Journal of Applied Agricultural Economics and Policy Analysis, 2019, Vol. 2, No. 1, 40-46
Available online at http://pubs.sciepub.com/jaaepa/2/1/6
Published by Science and Education Publishing
DOI:10.12691/jaaepa-2-1-6

Socio-Economic and Biophysical Constraints of Dry Season Cropping in Tidal Floodplain of Bangladesh

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Received August 10, 2019; Revised September 14, 2019; Accepted September 24, 2019

Abstract Cropping intensity and crop yields in tidal floodplain of southern districts of Bangladesh are low. Nearly all farmers grow transplanted aman rice in wet season, but a few farmers (29%) grow dry season crops leaving most land fallow. Based on the results of a survey conducted in two coastal districts in Bangladesh, this paper examines the constraints of growing dry season crops. Majority of the population in the area are engaged in farming; but most of them (77%) fail to earn livelihood through farming. Alternative livelihood strategies of the smallholders are (a) wage earning as labor, (c) farming as share croppers, (d) cultivating land of other landholders on seasonal/annual basis. Tidal flood being deterrent in growing modern varieties, invariably all farmers grow indigenous rice in wet season. Cropping intensity is low (152%). Khesari (*Lathyrus sativus*) and mungbean (Vigna radiata) are the farmers' preferred dry season crops, but productivity is low. Delay in rice harvest and slow land drainage delays planting khesari resulting in poor yield. Weeds and insect-pest infestation also keep the mungbean crop yield low. Late planted khesari also gives poor yield. Harvesting mungbean pods is labor intensive that smallholders cannot afford. Yields and monetary return thereof hardly equals production cost. Low yield and consequential poor return are the major causes of farmers being disinterested in dry season cropping.

Keywords: *tidal floodplain, transplanted aman, dry season crops, mungbean, smallholder farmers, farm labor crisis, profitability*

Cite This Article: M. Moksedur Rahman, M.G. Neogi, M. Faruque H. Mollah, A.K.M. Salahuddin, Md. Ruhul Amin, and Abdul Hamid, "Socio-Economic and Biophysical Constraints of Dry Season Cropping in Tidal Floodplain of Bangladesh." *Journal of Applied Agricultural Economics and Policy Analysis*, vol. 2, no. 1 (2019): 40-46. doi: 10.12691/jaaepa-2-1-6.

1. Introduction

A region of south central coastal districts of Bangladesh comprising all the six districts of Barishal Division once was the granary of Bengal. The region had surplus rice production in the sixties of the past century. The legacy has gone by with rising population, frequent natural hazards like cyclone and tidal surge, and decrease in productivity. The region could not harness the benefit of the green revolution because of unfavorable tidal floodplain ecosystem. Transplanted aman rice is single most important crop. Land inundation due to tidal flooding overflowing river banks in the wet season makes the land unsuitable for growing high yielding varieties (HYVs) of rice. Farmers are thus compelled to grow indigenous, taller varieties of aman rice which are moderate to highly photoperiod sensitive. Most popular varieties that farmers grow mature in early-December through mid-January. Rivers and canals flowing through the region impact on land drainage. High water level till mid-November coupled with rainfall in October and November causes slow land drainage. Slow land drainage and delay in harvesting transplanted aman rice consequentially delays land preparation and planting of post-rice dry season crops. Much of the agricultural land in the southern districts remain fallow during dry season and hence cropping intensity in the area is lowest in the country. All these contribute to low productivity in the south central coastal region. Brammer [1] provided general features of tidal floodplain in Bangladesh. A comprehensive analysis of the constraints of growing modern rice varieties during wet season when lands remain inundated due to tidal flooding has been presented [2]. In this paper we attempt to identify biophysical and socio-economic constraints of growing crops in dry season after the harvest of preceding transplanted aman rice conducting a baseline survey.

2. Research Methodologies

2.1. Description of Study Area

Among the six districts in the south central coastal region, Jhalokathi and Pirojpur are the two districts affected by wet season tidal flooding most. The selected districts are bounded by two large rivers. The river Bishkhali flows down and meets the Bay of Bengal bisecting Jhalokathi district. Likewise, the river Kocha flows through Pirojpur district. We selected Rajapur and Kawkhali upazila (sub-district) from each of the selected districts, respectively. Bishkhali river is on the east of Rajapur upazila while the river Kocha bisects Kawkhali upazila. Another small river Jangalia originates in the river Bishakhali near Jhalokathi and flows down meeting the Bishkhali near Niamati. For conducting the survey, we selected one larger village North Uttampur located in between the rivers Jangalia and the Bishkhali. It is closer to and on the eastern bank of Jangalia river.

2.2. Conducting the Survey

Baseline survey was conducted using a structured questionnaire (survey instrument). Major focus of the study being collection of information on the problems associated with dry season crop production, the questionnaire covered farmer's socio-economic profile, household assets, crops and cropping, and the problems associated with growing dry season crops farmers encountered. Prior to conducting survey, the questionnaire was pre-tested and subsequently questionnaire improved incorporating the feedback from the pre-testing. The baseline study was conducted in four villages (Table 1) North Uttampur in Rajapur, and Chirapara, Nilti, in Kawkhali. The survey was conducted during April 2019. Prior to conducting the baseline survey meetings were arranged in two villages – North Uttampur (Rajapur) and Chirapara (Kawkhali) inviting farmers. Farmers of Nilti, North Nilti and Subidpur villages joined the meeting in Chirapara village. Those who were present in the village or around enthusiastically joined the meeting. We explained the objective and methodology of the survey. Farmers voluntarily expressed their interest in participating the survey. We also picked some farmers at random. A total of 31 farmers were interviewed; none of them were female. This indicates that in Rajapur (Jhalakati) and Kawkhali (Pirojpur) female farmers are rare or absent.

Table 1. Villages and the number of farmers sampled for baseline study

District	Upazila	Villages	No. of farmers interviewed
Jhalakati	Rajapur	North Uttampur	16
Pirojpur	Kawkhali	Chirapa, Nilti, North Nilti and Subidpur	15

3. Results and Discussions

Household size: Size of the household varied from 2 to 10. Average farm family size was 5.03 (Table 2). The household profile of the sample farmers is in consistent with the country's Agriculture Census Report of 2008 [3]. Earning members (i.e. the number of family members engaged in farming or any other profession) in an average household is 1.45. In other words, livelihood of farm families depends on the earnings of less than 30% of the total family members.

Age of Farmers: Head of farm household was sampled for the interview. Age of the respondent farmers varied between 28 and 69 years with an average of 47 years (Table 2). Young farmers (<40 years) constituted only 19% of total farming population suggesting that most farmers are of middle age to old age. It is conceivable that with expansion of schooling (education) facilities in rural areas youth are finding better employment opportunity outside the farms, and youth are no longer interested in farming. The findings are in consistence with the results of Begum et al. [4]. Average farming experience of the respondents is about 27 years. This was expected since age of majority farmers exceeds 45 years in age.

Farmer's experience in farming:

Age of the respondent farmers varied from 28 to 69 years with an average age of 47 years (Table 2). Young farmers (<40 years) constituted only 19% of total farming population suggesting that most farmers are of middle age to old age. It is conceivable that with expansion of schooling (education) facilities in rural areas youth are finding better employment opportunity outside the farms, and youth are no longer interested in farming. The findings are in consistence with the results of Begum et al. [4]. Average farming experience of the respondents is about 27 years. This was expected since age of majority farmers exceeds 45 years in age.

Farmer's literacy: Over 80% of the respondent farmers are literate and only 19.4% farmers cannot read or write. Of the total respondent farmers, 29% and 13% were S.S.C. and H.S.C. passed, respectively and none of the respondent farmers are graduate (Table 2). Literacy rate in Rajapur and Kawkhali upazila seems higher than average literacy of the country [3].

Table 2. Socio-economic profile of respondent farmers

Number of Male Participant	31
Average age of respondents (years)	46.97
Primary Educated (%)	15
Can sign only (%)	4
SSC passed (%)	5
HSC passed (%)	4
Graduate (%)	0
Not educated (%)	2
Average farming experience (years)	26.71
Number of HH members	5.03
Average earning member	1.45

Farmer's land holdings: Every farmer interviewed owns land; but the size of land holding varies enormously. Land holding per HH ranged between 0.54 acres and 32.00 acres with an average of 3.35 acres (Table 3). All the farmers own homestead areas varying from 0.025 acres to 2.00 acres. However, 35% of the HHs surveyed

do not have agricultural land for crop growing. Farmers having no ownership of land either rent-in for crop growing or cultivate land on share cropping basis.

Farmers' ownership of farm machinery, implements, farm animals: Survey looked at the farmers' assets and income in order to make an assessment of their capability and efficiency in farming. Of 31 farm households, 2 farmers own tractors (one each), 1 farmer owns a thresher, and none of the farmers owns power tiller or reaper. Three STWs, one DTW and one LLP (low lift pump) are in operation on communal basis (Table 4). In Jhalakati and Pirojpur districts farmers still use draft animals and country plows. Survey revealed that for land tillage 5 households own draft animals, plows, 3 HHs are having bullocks and 3 HHs have buffaloes. 23 HHs own *khonta* a traditional implement for earth work. 21 farm families rear cows and it is reasonable to imagine that these cows are also used in tillage operation. For income generation, 15 HHs rear duck, 18 HHs rear chicken.

Table 3. Land holding and tenancy status of farmers

Landholding	Average landholding per household (acres)	3.348
	Average homestead area (acres)	
Tenancy	Land owners (%)	45
	Tenants (%)	55
Land sufficiency	Sufficient for family (%)	19
	Not sufficient for family (%)	77
Ownership of cultivable land	Farmers owning land sufficient for family	65
	Farmers taking land on rent (annual/seasonal)	52
	Farmers giving out land for sharecroppers (%)	3
	Farmers taking land for sharecropping (%)	13

Table 4. Households owning agricultural machinery, implements, farm animals etc

Type of asset	Asset	Households
Farm machinery	Tractor	2
	Shallow Tube-well	3
	Deep tube well	0
	Low lift pump	1
	Thresher	1
Implements	Spade	28
	Plow	5
	Khonta	23
	Any others	9
Farm animals and pets	Draft Animal	5
	Bullocks	3
	Cow	21
	Buffalo	3
	Goat	4
	Sheep	0
	Chicken	18
	Duck	15
	Pigeon	7

Farmer's major occupation and other income sources

Baseline survey also captured the information on the household source of income and livelihood strategy of farming communities. Survey included the farmers only. Interestingly, farming is the major occupation and source of livelihood of 68% of the respondents; while it was the secondary occupation of 19% of the respondents (Table 5). None of the respondents engaged in fishing, wage labor, agriculture labor, or rickshaw pulling as major occupation. Poultry farming is the main income source of 6% farmers while business is the major occupation of 13% respondents.

Table 5. Major occupation of the respondents

	Major occupation (%)	Other sources of income (%)
Farming	68	26
Service	6	6
Business	13	3
Fishing	0	29
Wage labor	0	3
Agriculture wage labor	0	32
Poultry farming	6	33
Rickshaw/van puller	0	10
Others	6	6

Farmers' annual income and source of income: Farmers' annual income varies enormously among the households. In the present survey it varied from Tk. 50,000 to Tk. 532,000 giving an average of Tk.174,387. Table 6 shows the annual income disaggregated into earning sources. The highest contribution to total household income comes from fishery and livestock (Tk. 67,097) pushing crop sector to second position (Tk. 53,694). However, a few farmers adopt livestock and fishery on commercial basis, but relatively much higher income accrued from this sub-sector making the sectoral contributions distorted. Rice is the major crop contributor to crop sub-sector but yield and rice grain price being low, monetary return becomes low often lower than production cost making the contribution of crop sector marginalized.

Table 6. Farmers' annual income disaggregated into earning sources

Farmer's earning sources	Annual income (Tk.)
Crop	53694
Livestock and fishery	67097
Non-farm activities	34323
Other sources	19354
Average HH income	174468

Livelihood strategy of small farmer having inadequate land: Based on land ownership, respondent farmers can be grouped into (i) tenant and (ii) non-tenant (land owner). Fifty-five percent of the respondents are tenant farmers.

Nineteen percent (19%) of the households have sufficient land area to support livelihood but 77% farmers reported that the land they own does not support their livelihood throughout the year. Our observations are in consistent with the results of a nationwide survey of smallholders [5] reporting that 77% of smallholders live in poverty, and 27% farmers live below poverty level (hardcore poor). Households having not enough land to support livelihood resort either to wage earner as labor, or share cropping or cultivate other farmers' or land owners' land on seasonal/annual basis. Table 7 shows that the percentages of such small land holders are 22% in wage earning, 22% as share cropper and 26% cultivating land owner's land either on seasonal or on annual basis.

Table 7. Livelihood strategy of farmers having not enough land

Wage earning labor (%)	22%
Share cropper (%)	22%
Season/annual basis cultivator (%)	26%
Others (%)	61%

Crops and cropping

Survey revealed that in the preceding year (2018) 29% farmers planted dry season crops after harvesting transplanted aman rice. However, area planted to dry season crops was much low. Farmers grow varieties of dry season crops, albeit the area planted to dry season crops is much less compared with wet season crops. Transplanted aman is the major crop in southern coastal districts. 100% farmers grow T. Aman rice during wet season. Table 8 shows seasonal variation in crops with area per household and production. Only 26% of farmers grow transplanted aus rice. However, area planted to transplanted aman rice per household is more than 2.3 times higher than the area under aus rice. Table 8 compares production and yields of aus, aman and boro rice. Aman rice yields about 10% higher than aus rice. Boro rice also yields slightly lower than aman rice. Despite higher production cost associated with boro rice compared with aman rice, getting lower yield of boro might be the reason that most farmers do not grow boro rice during dry season.

Khesari (*Lathyrus sativus*) is commonly grown in the southern districts, although area planted to khesari registered a downtrend during recent years [4]. Khesari yield of 206.37 kg/ha as reported by the farmers is too low to support production cost even. More farmers (55%) planted mungbean (*Vigna radiata* L. Wilczek) in their fields, but an average yield that the farmers reported (439.38 kg/ha) is also much low.

Table 8. Seasonal variation in extent of growing crops growing and yield

Season	Crop(s)	% farmers growing	Area (acres) planted/farmer	Yield (kg/ha)
Wet season	T. Aus	26	0.861	2,588
	T.Aman	100	1.981	2,863
	Vegetables	10	0.283	3,600
Dry season	Boro rice	23	0.646	2,579
	Khesari	39	0.638	206
	Mungbean	55	0.399	439
	Sweet potato	06	0.07	30,348
	Sweet gourd	03	0.01	6,175
	Others	45	0.229	2,405

Sweet potato and sweet gourd were planted by 6% and 3% farmers, respectively. Compared with other crops, productivity of sweet potato (30.348 t/ha) and sweet gourd (6.175 t/ha) was better. But the area planted to these two crops was too small to make direct comparison with mungbean, khesari or boro rice.

Farmer's choice of major crops:

While 100% farmers grow transplanted aman in the wet season with 87% farmers taking aman rice as major crop. 74% farmers grow both wet season and dry season crops. Only 10% farmers take dry season crops as their major crops. Conducting an intensive survey Ibrahim et al. [6] showed that single crop of transplanted aman rice was the most dominant cropping pattern in Barisal region covering 13.4% of net cropped area.

Cropping intensity estimate: Farmer's average agricultural landholding is 3.348 acres of which 1.424 acres remain fallow in dry season but in the wet season the fallow area per household comes down to 0.185 acres. Taking the fallow areas of both the seasons together, it can be shown that the cropping intensity in Rajapur and Kawkhali upazila is 152%.

Problems in growing dry season crops: Farmers' experiences

Khesari (*Lathyrus sativus* L.) and mungbean (*Vigna radiata* L. Wilczek) are the two important crops that farmers prefer growing in dry season. 68% of farmers in Rajapur (Jhalokathi) and Kawkhali (Pirojpur) planted khesari and mungbean in the previous dry season (2018-2019). It is apparent that many of the farmers growing khesari also planted mungbean; but the total area committed to these two crops per household was <1.00 acre suggesting that although majority of farmers grow khesari and mungbean but the area coverage with these two crops was low and thus the cropping intensity in these two districts remains the lowest in the country. Khesari is relay inter-planted with standing transplanted aman rice without land tillage and harvested in late March. But mungbean is planted in February and harvested in May-June. Since growing season of these two dry season crops differs, problems associated with growing these crops also differ.

The survey questionnaire focused on why the farmers are not growing crops during the dry season. Late harvesting of aman rice was pointed as main reason for late planting or not growing of khesari (Table 9). Most farmers (54%) mentioned that excessive rain at or prior to khesari planting time caused delay in planting khesari. Many of the farmers opted not to plant khesari late in the season. Analyzing historical data on rainfall Begum et al. [4] found no unusual rainfall trend in the region during the last few decades. Gafur and Akbar [7] showed that relatively high river water level in November and early December during recent years might have caused slow drainage in early dry season impeding timely planting of khesari.

In the tidal floodplain, HYV aman rice is not planted due to inundation of land. During wet season farmers grow local varieties of aman rice (e.g., Lalmota, Sadamota, Moulata). These indigenous varieties grow tall and can tolerate inundation [8]. These varieties are highly photosensitive and flower in November. The crop matures in mid-December through early January past the optimal planting time of dry season crops (khesari, wheat, lentil, chickpea etc.). In addition to planting of late maturing aman rice varieties, slow land drainage also impedes timely planting of khesari. 35% of respondents suggested that dry season crops are not profitable while 19% respondents said that growing dry season crops in Rajapur and Kawkhali are very labor intensive.

Weed infestation was identified as a major problem in growing dry season crops in the tidal floodplain of Jhalakati and Pirojpur districts. Among the sample farmers 68% relay planted khesari during 2018-19 season (Table 9).

Table 9. Farmers' views of bio-physical and socio-economic constraints of growing dry season crops in Jhalakati and Pirojpur districts

Problems in growing crops in dry season	Farmers (%)
Late harvesting of aman rice	26
Slow land drainage in early dry season	16
Drought	54
Too risky	3
Not profitable	35
Too labor intensive	19
Others	45

Table 10. Farmers applying irrigation in dry season crops

Irrigation applied	35%
Source of irrigation	
Low lift pump	16%
Overflowing river banks/canals	10%
Other conventional methods	10%

Drought is a regular phenomenon during dry season. To overcome drought stress, 36% farmers irrigated crops, mostly boro rice (Table 10). Surface water is available for irrigating crops in the dry season. Deep tube wells (DTW) are not operational perhaps due to aquifer polluted with salinity. Low lift pump (LLP) is used for irrigating crops on communal basis organizing farmers into groups. Irrigation to dry season crops through LLP was applied in 35% farmers' plots. The easiest and no-cost conventional practice of applying irrigation is allowing overbank flow into the fields when river/canal water level rises. 10% farmers applied irrigation overflowing riverbanks. 10% farmers resorted to conventional practice of irrigation.

In growing mungbean in dry season weed has been identified as the most prevalent problem in both Rajapur and Kawkhali upazila (Table 11). Among the mungbean growers 71% had their mungbean plots infested with weeds. Weeding in mungbean is rather widely practiced and 65% of the farmers had weed management deploying family labors (39%) or hired labors (6%). Unlike in light textured sandy or sandy loam soils, weeding in heavy clayey textured soils during dry season in Jhalokathi and Rajapur upazila is more difficult and expensive operation.

Table 11. Extent of weed infestation and weed management in mungbean

Farmers having mungbean plots infested with weed (%)		71
Farmers adopting weeding		65
	Using family labors (%)	39
	Using hired labor	6

Mungbean is often damaged due to soil flooding occurring at flowering or pod filling stage. This is rather a new phenomenon. Rising tidal water early in April inundates agricultural fields along the Kocha and Bishkhali rivers damaging mungbean crop. High river water level in early dry season and advancing of high tides overflowing river banks [8] might be due to climate change related sea level rise.

Labor crisis

Bangladesh agriculture is increasingly facing farm labor shortage. Most farmers (90%) reported that crop production suffers due to shortage of family labors. Shortage of labor has been identified a major constraint to producing dry season crops, particularly mungbean. The farmers we sampled and talked to are all male and female family members usually do not engage in field activities although farmer's female counterpart more than equally participate in post-harvest processing. The total family member in a household being 5.03 and earning members per household 1.45, it is possible that family members assisting post-harvest processing is not counted as an earning member. Table 12 indicates that school going children do not participate in farming operations. It thus almost improbable that an agricultural household having 3.348 acres of land operates depending on family labors and without engaging hired labor. Shortage of farm labors and high wage rate thus can be the major limitation in crop intensification in Jhalokathi and Pirojpur districts.

Table 12. Engagement of women and children in household and farm activities

Activities	Women/children engagement	Households (%)
Household	Children	16
Agricultural activities in field	Children	23
	Women	16

Youth disinterested in farming and aging of existing farmers are the major concern of Bangladesh agriculture. Industrial development in the southern districts, particularly Jhalokathi and Pirojpur, is not even at the rudimentary stage. Job opportunities due to urbanization and industrial development elsewhere in the country opened up opportunities for the rural youth of remote villages in Rajapur and Kawkhali upazila. Country's economic growth also opened up new opportunities even in the villages. Young and educated labor force prefers jobs in expanding communication networks, business centers, construction works rather than joining family farming. The trend is not new, nor is it a problem faced only by developing or least developed countries. What we now have is a better sense as to why it is happening. Turning family farm into business might lure the youth come back to family farming provided greater investment is made to farming. Presumably investment will make the farming profitable presenting descent livelihood and life style of youth the corporate business offers.

Shortage of farm labor gives rise to secondary problems. Rising of farm labor wage in cohort with industrial and service sector raises production cost. Farmers who operate farming engaging family labors as well as hired labors cope up with reducing cropping areas to avoid hiring labor. Growing transplanted aman rice in tidal floodplain ecosystem is neither labor intensive nor input sensitive. Because of low production cost, a transplanted rice yielding > 2.00 t/ha becomes profitable. Since 100% farmers in Rajapur and Kawkhali grow transplanted rice, the only option remaining is reducing the area of dry season crops. Khesari is the most profitable crop requiring minimum inputs. Growing of khesari involves seeds and labor cost for harvesting and post-harvest processing. Invariably no farmer uses fertilizers or pesticides in producing khesari. Reduction in area and production of khesari is not associated with rising production cost. But growing of mungbean requires inputs and labors. Since

pods are harvested in three or more pickings, huge labor cost offsets the income. Farmers thus reported mungbean not being profitable any longer. Vulnerability of mungbean to drought at the early growth stage and land inundation due overbank flowing of river water causing land inundation and eventual crop failure at reproductive and pod-filling stages make the farmers cautious about mungbean production. Moreover, markets are seldom farmer-friendly. While inputs and labor cost is on the rise, demand of and return from mungbean remain static or in the decline.

Worldwide farm labor shortage has been a major problem sustaining agriculture. Mechanization of farm operations could be one of the viable options in mitigating labor problem. Economic conditions of farmers very often impede farm mechanization. Draft animals are still being used extensively in wetland agriculture, for appropriate machinery for farm operations in tidal floodplain during rainy season is either too expensive or unavailable. On the other hand, clayey to silty clay soil in the region becomes too hard to plow during post-monsoon dry season. this might be the reason why farmers in Rajapur and Kawkhali are not using power tillers. Instead, farmers usually use bullock and buffalos for land tillage.

Engaging children (12-22 years) in lighter agricultural operations like weeding, harvesting of mungbean etc. may be thought of. From Table 12 it is apparent that children's engagement in household activities (16% HH) is minimum and children of only 23% farm families engage in agricultural fields. Likewise, women engage in field activities from 16% farm families only. In a separate study ARF researchers showed that mungbean being a 'women friendly' crops women of smallholder families in neighboring Patuakhali and Barguna districts happily engage in mungbean harvesting but those of Bhola district do not engage in activity on farm [4]. Women in Rajapur and Kawkhali upazila might be more conservative that restricted them to engaging in field operations.

4. Conclusion and Policy Implications

Results of the study suggest that the farmers in the survey area are smallholders most of whom live in poverty or below poverty line with low productivity and income. Physical constraints like tidal flooding is the major constraints of growing modern rice varieties or other crops in wet season. On the other hands, physical and socio-economic determinants are either deterrent of crop production in the dry season, or improving yields of dry season crops. Yields of popular crops mungbean and khesari also do not encourage farmer growing these crops, for economic return barely equals production costs.

Given the biophysical constraints in the tidal floodplains of Jhalokathi and Pirojpur districts, the smallholders of whom majority live in poverty strive to increasing income and improving livelihood. Until appropriate rice varieties tolerant to tidal flooding are developed and adopted, farmers continue growing low yielding late maturing local varieties, it is imperative that farmers are given technological support so that they can raise dry season crops. However, yields of major dry season crops (khesari and mungbean) are too low. Mere increasing cropping intensity matters little to farmers unless the dry season crops turn to profitable. Profitability depends on higher yields and greater return. Getting higher yields of dry season crops requires capital investment for intercultural operations (e.g., weeding, pest control, irrigation); but shortage of capital and labor are the major impediments. Growing mungbean is labor intensive production system. Most farmers cannot afford to engaging hired labors. In conservative societies like in Rajapur and Jhalokathi, change in culture will take time. Meanwhile, smallholders may engage school-going children in harvesting mungbean instead of hiring scarce and costly labors. Mungbean price in the local market is exceedingly low. Should there be mungbean processing mills (or dal mill), farmers could benefit selling processed 'dal'. Milling out-turn is about 83% while processed dal costs about 2.5 times higher than mungbean without husking.

Crop production technologies developed and adopted for dry season crops elsewhere in the country may not be appropriate for tidal floodplain ecosystem. Perspective of designing and developing technologies for dry season crops in this region should be different in view of differences in ecosystem and farmers' socio-economic conditions of Jhalakati and Pirojpur districts.

Acknowledgements

This research was funded by BARC NATP-Phase II Project. We thank Dr. Mian Sayeed Hassan for providing technical assistance.

Statement of Competing Interests

Authors declare no competing interests.

References

[1] Brammer, H., Bangladesh's Dynamic Coastal Regions and Sea-Level Rise, *Climate Risk Management*, 1, 51-62, 2014.

[2] Hamid, A., Ullah, M.J., Haque, M.M., Mollah, M.F.H. and Rahman, M.M., Improving Grain Yield of Indigenous Rice in Tidal Floodplain of Southern Bangladesh: Effect of Seedling Age and Transplanting Method. *Agricultural Sciences*, 6, 1538-1546, 2015.

[3] Bangladesh Bureau of Statistics (BBS), *Census of Agriculture 2008. Structure of Agricultural Holdings and Livestock Population*, Volume-1. Ministry of Planning, Government of Bangladesh. 2010.

[4] Begum, T., Hamid, A. and Salahuddin, A.K.M., *Biophysical and Socio-economic Constraints to Expanding Mungbean, Grasspea and Cowpea Production during the Dry Season in South Central Coastal Region of Bangladesh*, A Report Submitted to University of Western Australia. Agrarian Research Foundation, Dhaka. 60 pp. April, 2019.

[5] Consultative Group on Assistance to Poor (CGAP). *Smallholder Household Surveys User Guide to the Data Set for Bangladesh*, Working Paper, December 2016. 152 pp.

[6] Ibrahim, M., Zaman, M.A.U., Mustafizur, A.B.M. and Shahidullah, S.M., Diversity of Crops and Land Use Pattern in Barisal Region. *Bangladesh Rice J*., 21 (2): 57-72, December 2017.

[7] Gafur, A. and Akbar, M.A., *Rising River Water Level Inundating Land and Affecting Grasspea and Mungbean Production: Evaluation of Nature and Extent of Crop Damage*. A report

submitted to the Ministry of Science and Technology, Government of Bangladesh. May 2019. 20 pp.

[8] Ullah, M.J., Aminul Islam, M., Rashid, M. H., M. Rahman, M.M., Siddique, A., Akbar, M. A., Razzaque, M.A., Mollah, M. F. H. and Hamid, A., Evaluation of Indigenous and High Yielding Rice Varieties for Growing in Tidal Floodplain Ecosystem of Southern Bangladesh. *Agric. Forest. Fisheries*, 5: 237-24, 2016.