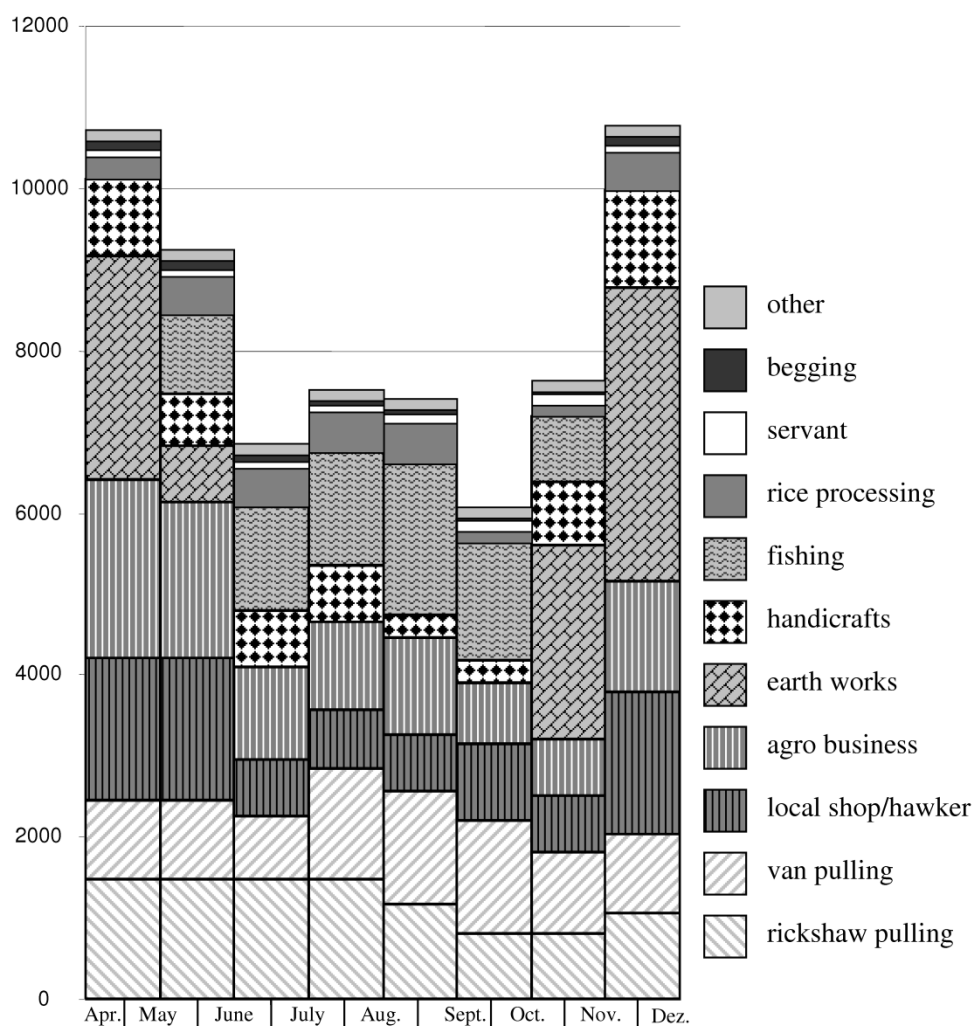
crop and working step	timing (week/month)	labour costs per dhon in taka	no of family labour	assumptions
boro				
seeding	1/11-3/11	19.8	0.73	Costs and share of family labour is assumed to be equal than <i>amon</i> cultivation.
harvest	2/05-1/06	604.2	1.50	Based on the group discussion the <i>boro</i> harvest is assumed to cost 150 taka more than the harvest of <i>amon</i> because of a higher yield and more time pressure since the rain is interfering in the activities. Additionally three women are required for drying the straw, which is not required for <i>amon</i> , since straw is drying on the fields. It is assumed that one woman is family labour.
late boro				
harvest	3/06-1/07	604.2	1.5	Harvest costs of <i>boro</i> and <i>late boro</i> are assumed to be equal. Yield is lower, but rains are more disturbing the work. (based on group discussions)
crop and working step	timing (week/month)	labour costs per dhon in taka	no of family labour	assumptions
maize				
harvest	2/06-1/07	393.5	1.0	Maize cutting needs about 5 labours per dhon including transport to the homestead. It is assumed that maize cutting involves the same share of family labour than <i>amon</i> harvest. There are two ways of processing maize: either by machine, which costs 44 taka per dhon or by household labour (mainly women and children). If maize is manually processed 3.3 labourers/dhon are needed, However, since many farmers use machines, which only need 2 hours per acre (0.06 labour days /dhon), labour costs are hardly relevant. Since most families who do manual processing use family members 1 labour day was added for farmers and 0.5 labour days for labourers. The average wage rate for <i>amon</i> cultivation was used.

crop and working step	timing (week/month)	labour costs per dhon in taka	no of family labour	assumptions
jute				
2. weeding	3/04-2/05	227.2	1.55	Jute requires three times weeding. The last week of the 2 nd weeding takes place in the analysed period. The 2 nd weeding requires 5 labourers. It is assumed, that the share of family labour equals weeding of <i>amon</i> . The average wage rate of <i>amon</i> cultivation was used
3. weeding	1/05-4/05	252.4	1.55	The 3 rd weeding has the same requirements in labour than the 2 nd weeding, but only men are working, because it is too insecure for women to work in the high fields. The average male wage rate was used.
thinning	3/05-2/06	101.0	0.62	The process of thinning equals the 3 rd weeding, but only 2 labourers are needed.
cutting and watering	2/07-1/08	549.9	1.35	After cutting the jute sticks have to be bound together and put into water for several weeks. The whole process costs 650 taka per dhon. It was assumed, that household labour is involved in this process like in <i>amon</i> harvest, which reduces the labour costs by about 15.4%.
washing and drying	1/08-4/08	549.9	1.35	Washing and drying is assumed to require the same labour than cutting and watering
early potato				Total potato cultivation is not made in contract-labour. It is assumed that the share of family labour equals <i>amon</i> weeding, since the type of work is very similar. Female labour is important in all steps. In the group discussions a share about 40% female labour was determined. For the calculations the average wage rate of <i>amon</i> cultivation for males and females, respectively, was used.
planting	2/11-3/11	179.8	1.93	Planting requires in total 4 labourers.
hand raising + 1. Irrigation	3/11-1/12	98.2	0.70	Hand raising requires 2 labourers. Irrigation needs about 0.25 labourers per dhon. Normally about 1-1.25 hours water are needed to irrigate one dhon, one person is needed for channelling, repairing etc. a second one belongs to the irrigation facility. Large farmers might need less labour. Irrigation is assumed to have a high share of family labour like weeding
1. earthing	2/12-3/12	89.9	0.64	The first earthing requires 2 labourers.
late potato				
planting	1/12-3/12	179.8	1.93	like early potato
hand raising + 1. irrigation	2/12-1/01	98.2	0.64	like early potato

Annex I.c: Non-agricultural Occupations

The following graph shows the different income from non-agricultural occupations of those people in the sample, who are also doing agricultural labour. The information is based on the questionnaire survey.

Figure 15: details about the labour model: other occupations



Annex II: Questionnaire

1. serial number. _____ 2. filled by: _____ 3. date: _____
 4. name: _____ 5. father's name: _____
 6. village: _____ 7. para: _____

8. How many people live in your family? _____ persons
 (Clarification: A family is formed by those people, who eat their meal from the same pot and same kitchen. A family means father, mother, sister brother and sons and daughters who also share the same kitchen and same meals. But the sister or the daughter who is married and lives with her husband's family is not counted as a family member.)
9. How many members are earning income? _____ persons
10. What are the income sources of your family members? (*Tick in the table below*)
11. If the respondent's total income is 10 (or 100), than how big is the share of the individual income types?

Income Source	√	Share of total income
Farming		
Agricultural labour		
Seasonal migration (those who go to another place for seeking a job)		
Other occupations (bagging, fishing, earth works, job, rice mill, brickfield, business, household work, rickshaw, van etc.)		
Government Support Programmes (VGD Card, old people allowance...) taka/month _____ type: _____		
Other (support from family members or others, who live somewhere else) specify _____ taka/month		
Other (specify): _____		

→ If a source of income is farming in question 11, than ask the question 12-21, otherwise continue with question 22)

12. How much land do you cultivate? _____ dhon

13. Type of Land

Land Type	Amount (dohn)
Highland	
Medium highland	
Medium lowland	
Lowland	

(22 decimal = 1 dhon)

(highland: flood water does never stay; medium highland: flood water reaches highest 3 foot; medium lowland: 3-6 feet; lowland above 6 feet)

14. Who owns that land?

Ownership pattern	Amount of land (dohn)
Owned	
Share-cropping	
Lease	
Mortgage	
Other: _____	

→ if the land is under share-cropping than go to question 15 otherwise go to 17
15. What do you have to give to the landlord for cultivating amon?

Sharing Arrangement	amount	unit
Share of Harvest		%
Fixed amount of paddy		
Other: _____		

16. Is the landowner covering some production costs? yes ☐ no ☐

→ If yes than go to question 16a. if not continue with question 17

16a. Which production costs does he cover and how much does he pay?

→ if the land is leased in question 14 fill question 17 otherwise go to 18

17. How much lease do you pay per dhon? _____ taka/year

→ if land is mortgaged in question 14 fill question 18 otherwise go to 19

18. How money did you pay for every dhon of mortgaged land?

_____ taka per _____ year

19. Questions on cultivation amon season.

19.a. Which crops do you cultivate during amon season this year?

(collect data for every crop)

19.b. How much area do you cultivate for every crop?

19.c. For one dhon: How many labour days did you need?

19.c.1. How many labour days do you take from your family?

19.c.2. How many labour days do you hire?

19.d. What is the average wage rate you paid?

19.e. Do you also provide a meal?

		BR11					Other_____					Other_____					Other_____								
Step of cultivation		dhon					dhon					dhon					dhon								
		Cost of specific step	Total Labour days	Own working days	Labour days hired	Taka /day	Incl. Meal?	Cost of specific step	Total Labour days	Own working days	Labour days hired	Taka /day	Incl Meal?	Cost of specific step	Total Labour days	Own working days	Labour days hired	Taka /day	Incl. Meal?	Cost of specific step	Total Labour days	Own working days	Labour days hired	Taka /day	Incl. Meal?
Seedling raising																									
Transpl. Inter-mediate field	Land Prep.(animal)																								
	Land Prep.(power-tiller)																								
	Transplantation in the main land																								
Transpl. Main field	Land Prep.(animal)																								
	Land Prep.(power-tiller)																								
	Transplantation in the main land																								
Intercult. Operations.	1. Weeding																								
	2. Weeding																								
	3. Weeding																								
	Fertilizer top dressing																								
	Chemical application																								
	Other_____																								
Harvest																									

Annotations:

1. Land preparation of the big field includes ploughing and levelling and all other steps to make the field ready for transplantation.
2. Transplantation includes the uprooting of the seedlings from the small fields, the transport, and the planting on the new field.
3. Harvest includes cutting, transporting, thrashing, drying and storing of paddy and straw.

20. Questions on Cropping pattern

What cropping patterns do you plant? How much land do you plant?

1 (now)	2	3	Amount of land (dohn)

21. Did members of your family sell a crop from the field in advance?

this year? yes ☐ no ☐

last year? yes ☐ no ☐

two years ago? yes ☐ no ☐

→ If a source of income is agricultural day labour in question 11 continue, otherwise continue with question 27)

22. How many members of your family are doing agricultural wage-labour?
_____persons

23. Questions on labour and wages

Answer the questions about the cultivation of amon, only.

23.a. Who is doing agricultural labour in your family? (*note down names*)

23.b. How many days were they working in the period of cultivation?

23.c. How many taka did your family members earn at maximum per day and person?

23.c.1. Was a meal included?

23.d. How many taka did your family members earn at minimum per day and person?

23.d.1. Was a meal included?

Amon Cultivation		name / labour days					Maximum daily wage	Incl. Meal?	Minimum daily wage	Incl. Meal?
Seedling raising										
Transpl. Intermedi-	Field Prep.(animal)									
	Field Prep.(power-tiller)									
	Uprooting, transport and planting									
Main field Transpl.	Field Prep.(animal)									
	Field Prep.(power-tiller)									
	Uprooting, transport and planting									
Intercultural activities										
Harvest and storing										

24. Which agricultural activities did your family members in the following periods? (beside amon cultivation)

Activity	Name / days				Average wage rate	Meal included?
Between seeding and transplanting of amon						
During the month before amon was seeded						

25. What is the lowest wage you would work for without getting a meal, when there is hardly any work available? _____ taka

26. Did members of your family sell labour in advance?

this year?	no <input type="checkbox"/>	yes <input type="checkbox"/>	if yes: what was the wage rate? _____ taka
last year?	no <input type="checkbox"/>	yes <input type="checkbox"/>	if yes: what was the wage rate? _____ taka
two years ago?	no <input type="checkbox"/>	yes <input type="checkbox"/>	if yes: what was the wage rate? _____ taka

→ If the Income Source in Question 11 is migration, than collect the data below otherwise go to question 29

27. How many members of your family do seasonal migration; that means go to another place to work? _____ person

28. What are their names?

Person 1: _____ Person 2: _____ Person 3: _____

Ask for every person and migration period in the table below

28.a. In which weeks did [name] migrate?

(mark the period in table and add a number and go to the next table)

28.b. Where did he migrate to?

28.c. Which work did he do?

28.d. How many days did he work?

28.e. With how much money did he return home? *(Transport costs, accommodation etc are already deducted)*

Month	Week	Name	Name:	Name:
Boishak	1			
	2			
	3			
	4			
Jaistho	1			
	2			
	3			
	4			
Ashar	1			
	2			
	3			
	4			
Sharaban	1			
	2			
	3			
	4			
Bhadra	1			
	2			
	3			
	4			
Aswin	1			
	2			
	3			
	4			
Kartik	1			
	2			
	3			
	4			
Agrahayan	1			
	2			
	3			
	4			

Period	Where did he go	What work did he do	Days away from home	Money brought back home
1			days	taka
2			days	taka
3			days	taka
4			days	taka
5			days	taka
6			days	taka
7			days	taka
8			days	taka
9			days	taka

→ If other occupation (bagging, fishing, earth works, job, rice mill, brickfield, business, rickshaw, van etc.) in question 11 than collect the questions below, otherwise continue with question 40

37. a Which other work does your family do?

37. b. Who does this work? *[fill name]*

For every month:

38. How many days per week does one person do that work?

39. How much money does he earn per working day?

	occupation 1		occupation 2		occupation 3		occupation 4	
	_____		_____		_____		_____	
	_____		_____		_____		_____	
	Name: _____		Name: _____		Name: _____		Name: _____	
	days/ week	taka/ day	days/ week	taka/ day	days/ week	taka/ day	days/ week	taka/ day
Boishak								
Jaistho								
Asher								
Sharaban								
Bhadra								
Aswin								
Kartik								
Agrahayan								

	occupation 5		occupation 6		occupation 7		occupation 8	
	_____		_____		_____		_____	
	_____		_____		_____		_____	
	Name: _____		Name: _____		Name: _____		Name: _____	
	days/ week	taka/ day	days/ week	taka/ day	days/ week	taka/ day	days/ week	taka/ day
Boishak								
Jaistho								
Asher								
Sharaban								
Bhadra								
Aswin								
Kartik								
Agrahayan								

Basic needs (to be filled for all)

40. Is there a period in the year, when you cannot afford to buy enough food for your family?

yes ☐ no ☐

→ if yes continue (if no continue with question 42)

41. a. In which months of the year does this usually happen? (*multiple answer*)

<input type="checkbox"/> baishakh	<input type="checkbox"/> jaistha	<input type="checkbox"/> ashar	<input type="checkbox"/> sharaban	<input type="checkbox"/> bhadra	<input type="checkbox"/> aswin
<input type="checkbox"/> kartik	<input type="checkbox"/> agraha- yan	<input type="checkbox"/> paush	<input type="checkbox"/> magh	<input type="checkbox"/> falgun	<input type="checkbox"/> chaitra

41. b. In which month is the situation worst? (*only one answer*)

<input type="checkbox"/> baishakh	<input type="checkbox"/> jaistha	<input type="checkbox"/> ashar	<input type="checkbox"/> sharaban	<input type="checkbox"/> bhadra	<input type="checkbox"/> aswin
<input type="checkbox"/> kartik	<input type="checkbox"/> agraha- yan	<input type="checkbox"/> paush	<input type="checkbox"/> magh	<input type="checkbox"/> falgun	<input type="checkbox"/> chaitra

42. How much money do you need at least per day to buy enough food for your family?

Annotation: For farmers excluding the money, they spend for cultivation.

_____ taka / day

43. How much money do you currently spend for food for your family?

_____ taka/day

44. Did you generate savings for aswin/kartik? yes ☐ no ☐

→ If yes fill the following questions, otherwise continue with question 45

44.a. What did you save?

	Amount	Unit
Rice		
Paddy		
taka		taka
Other: _____		

45. a. Did you take a loan or loans during aswin/kartik?

			Bank	NGO	Moneylender	others
this year	_____taka	_____ interest/month	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____
last year	_____taka	_____ interest/month	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____
two years ago	_____taka	_____ interest/month	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____

45. b. If other arrangements than interest please specify:

45. c. What did you use the loan for?

- ☐ for food
☐ to cover cultivation costs
☐ other specify: _____

Annex III: Format for Discussions on Seasonality

May	Raishak বৈশাখ	1	
		2	
		3	
		4	
June	Jaistha জ্যৈষ্ঠ	1	
		2	
		3	
		4	
Juli	Ashar আষাঢ়	1	
		2	
		3	
		4	
August	Srabon শ্রাবণ	1	
		2	
		3	
		4	
September	Badhra ভাদ্র	1	
		2	
		3	
		4	
October	Aswin আশ্বিন	1	
		2	
		3	
		4	
November	Khartik কর্তিক	1	
		2	
		3	
		4	
December	Agrahavan অগ্রহায়ণ	1	
		2	
		3	
		4	
January	Poush পৌষ	1	
		2	
		3	
		4	
February	Manh মাঘ	1	
		2	
		3	
		4	
March	Falgun ফাল্গুন	1	
		2	
		3	
		4	
April	Chaitra চৈত্র	1	
		2	
		3	
		4	

Abstract

Transformation processes in the mode of agricultural production can significantly influence both, the farmers' and the labourers' social welfare. Active promotion of new forms of agricultural production through Governments and NGOs has to be in line with their policies. In the example of Bangladesh poverty reduction is the principle concern of rural development policies. Hence, an ex-ante evaluation to determine an agricultural project's impact on the rural people's livelihoods is a central precondition prior to the implementation of such a project.

In this working paper an agricultural pilot project was analysed, which is going to be implemented in a vast area of Northern Bangladesh. Through agricultural extension a short-duration paddy variety, early planting dates, and mechanization of the plantation process are being promoted. This allows harvest of paddy one month ahead of current practice. Major positive welfare changes can be expected for the farmers, especially since earlier plantation of subsequent crops leads to higher yields. The labourers' social welfare will be affected by two aspects. Since mechanization is labour displacing, the overall employment is expected to decrease. Secondly, a positive effect of the project is expected because of the high seasonality of employment opportunities in the region. Harvest will take place in the current agricultural lean season, which corresponds to the period of seasonal food crisis. Hence, harvest is shifted to that period, when labourers are most in need of it.

The expected change in social welfare of the farmers and the labours was determined independently by applying cost benefit analysis. Farmers are expected to be the winners of the project, while the labourers' loss in seasonality cannot be compensated by the benefit from smoothened seasonality. The working paper will discuss in how far normative development objectives of the implementing organizations are in line with the reality of the project, which favours those considered being less poor (farmers) and disfavours those considered being more poor (labourers). Additionally, an alternative project idea will be analysed and discussed, which does not mechanize agriculture and therefore has a less widening effect on rural income distribution.