IMPACT ASSESSMENT REPORT

Bangladesh

Coastal Climate Resilient Infrastructure Project (CCRIP)

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Executive summary

The Coastal Climate Resilient Infrastructure Project (CCRIP) is a $150 million rural infrastructure project which was implemented in 12 districts of Bangladesh since 2013, and is due to be completed by the end of 2019. The project is funded by IFAD, the ADB, KfW of Germany, and the Government of Bangladesh. The project aims to improve the connectivity of farms and households in the face of climatic shocks, focusing on one of the most shock-prone areas of one of the most shock-prone countries in the world. The main component of the project is the construction of improved markets and market connecting roads, that are designed to remain useable during the monsoon season. This is expected to improve sales of on-farm produce, along with access to inputs as well as opportunities for off-farm income generation, leading to increased productivity and income. The project also aims to improve women's empowerment by employing Labour Contracting Societies (LCS), consisting mainly of destitute women, to carry out some of the construction work.

This impact assessment focuses on the activities funded by IFAD, which includes the strengthening of markets and roads at the community and village levels. Using data from an in-depth household questionnaire covering 3,000 treatment and control households, combined with extensive qualitative interviews, we analyse the project's impact on a range of impact indicators relating to income; crop, fish and livestock production and sales; assets, food security and education; financial inclusion; and women's empowerment. We assess impact on the whole sample, as well as for a range of sub-groups, including by geographic location, location within the market catchment area, and by livelihood activity, integrating findings from the qualitative data to help to explain the mechanisms that shaped the project's impact.

Regarding on-farm activities, we find that, despite a lack of impact on productivity, income from selling crops and fish increased significantly (by 104 and 50 per cent, respectively). However, we do not find a similar increase in income from the sale of livestock and livestock products. The lack of impact on productivity was seemingly caused by persisting issues with accessing high-quality inputs during the monsoon season, as well as households having limited capital to purchase these inputs. Despite this, the project increased the amount of produce that was sold, the amount that was sold at a market rather than from home or the farm gate, and increased the likelihood of growing cash crops, leading to the large increase in on-farm income.

As well as improving on-farm income, the project also increased income from wage labour, which together produced a positive impact on total income of 11 per cent, along with a four per cent reduction in poverty. This increased prosperity was also reflected in reduced food insecurity and increased ownership of households assets.

The project was intended to improve women's income generation and standing in the community, mainly through its work with LCS, but we do not find an impact on women's contribution to household income, or on their involvement in household decision making. When we analyse data separately for Muslim and non-Muslim housheolds, we find that the project did improve these

indicators for non-Muslim households, suggesting that there were specific barriers faced by women in Muslim households that the project was unable to overcome.

The additional sub-group analyses provided a number of additional insights. First, we find variation in impact according to project district, which is caused by different impacts on income from crop sales, livestock rearing, and wage employment. For the districts in Dhaka, for example, there was a large positive impact on income of 21 per cent, which was driven by a large impact on livestock income, which wasn't achieved in other areas. We also find that within the catchment areas of each market, the larger impacts on income and poverty were achieved for the poorer, more remote households. Finally, we find that the overall impact of the project was driven by improvements for farming households (i.e. those with crop, fish or livestock production), while non-farming households did not benefit significantly from the project.

Based on the findings of this impact assessment, we draw a number of important lessons for future projects and policies that address the connectivity problem. First, future projects should pay special attention to ensuring households have access to high-quality agricultural inputs, as improved access to output markets does not necessarily improve access to inputs especially for credit constrained households. This would help to increase productivity and thus stimulate larger impacts on income. In addition to improving input access, agricultural productivity and income could also be improved by providing complementary training and agricultural technology support.

Second, future projects should consider different components of beneficiaries' livelihoods and provide activities to stimulate the main sources of income, which may vary for different areas. In some cases for CCRIP, there was a lack of impact on the main income sources for some households (mainly wage labour and household enterprises), leading to a lack of impact on total income. Impact on income could thus be enhanced by offering complementary support for the livelihood activities that are the most important in each local context. In the case of wage labour, this could involve a redesign of the LCS activities to ensure that the valuable employment and training provided does not remain short-term in nature and includes support to establish linkages with local labor market for sustained impacts. In terms of household enterprises, these activities could be improved by facilitating easier entry into local markets for small shops and traders, as well as providing credit and training for setting up and managing these businesses.

Finally, future projects should provide more extensive support to improve the income generating opportunities and overall empowerment of women, especially in countries such as Bangladesh where women face ingrained barriers to their mobililty and autonomy. Based on the success of initiatives such as BRAC's Empowerment and Livelihood for Adolescents program in Bangladesh (as well as Afghanistan, Haiti, Sierra Leone, South Sudan, Tanzania and Uganda) future projects could provide multi-faceted support to improve the hard and soft skills of women, provided within a safe space environment, and involve the wider society to ensure sustainability of impacts.

Introduction

The Coastal Climate Resilient Infrastructure Project (CCRIP) is an inter-agency infrastructure development intervention located in three divisions of southwest Bangladesh. The project implementation started in 2013 and is due to be completed in 2019. It is funded with a combined US$150 million from IFAD, the Asian Development Bank (ADB), KfW of Germany, and the Government of Bangladesh, and is being implemented by a team from the Local Government Engineering Department (LGED). In 2018, a combined data collection exercise was conducted by the project team and a team from the Research and Impact Assessment (RIA) Division of IFAD to be used for both the project's Mid-Term Report and an impact assessment study. This report details the design and the findings of the impact assessment study.

CCRIP aims to improve the connectivity of farms and households in the face of climatic shocks, focusing on one of the most shock-prone areas of one of the most shock-prone countries in the world (Saha, 2014; Kreft, 2017). The project has three broad components: (i) Improved roads; (ii) Improved market access; and (iii) Enhanced climate change adaptation capacity. One common theme across the IFAD-funded components is their involvement of Labour Contracting Societies (LCS), which are groups of mainly destitute women. These groups are contracted to carry out construction work, and some of them are also provided with Women's Market Sections installed in community markets.

Upon completion, the project aims to reach 600,000 households from 32 Upazilas across 12 coastal districts in the country. CCRIP was formed from the merging of IFAD's Sustainable Infrastructure for Livelihoods Enhancement (SMILE) project with the ADB and KfW's Climate Resilient Infrastructure Improvement in Coastal Zone Project (CRIICZP). This impact assessment focuses only on the impact of the activities funded by IFAD, which consisted of the construction of climate resilient community, union and village roads and markets, and the use and support of LCS.

In this impact assessment we test the impact of the project on a set of relevant impact indicators using rigourous impact assessment methods, involving both quantitative and qualitative data and a carefully constructed comparison group. This assessment has a number of benefits. Firstly, the insights from this analysis help further understand how this type of project is expected to impact beneficiaries and the contextual factors and barriers that can shape impact. Such insights can help to improve future projects that seek to improve rural livelihoods in the face of climatic shocks, which are increasing and are threatening rural poverty reduction worldwide (Kirtman et al., 2013; World Bank, 2017a).

The second benefit of this analysis is that it contributes to IFAD's mandate to increase the accountability of development spending. Along with 17 other projects, CCRIP was selected as part of the IFAD10 Impact Assessment Initiative. Following on from the IFAD9 Impact Assessment Initiative, the RIA division will use this set of impact assessments to extrapolate and estimate the impact of IFAD's overall portfolio for its 10th replenishment period (2016-2018) (Garbero, 2016). This initiative provides one of the most robust investigations into the impact of a development institution's portfolio, and thus generates reliable insights into the results of IFAD's work and investments.

The final benefit of this work comes from its collaborative nature. By combining the work of the project team and RIA, this assessment grants the opportunity to connect IFAD's field operations with its impact assessment programme, creating a multi-stakeholder approach that facilitates insights that are of the highest relevance and usefulness. In collecting detailed quantitative and qualitative data that can be used to fulfil multiple reporting requirements, the work also provides an example of conducting rigorous research on project performance in a cost-efficient manner.

The remainder of this report is structured as follows: Section 1 provides an overview of the context in which the project was implemented, outlines the Theory of Change of the project, from which we select our impact indicators, and presents the main research questions; Section 2 provides details of the study methodology, the data, and the impact indicators analysed; Section 3 provides a profile of the households included in the sample; Section 4 contains the results and discussion of the project's impact; and Section 5 concludes with policy and programmatic implications.

1. Project details, theory of change and main research questions

a. Project implementation

CCRIP effectively functions as three separate but conceptually linked sub-projects. IFAD's component focuses on union and village roads and bridges, and on community and village markets; while the ADB component focuses on larger scale Upazila roads, and large markets and growth centers; and KfW focuses on the provision of cyclone shelters and other climate resilience support.

The IFAD interventions are being implemented in 32 Upazilas of 12 districts in southwest coastal Bandladesh. Table 1 presents the CCRIP districts and the spread of project Upazilas across these districts. These were identified from a set of 77 Upazilas that were assessed for inclusion using a scoring system, which resulted mainly in the prioritisation of coastal, flood-prone, low-lying, and infrastructure-poor chars. The scoring system was based on the following criteria:

- Proportion of population below the poverty line
- Low wages for farm labour
- Vulnerability to tidal surges, storms, floods and river erosion
- Remoteness
- Poor communication (per cent of paved road to total road)
- Road density by population
- Per cent of undeveloped markets

Table 1: Distribution of Upazilas across project districts

District	Nr. Upazilas	District	Nr. Upazilas
Bagerhat	2	Khulna	3
Barisal	3	Madaripur	2
Bhola	3	Patuakhali	5
Borguna	4	Pirojpur	2
Gopalgonj	2	Satkhira	3
Jhalkati	1	Shariatpur	2

Within selected Upazilas, IFAD roads and markets are placed in areas that maximise the reach of their benefits to poor people. This involves identifying the least developed unions and villages within each Upazila, especially rural markets from char, low-lying, disaster-prone, and infrastructure poor villages. For the LCS groups, households apply to be members, and are then selected based on their poverty levels and experience in either construction or running a market stall.

For markets to be eligible for CCRIP support, they must meet the following criteria:

- Strategically located and serve as an assembly market to benefit a large number of villages and connect other larger market and growth centers;
- Location not vulnerable to river erosion in the short and medium term;
- Has potential for development in terms of availability of space and placing suitable layouts;
- Support from market stakeholders;
- Agreement to share lease income with Market Management Committee.

Within the markets that meet this criteria, the final beneficiary markets are selected based on their potential for poor women to participate in the construction of the market and as buyers and sellers; the willingness of stakeholders to share part of the development cost to be used for the further expansion of the works; and willingness of stakeholders to reserve sections for temporary sellers, especially women and smallholders.

b. CCRIP Theory of Change

CCRIP is trying to solve a fundamental problem of rural development in southwest Bangladesh: the low connectivity of smallholders' farms and households to markets, roads and urban centers (Rahman and Rahman, 2015). The project has a particular focus on households living in char areas, which are areas of land created by river sediment formed into sandbars along river channels, and are especially remote and vulnerable to extreme weather shocks (Islam et al., 2014).

Low connectivity of households and farms hinders access to education, healthcare, financial and support services, as well as employment oportunities. It also constrains access to input and output markets, technology and productive facilities, and market information and extension services. This lack of access has significant livelihood implications. At the household-level, limited access to these services is widely regarded to negatively affect short and long-term livelihood quality and wellbeing, including household food security and nutrition (Alkire and Santos, 2010,; Sibhatu et al., 2015; Koppmair et al., 2017; Islam et al., 2018). At the farm-level, restricted access to input, technology, extension and financial services can hinder the volume, quality and diversity of production, and integration into value chains (Fan et al., 2012; Rehima et al., 2013; Bokelmann and Adamseged, 2016). Combined with poor access to vibrant markets and market information, plus high transport costs, this can have a negative effect on the prices and profits that farmers receive for their goods (FAO, 2003).

Both regular and unexpected climatic stresses exacerbate the connectivity issues in already remote areas of southwest Bangladesh, especially in the char areas (Huq et al., 2015). During the annual rainy season, many connecting roads become submerged and unusable, severely restricting transport. In terms of unexpected shocks, the country experiences a tropical cyclone every three years, and a severe flood every four-to-five years, with the southwest coastal region often bearing the brunt of the damage (Nishat et al., 2013; Saha, 2014). For instance, two of the most recent major disasters in the country damaged mainly the southwest region: Cyclone Sidr in 2007 caused 3,400 deaths and damaged

8,000km of roads; and Cyclone Aila in 2009 caused 180 deaths and damaged 7,000km of roads (Relief Web, 2008; Relief Web, 2009).

CCRIP addresses the connectivity issue in the region by building and upgrading climate resilient roads and markets. Roads are built to connect districts, villages and unions to each other and to markets. These roads are made from materials that can withstand frequent submersion by salty or brackish water. Roads are also raised and have higher and wider shoulders, with culverts and water gates installed to manage flood water. Where suitable, vetiver grass is also used to line road slopes to prevent erosion.

Households' market access is hindered by both a lack of transport infrastructure and a lack of physical markets themselves. Cyclone Sidr alone is estimated to have caused damage and losses to the country's agriculture sector of US$437 million, partly through damages to physical markets (Relief Web, 2008). In order to complement the road work, CCRIP also establishes new markets and upgrades existing ones. These markets range from "special" markets with over 200 permanent shops serving over ten villages implemented by the ADB, to medium markets with around 100 permanent shops serving up to ten villages, and smaller village markets with 10-50 shops serving up to four villages implemented by IFAD. In terms of upgrades, CCRIP adds multi-purpose sheds, fish sheds, boat landing platforms, open paved/raised areas, women's sections, toilet blocks, internal roads, and improved drainage, depending on need.

The project also recognises that improving the management of markets in Bangladesh is key to market sustainability (Ahmed, 2010). Market Management Committees (MMCs) are groups made up of market users and local government, with a proportion of the committee having to be made up of women, who are tasked with administration, maintenance and security of markets, but are often not functional. As part of the market access component, CCRIP helps to organise these groups and provides them with capacity building support. It also works with the local government to enforce the legal stipulation that 25 per cent of the market lease income should go to the MMCs for maintenance costs.

CCRIP is designed to improve the livelihoods of vulnerable women across the IFAD-funded components, using LCSs as its primary tool. These groups consist of around 25 mainly destitute women, who are trained and contracted to carry out road and market construction. In selected markets, Women's Market Sections are also established. These areas are reserved for LCS members and provide a permanent shop with favourable rent agreements in a safe environment. The project also provides training to these groups to support other income generating activities. By offering these opportunities, the project seeks to address the low social and economic status and the skills gap of women in Bangladesh that restrict their livelihood activities (Roy et al., 2008).

Figure 1 presents the Theory of Change (ToC) for CCRIP, which maps the impact pathways expected to link the activities of the project through outputs and outcomes to final intended impacts. The ToC helps to identify the key indicators of success at each stage in order to track the expected impact pathways of the project (White, 2009). In order for project activities to achieve their intended impacts, there are a number of contextual factors that are required, which are outlined as part of the ToC. Outlining these assumed conditions is an important part of the ToC that helps to identify additional

factors that need to be investigated in order to generate a thorough understanding of the project's impact "story."

Figure 1: CCRIP Theory of Change

CCRIP is designed to increase household income through a number of intermediate outcomes. First is increased market participation. With improved roads and accessible, better-managed markets, farmers are expected to face lower costs associated with bringing their goods to market and thus to sell more. Selling a higher proportion of their crops should lead to higher incomes, and over time an increase in household and productive assets. The volume of sales as well as household food security are expected to also be boosted by higher productivity. With better farm connectivity, and more sellers at markets, farmers are expected to have better access to productivity-increasing inputs, technology, and extension services. They may also be able to invest more in their production if improved connectivity leads to improved access to credit providers.

Another expected intermediate outcome is higher prices. Better market access means more buyers at markets, more demand, more options, which are likely to drive up prices. Although the upward effect on prices of increased demand could be cancelled out by a downward effect of increased supply. Before the project, farmers were often forced into taking lower prices by selling to traders directly after harvest at the farm gate. With more favourable marketing options and improved access to inputs to improve crop quality, better market information from CCRIP's radio service, and better connection to post-harvest processing and storage facilities, this situation is expected to change (Barrett, 2008; Svensson and Drott, 2010).

In addition to selling more and receiving higher prices, production and marketing expenditures are expected to decrease, boosting profit margins and adding to the expected income effect. Along with reduced transport costs, this is expected to occur as improved market access leads to improved input access, which has the potential to increase the quality and profitability of farmers' crops (Gulati et al., 2005; Khandker et al., 2009).

The project's work to build climate resilience is expected to ensure the intended outcomes outlined above are not disrupted by climatic stresses and shocks, and to increase the overall stability and sustainability of household livelihoods (Meybeck et al., 2012). By making roads and markets more resistant to cyclones and floods, the vulnerability of livelihoods that are dependent on this infrastructure is expected to decrease, meaning shocks have lower impacts, and households need less time and resources to recover after them (Vallejo and Mullan, 2017). The cyclone protection and disaster preparedness training of KfW and the support to MMCs to increase their capacity to repair markets after a shock are also expected to contribute to improved climate resilience.

The above effects are targeted at all beneficiaries, whilst the LCS work is designed to produce income and wellbeing benefits specifically for vulnerable women and women-headed households. In addition to increased income generating capacity and increased economic opportunities from LCS participation, LCS members' increased economic independence is expected to lead to the resource and power allocation shifts needed for increased empowerment and wellbeing (Sheoran, 2016). Whether the LCS member is the household head or not, members' households are also expected to benefit as LCS members contribute more to household income and its diversification. Diversification potentially further boosts the resilience of household livelihoods to shocks (Ellis, 1999; Arslan et al. 2018a).

At the bottom of Figure 1, we identify a number of key assumptions that are required to hold in order for the above impacts to be fully achieved. If these assumptions do not hold, project's impact could be constrained. For outputs to be achieved, it is assumed that the project will actually be able to identify and acquire suitable land for roads, markets and shelters, and that these will be effectively placed, so that they are used by intended beneficiaries. In terms of translating outputs into outcomes and impacts, the project is designed under the assumption that households face no other significant barriers to their production or market access such as a lack of capital. Finally, for the LCS activities, it is assumed that women face no other barriers to their participation, and that women have demand for this support. Once they have joined, it is also assumed that they face no other economic or social barriers to their empowerment that the project does not address. The last assumption is a strong one in a country like Bangladesh, where social norms constrain women in multiple ways, and the implications of this are discussed further in the results and lessons learned sections below.

c. Research questions

This impact assessment focuses on the impact of IFAD's activities delivered through CCRIP as noted above. The ToC diagram considers all of CCRIP's components in recognition of the expected overlaps with the ADB and KfW work. Based on the expected impact pathways of IFAD's activities and the potential complementarities with the activities of other agencies, this impact assessment answers the following questions:

1. Did the community roads and markets delivered through CCRIP improve the household and farm connectivity of beneficiaries? What were the subsequent effects on agricultural productivity, market participation, and household income?

2. Did the IFAD activities delivered through CCRIP improve the climate resilience of beneficiary livelihoods? What were the subsequent effects on household income levels and stability?

3. What were the impacts on women's livelihoods from the LCS-related activities? Were there barriers to their participation in these groups? How effective were the different LCS activities (labour contracting, income generation training,Women's Market Sections)?

4. What are the contextual factors that may have shaped the impacts of the project on beneficiary households and women? What other lessons can be learned from the project that can be incorporated into future rural development, climate resilience, and rural women's empowerment work in Bangladesh?

2. Impact assessment design: Data and methodology

For this impact assessment a combination of quantitative and qualitative data was collected in order to produce a holistic picture of the project's impact. The main data source is a quantitative household survey of beneficiary and control households. This section presents the sample design of the household survey and of the qualitative data collection, along with the statistical methodology employed for impact analysis, followed by an overview of the key impact indicators used in the analysis.

a. Overall approach

The CCRIP impact assessment is a collaborative effort between the project team and RIA. In order for the quantitative household survey to be usable for both this impact assessmet and the project's Mid-Term Report, we specifically sample beneficiary households who were reached during the early stages of the project's implementation. In this way, data from these households can be used to measure the project's performance against the mid-term indicators according to the log-frame in the Project Design Report. At the same time these households have been exposed to the project's activities for a sufficient amount of time, the data can also be used to measure the project's overall impact.

The household survey covered both beneficiary and non-beneficiary households. The key to an effective impact assessment is to compare a set of beneficiaries (the treatment group) with a set of non-beneficiaries (the control group), who accurately represent how the set of beneficiaries would have fared in the absence of the project. In this way, we are able to isolate the effect caused by the project from other effects that occurred over time. The treatment population of interest for the CCRIP impact assessment is all smallholder households within the catchment areas of CCRIP roads and markets. The challenge of this assessment is therefore to identify a representative sample of this population for the treatment group, and to identify a suitable comparable group of control households.

To produce the final impact estimates, we conduct an econometric analysis of the household data, comparing treatment and control households in a model that estimates the size of the effect on each impact indicator, along with a measure of the effect's statistical significance. Statistical significance represents the reliability of the result, giving the percentage probability that the result is a reflection of reality and not due to chance (Gallo, 2016). In order to generate contextual insights, we conduct our analysis on a range of sub-samples, in addition to the full sample. Table 2 presents the different sub-samples that we test and the reason for assessing them.

Table 2: Overview of sub-sample tests

Sub-sample	Hypotheses Tested
Households within 1km of market	Did the impact differ based on market proximity?
Households within 2km of market but not 1km of connecting road vs. Households within 2km of market and 1km of connecting road	Did being close the connecting road as well as the market provide a larger impact?
District	Did district-specific local factors influence impact?
Households involved in farming activities (crop or fish production or livestock rearing) vs. Households not involved in farming activities.	Did project benefits on farm households also spread to households primarily involved in wage labour, household enterprises and other off-farm activities?

The type of impact assessment conducted in this report is termed "ex-post" as we use one round of data collection without a baseline. Ideally the control group would be constructed at baseline, but without this benefit we employ statistical matching techniques and expert consultations to improve the accuracy of the treatment and control group comparison. This method has been shown to be almost as effective as baseline control group construction in some cases (Dehejia and Wahba, 1999). These matching techniques consist of a variety of matching algorithms to ensure that only similar households are compared across the treatment and control groups, and is the primary method used for ensuring accurate impact estimates in the absence of suitable baseline data (Austin, 2011).

b. Data

i. Sample distribution

The sample for the household survey is drawn from eight of the 12 project districts. Given the size of the area, to collect data from all 12 districts would have been unfeasible and inefficient, thus we selected eight districts covering the three project divisions (Barisal, Khulna, and Dhaka) according to those with the largest CCRIP presence and those with the largest number of potential treatment and control markets. In discussion with the project team, it was decided that the total sample size of the household survey would be 3,000: a sample size deemed to provide sufficient power to detect impact, and to cover a large enough area so that the estimation of impact is reliable and representative.

In terms of the distribution of the sample, the sample frame was designed to achieve representativeness at the divisional level using data on CCRIP investment by division as a proxy for the number of beneficiaries in each division. Within each division, the sample is evenly distributed across the eight districts. Table 3 presents the distribution of the sample across divisions and districts, based on a sample size of 3,000, with 45 per cent allocated to treatment and 55 per cent to control.

Table 3: Sample distribution across project divisions and districts

Division	Sample allocation (%)	Nr. treatment households	Nr. control households	Nr households per district
Barisal	61	824	1,006	Treatment = 206; Control = 252
Khulna	16	216	264	Treatment = 108; Control = 132
Dhaka	23	311	380	Treatment = 156; Control = 190

The quantitative household data are complemented with qualitative data to contextualise findings based on input from key informants and focus group participants. The qualitative data therefore focuses upon the underlying impact mechanisms and the barriers to impact that may have been faced. The collection of qualitative data was conducted simulatenously with the household survey and consisted of the following:

- Treatment markets: 5 x Key Informant Interviews (KII) with MMC members; 5 x Focus Group Discussions (FGD) with road construction LCS members; 5 x FGD with market construction LCS members.
- Control markets: 3 x KII with MMC members or Market Manager; 2 x KII with Union Parishad Womens' Representative.
- Project staff: 3 x KII with senior project staff; 3 x KII with regional staff (one for each project division).

ii. Identification of treatment and control groups

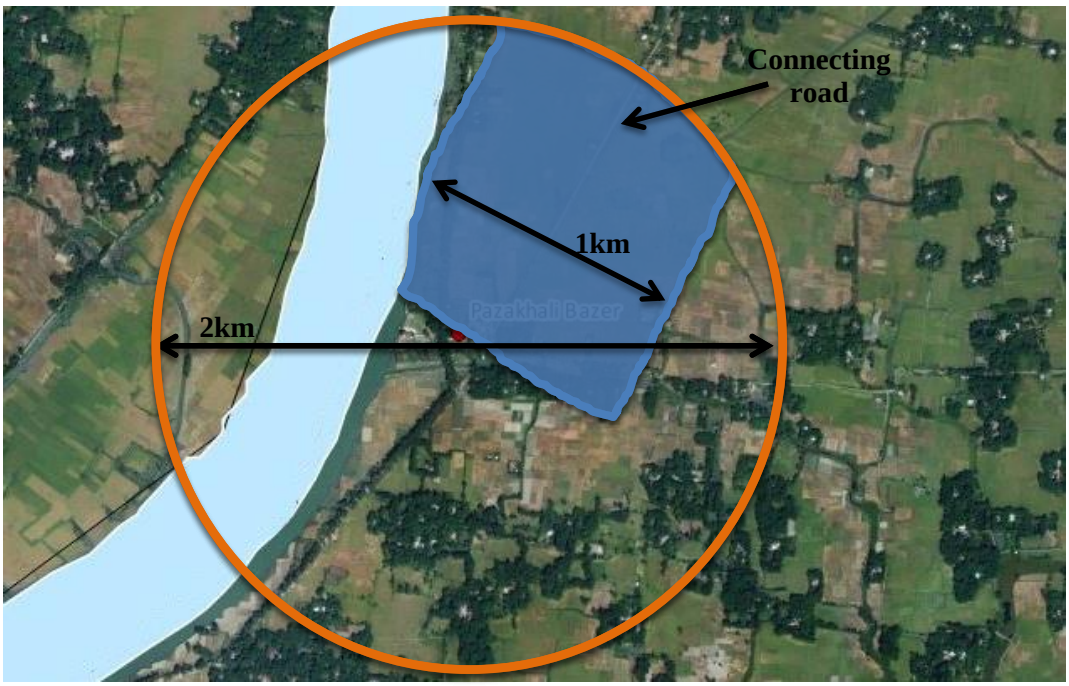
For both the treatment and control groups, we first identified suitable treatment and control markets, with the intention of sampling households from villages within the catchment areas of these markets. In order to capture the impact of being close to a CCRIP market, and the incremental impact of being also close to a CCRIP connecting road, two catchment areas were defined for each market. To capture the impact of being close to a CCRIP market without a CCRIP road, we sampled households who are located within 2km of a CCRIP market (or control market) but not within 1km of a CCRIP connecting road (or a un-improved connecting road in the case of control markets). To capture the impact of being close to both a CCRIP market and a CCRIP connecting road, we sampled households who are located within 2km of a CCRIP market and within 1km of a CCRIP connecting road.

The radius size used for these catchment areas was decided with assistance from the project team. They explained that these were distances within which households would travel to the market or road, meaning these were the areas of expected impact. The 2km radius for the markets was also

used for a baseline study conducted of CCRIP. A small number of the control markets did not have a main connecting road, in which case we sampled all households for the first catchment group.

Figure 2 maps the two catchment areas for one of the markets included in the sample (Pazakhali Bazar). The orange circle represents the 2km radius around the market. The blue zone represents the catchment area for household located withing 2km of the market and within 1km of the connecting road. The other catchment area-for households located within 2km of the market but not 1km of the road-consists of all other areas within the orange circle but not within the blue zone.

Figure 2: Diagram of the two sample catchment areas



Source: Authors' elaboration with technical support from IFAD-ICT Solutions Team.

The treatment markets for the sample were selected from CCRIP markets where market construction work was completed before July 2015. The period 2013-2015 was considered as Phase 1 of CCRIP's implementation, and taking households from the earliest phase means they will have been exposed to CCRIP's work for a sufficient amount of time for impact to develop. Using households linked to markets where work was completed later risks underestimating project impact by not allowing enough time to pass before collecting the impact assessment data.

The control markets for the sample were selected from markets on CCRIP's back-up list, along with additional markets identified by local project staff within the eight project districts covered by the sample. The back-up list contains 19 markets located in the 8 project districts that were identified for inclusion in the project according to the project's market selection criteria outlined in Section 1a, however due to financial reasons these markets were eventually not covered. This means that households linked to these markets should be suitably comparable to treatment households, and also facilitates the availability of sufficient information and connections to identify a suitable sample. Due to the limited number of markets on this list, a further 32 additional control markets were

identified based on expert consultations with the local project staff, who were instructed to identify markets that would also have been eligible for inclusion in the project at the baseline stage.

Using the above strategies, we identified a total of 46 potential treatment markets for the sample, and 51 potential control markets. In order to identify the most suitable control markets we conducted a scoring exercise, whereby we asked local project staff to assign scores for each market for a set of criteria that represented the selection criteria for CCRIP markets[1]. In this way we were able to build a better picture of which markets would provide the most accurate counterfactual to treatment markets. Through this process we eliminated 32 of the potential control markets which were deemed as unsuitable for inclusion. This left us with 19 potential control markets.

In order to identify the final set of markets that were the most well-matched, we used GIS mapping to obtain the population densities of the 2km catchment areas around each of the shortlisted treatment and control markets. This allowed us, first, to identify whether any of the markets had overlapping catchment areas, and to thus eliminate treatment and control markets that were overlapping. Secondly, it provided an additional characteristic upon which to match treatment and control markets—a characteristic that is linked to market size and the income level and environmental quality of the surrounding area (Cropper and Griffiths, 1994). We therefore selected the final set of treatment and control markets by producing matched pairs according to population density and also, when possible, from within the same upazila to avoid the between upazila socio-ecological hetorogeneity.

For each treatment and control market selected for the sample, the distribution of the sample across the two catchment groups is equal in order to obtain a sufficient sample size to measure impact on both of the catchment groups. From within the catchment areas of each market, households were selected randomly. As we did not have lists of all households within each area from which to conduct a purely random selection, we devised a three-stage process. Firstly, for each market, with the assistance of the local leaders (primarily the Union Parishad Chairman), we compiled lists of all of the villages located in each of the catchment areas, along with an estimate of the number of households in each village. Our target was to collect data from a minimum of 15 households per village, meaning the second stage involved randomly selecting the villages to be included in the sample in order to meet this target. In cases where there was an insufficient number of villages in the catchment area to meet the target, we included all villages located in the catchment area and increased the sample size per village. For the final stage, within each village, households were then randomly selected through the random walk method, using a sampling interval based on the estimated village population size.[2]

[1] To reflect the CCRIP market eligibility criteria, scores were assigned for the following: (i) Based in char, low-lying, remote, disaster-prone and infrastructure poor area (Yes/Somewhat/No) ; (ii) Connecting roads to market are dirt roads that are not flood resistant (Yes/Somewhat/No); (iii) Market has a multi-purpose shed (Yes/No); (iv) Market has a fish shed (Yes/No); (v) Market has a boat landing platform (Yes/No); (vi) Market has an open paved/raised area (Yes/No); (vii) Market has a women's section (Yes/No); (viii) Market has an internal road (Yes/No); (ix) Market has improved drainage (Yes/No).

[2] For this method we first selected a landmark within the village (such as a school or communal area) and assigned four teams to walk north, south, east and west of the landmark. The teams were assigned to sample households in their direction according to a pre-assigned interval. This interval was calculated based on the total population of the village and the required sample size for the village. We divided the total population by four (based on the four directions), and

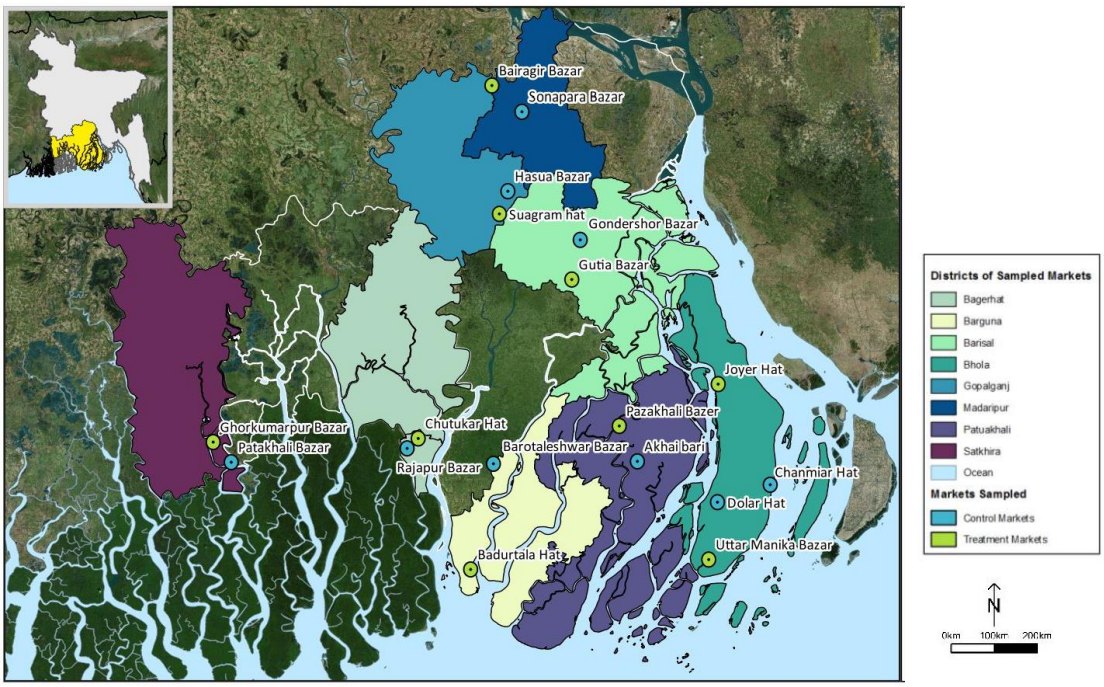
Based on this strategy, the final set of treatment and control markets, and their associated sample sizes are presented in Table 4 below, and Figure 3 contains a map of the sampled area where the sampled markets and their catchment areas are plotted.

Table 4: Distribution of final sample

Market name	Division	District	Upazila	Treatment group	Sample size
Joyer Hat	Barisal	Bhola	Burhanuddin	Treatment	103
Chanmiar Hat				Control	126
Uttar Manika Bazar			Charfession	Treatment	103
Dolar Hat				Control	126
Pazakhali Bazer		Patuakhali	Sadar	Treatment	206
Akhai Bari				Control	252
Gutia Bazar		Barisal	Uzirpur	Treatment	206
Gondershor bazar				Control	252
Badurtala Hat		Barguna	Pathorghata	Treatment	206
Barotaleshwar Bazar			Bamna	Control	252
Chutukar Hat	Khulna	Bagerhat	Sharankhola	Treatment	108
Rajapur Bazar				Control	132
Ghorkumarpur Bazar		Satkhira	Shyamnagar	Treatment	108
Patakhali Bazar				Control	132
Suagram hat	Dhaka	Gopalgonj	Kotalipara	Treatment	156
Hasua Bazar				Control	190
Bairagir Bazar		Madaripur	Rajoir	Treatment	156
Sonapara Bazar				Control	190
Total					**3,004**

the required sample size by four (based on the four directions and four teams), and then calculated the interval by dividing the share of the total population by the share of the sample size. For a village with 100 households and a required sample size of 16, the calculation would be as follows: (100/4)/(16/4) = 25/4 = 6.25. Meaning the sampling interval would be every 6 households in a given direction.

Figure 3: Map of treatment and control markets



Source: Authors' elaboration with technical support from IFAD-ICT Solutions Team. Each market is represented by its centroid on the map and the circles around the centroid represent the cathment area within 2km of each market.

Table 5 presents an overview of key descriptive statistics of the treatment and control groups, giving an idea of the effectiveness of our sampling strategy in constructing comparable treatment and control groups. Although in most cases the statistics are reasonably similar across the two groups, there remains important statistically significant differences in household composition and religion, and the average distance of the household to the sample market. This highlights the challenge of creating accurate comparison groups ex-post, and underlines the need to use additional statistical techniques as in this impact estimation analysis to minimise these remaining differences.

Table 5: Comparison of treatment and control samples

	Treatment (1,188 households)	Control (1,552 households)	Difference
Household size	4.57	4.53	0.04
Dependency ratio (%)	61.66	69.27	-7.61***
Age of h'hold head	49.82	48.31	1.51***
Average household age	31.56	30.51	1.05**
Religion (%):			
– Muslim	83.75	94.85	-11.10***
– Hindu	14.81	5.15	9.66***
– Christian	1.43	0	1.43***
Gender of household head (%):			
– Male	90.15	86.21	3.94***
– Female	9.85	13.79	
H'hold head is literate (%)	76.09	73.32	2.77*
Nr. literate h'hold members	2.02	1.92	0.10**
Nr. climatic shocks in the past year	0.15	0.16	-0.01
Distance to sample market (km)	1.21	1.09	0.12***

Note: *,** and *** indicate that results of a t-test for the difference between the treatment and control groups, representing whether the difference is 90, 95 and 99% significant, respectively.

c. Questionnaire and impact indicators

The household questionnaire collected a wide range of information to create the impact indicators and other variables used in the data analysis. The questionnaire was designed to collect detailed information on agricultural production (separated by crop and by the three main cropping seasons), fish production (separated by pond), livestock rearing, income from other sources, asset ownership, food consumption, financial inclusion, shock exposure, social capital, access to services, and household decision making. The questionnaire was conducted between late August and early November 2018 and collected information covering the 12 month period between August 2017 and July 2018.

In addition to the qualitative and quantitative data, the project team have also conducted the following additional surveys: (i) Survey of LCS members; (ii) Child anthropometric measurement; and (iii) Surveys of road and market performance, some of which are used to inform this study.

Based on the ToC for CCRIP presented in Figure 1, we use the statistical analysis outlined in the proceeding section to test the project's impact on a wide set of indicators. The agricultural indicators and those relating to fish production are all aggregated across plots and ponds to the household level.

All of the indicators used, along with how they are constructed and the impact areas they are linked to are presented in Table 6.[3]

[3] Appendix I contains the mean values for the treatment and control groups for all of these impact indicators.

Table 6: List of impact indicators

Indicator	Description	Impact area
Agricultural and fish production and sale		
Gross value of agricultural/fish production	Converts harvest of all crops/fish into a monetary unit. Equal to the income from crop/fish sales, plus the value of non-sale uses, valued using the median price for the sample for each crop/fish when sold (Carletto et al., 2007).	Volume of production; effectiveness/efficiency of farming/fishing practices.
Gross margins/ha	Equal to the gross value of production minus the value of all inputs. Inputs that were not purchased were valued using the median price for the sample for each input.	Effectiveness/efficiency of farming practices.
Proportion of harvest sold	Gross value of the crops sold as a percentage of the total gross value of crop production.	Market participation and access
Sold at a market	Household sold at least a portion of its crop/fish harvest at a market, rather than from home or farm gate	Market participation and access
Total revenue from crop/fish sales	Cash income received from sale of all crops/fish.	Market participation and access; income.
Nr crop varieites	Count of the different crops grown.	Input access, farming practices, shock resilience.
Grew high value crops	Household cultivated at least one high value seasonal or perennial crop	Input access, farming practices
Land cultivated	Number of hectares of land cultivated.	Input access, wealth
Value of inputs (BDT/ha.)	Calculated for agriculture and fishing. Total monetary value of all inputs used. Inputs that were not purchased were valued using the median price for the sample for each input.	Input access; investment in agriculture; effectiveness/efficiency of farming/fishing practices.
Productivity of inputs (BDT)	The gross value of production per one Taka of input used.	Input access; effectiveness/efficiency of farming practices.
Value of fish consumption (BDT/capita)	The gross value of fish that was produced and used for home consumption	Market access and participation; nutrition

Table 6: List of impact indicators (cont'd)

Indicator	Description	Impact area
Livestock ownership and production		
Gross value of livestock production	Calculated in the same was as for crops and fish. Median price used to value livestock and livestock products that were consumed at home or given away as gifts.	Livelihood practices, effectiveness/efficiency of livestock prod.
Net value of livestock production	Calculated in the same way as for crops and fish	Livelihood practices, effectiveness/efficiency of livestock prod.
Income from livestock activities	Cash income from sale of whole livestock and livestock products, including cuts of meat, milk, eggs and manure.	Effectiveness/efficiency of livestock prod., income.
Milk productivity (ltr/cow)	Amount of milk produced per adult cow	Input access; Effectiveness/efficiency of livestock prod.
Livelihood composition and poverty		
Gross household income per capita (BDT)	Total cash income from all sources per household member	Income, poverty.
Net income per capita (BDT)	Equal to gross household income minus all economic expenditures	Income, investment, livelihood effectiveness.
Above poverty line	Household income is above the $1.90 per person per day poverty line set by the World Bank (Ferreira et al., 2015)	Poverty
Number of income sources	Count of the number of different sources of income in the household	Livelihood practises; livelihood resilience.
Income compositon	Percentage of household income comprised from crop sales, livestock, formal and casual wage labour, household enterprise, remittances, land rental and other (interest, pension, etc.)	Livelihood practises, income
Sector participation	A yes/no indicator for household being involved in the following sectors to earn income: agriculture, fishing, livestock, waged labour, and household enterprise	Livelihood practises

Table 6: List of impact indicators (cont'd)

Indicator	Description	Impact area
Assets, food security and education		
Asset indices	Composite indices constructed using Principle Component Analysis, calculated separately for Productive assets and household assets (Filmer and Pritchett, 2001)	Wealth, shock resilience.
Tropical Livestock Units	Count of livestock owned, with different livestock converted into common unit (Jahnke, 1982).	Wealth, shock resilience.
Food insecurity experience	Standard indicators of food insecurity also adopted by SDGs (2.1.2), responses to eight questions tallied into one Food Insecurity Experience Score (FIES) (Ballard et al., 2013).	Wealth, food security
Dietary Diversity Score	Score based on the consumption of different food groups in the past seven days (Kennedy et al., 2011).	Nutrition
Childrens' school enrolment	Proportion of school-age children currently enrolled in school	Education
Financial inclusion		
Have formal bank account or other account	Yes/no indicators for whether the household has a formal bank account (held with a registered bank), and whether they have another type of account, such as those held with a microfinance institution, a non-bank financial institution, or a mobile money account (Anderson et al., 2016)	Wealth, market access
Received loan	Yes/no indicator of whether household has received at least one loan in the past year	Market access
Cash savings	Total cash savings per capita, totalled across all savings locations.	Market access, shock resilience, income
Women's empowerment		
Womens' autonomous income generation	Proportion of household income from the wage labour of female household memebrs or from household enterprises owned or managed by female household members.	Women's empowerment
Womens' decisionmaking involvment	Female household members are involved (either individually or jointly) in decisions regarding: household purchases, children's education, farm and livestock production and sale.	Women's empowerment

d. Impact estimation

The main aim when estimating impact is to ensure that there is minimal difference between the treatment and control group that are being compared. As well as our efforts to ensure that the two groups are comparable during the sampling stage, as outlined above, we also employ statistical techniques to further improve comparability during the data analysis stage. There are a number of different statistical techniques that can be used to improve comparability and we use two separate analytical models to test CCRIP's impact. Given the variety of approaches to ensuring comparability, it is best-practice to employ one primary approach and one secondary approach that serves as a means of testing the robustness of the results from the primary model. If the results are qualitatively similar across the two approaches, then we can be assured that the results are valid and are not model-specific.

Before running our impact estimation models, data quality checks were performed and 142 treatment and 90 control households were removed from the final sample, either because the household was incorrectly sampled from outside the 2km sampling zone around the focal market, or because their data on key impact indicators (crop or fish harvest and income) were identified as outliers. In cases where households had outlier data for minor variables, these values were replaced with imputed values based on the distribution of the rest of the data.

Using the remaining sample, we then conducted an initial round of trimming using Propensity Scores, whereby households that were clearly very different from the rest of the sample were identified and dropped as they were unlikely to have comparable households in the opposite group (Caliendo and Kopeinig, 2008). The propensity scores represent the likelihood of a household being selected for project inclusion based on a set of relevant pre-project variables (or variables that are unlikely to have been affected by the project), and are commonly used in impact assessment to identify treatment and control units that would have been similar before project implementation, in the absence of baseline data.[4] Similar scores between a pair of treatment and control households suggests that the two households were in a similar situation before the project began, meaning that the control household can provide an accurate picture of how the treatment household would have fared in the absence of the CCRIP.

Once we created these scores, we identified and dropped all households that had a Propensity Score outside the area of common support, meaning that we dropped households with a score that was above the highest score from the opposite group, and all those with a score below the lowest score in the opposite group. For treatment households, the lowest score was 0.18 and the highest score was 0.88, and for control households, the lowest score was 0.17 and the highest score was 0.87. Based on this we dropped ten treatment households and three control households.

In addition, we also dropped all treatment and control households that did not have at least one household in the opposite group whose score was within 0.01 of their own score. From this, we

[4] Specifically, the Propensity Scores in this case were created by running a logistic regression model where the dependent variable is the binary treatment status (treatment or control) and the independent variables are variables linked to CCRIP selection and/or livelihood capacity from 2014 (i.e. before the project was implemented), and then deriving the scores (representing the probability of treatment) using the coefficients for each of the independent variables in the model, which represent their effect on the likelihood of being treated (Caliendo and Kopeinig, 2008).

dropped an additional 13 treatment and 17 control households (see Appendix II for the distribution of the propensity scores before and after these households were removed).

With the trimmed datset that consists of 1,192 treatment and 1,546 control households, we then run our analytical models. The primary model we employ is a nearest neighbour matching (NN) model (Khandker et al., 2010; Austin, 2011). This is similar to the approach used in the trimming process, in that it creates Propensity Scores using the same set of matching variables, and identifies all matched pairs within a set radius, although we narrow the radius in the model to 0.001 to increase precision.[5]

The radius we have set for this model is relatively small, meaning that only the most well-matched households are paired in the model. It is not always possible to set such a small radius size, however because our treatment and control groups were already similar due to the efforts taken in the sampling stage (as shown in Table 5), we were able to set this small radius with the confidence that there are sufficient matches within the radius, and that we would not have to drop households that did not have any matches within the radius.

One of the main benefits of the NN model is that it allows us to ensure that households are matched exactly on variables of particular importance. As noted, we split the sample into two catchment areas for each market: those 2km from the market but not from the connecting road, and those 2km from the market and 1km from the connecting road. In order to ensure that we are not comparing households located in different catchment areas, we implemented exact matching within each catchment area as part of the NN model. Using GIS data, we also investigated implementing exact matching on the distance of the household from the market (e.g above or below the median distance), but we found that the level of comparability was best achieved when this distance was included in the set of matching variables used to create the Propensity Scores, rather than using a categorised version of this variable in exact matching.

Once the matched pairs are created using the NN model, impact is then estimated by taking the average of the difference between the matched pairs. For example, if we compare the income per capita of the treatment household with that of the control household within all of the matched pairs, the impact estimation, termed as the Average Treatment Effect (ATE), is the average of the differences in income across the pairs. The ATE is defined as:

$$\text{Average Treatment Effect} = E(y_{1i} - y_{0i}) \quad (1)$$

Where y_{1i} represents the outcome for treatment household *i*, and y_{0i} represents the outcome for control household *i*, and the E is the expectations operator

The secondary model we employ is an Inverse Probability Weighted Regression Adjustment (IPWRA) model (Wooldrige, 2010; Austin and Stuart, 2015). In this model, impact is estimated using a weighting rather than a matching approach. The model first assigns a weight to each household in the analysis that represents the inverse of the probability of their receiving the

[5] A number of different radius sizes for this model were tested, and this radius produced the strongest set of comparable matches whilst minimising the need to drop households who do not have a match (which is the downside to using smaller radius sizes).

treatment that they actually received (beneficiary or control), with the probability calculated based on the same set of variables used to create the Propensity Scores in the NN model. An econometric regression model is then run with the weights applied, which estimates the average expected value of the outcome if all units in the sample received the project and if all units in the sample did not, controlling for a set of relevant covariates, with the final impact estimate being calculated by subtracting the control outcome estimate from the treatment estimate.

The set of control variables used in the IPWRA model cover household socio-economic characteristics, land characteristics (for the agriculture indicators), geographic area, and exogenous shock exposure. Control variables were chosen based on their likelihoods to have influenced the outcome variable, while not having been affected by the project; thus different sets of control variables were used depending on the outcome variable being analysed [6].

As mentioned, there is a wide variety of potential analytical models to employ for impact estimation, and these must be selected based on which model provides the most reliable comparison between treatment and control. In this case we tested a number of different models and found that the NN model and IPWRA model were the most effective in this instance. The main way that we assessed the effectiveness of the models was by assessing the change in the Standardised Mean Difference (SMD) and in the Variance Ratio (VR) of the set of matching/weighting variables used for the analysis (Austin, 2009).

The SMD measures the difference in the treatment and control means of a variable by the difference in standard deviations, allowing for differences across variables to be compared in the same unit. The VRs give a picture of how the relative variation across the treatment and control groups for each matching variable has been altered. Table 7 contains the set of variables that were used in the matching for the NN model and the weighting for the IPWRA model, and presents the change in the SMD and the VR for each variable before and after the models are applied.

The average SMD between the treatment and control groups across the variables in the unadjusted sample is 9.5 per cent, and we see that this is reduced to 2.1 per cent by the NN model and to 2.5 per cent by the IPWRA model. For the average VR, we see that this has been reduced from 1.2 for the raw sample, to 1.1 by the NN mode and to 1.1 by the IPWRA model. These statistics show that we were able to significantly improve the comparability of the treatment and control groups for the impact estimation with both models, highlighting that we can interpret our results with confidence that there is negligible bias in the comparison. As the NN model performs slightly better in these tests in addition to allowing for exact matching on catchment area, we employ the NN model as the primary model for our analysis.

[6] See Arslan et al. (2018b) for a detailed statistical specification of this model.

Table 7: Change in SMD and VR from the two impact estimation models

	Standardised Mean Difference			Variance Ratio		
Variables	**Raw (%)**	**After NN (%)**	**After IPWRA (%)**	**Raw**	**After NN**	**After IPWRA**
HH size	1.83	-3.72	1.29	1.23	1.06	1.15
Dependency ratio	-13.45	-3.13	2.64	0.73	0.84	0.89
Age of HHH	9.96	2.04	-2.82	0.99	0.97	0.98
Gender of HHH	-11.66	0.45	1.50	0.76	1.01	1.04
Age * Ed of HHH	8.83	1.86	-4.19	0.94	0.95	0.88
Mean HH age	9.06	3.14	-1.86	0.99	0.97	0.96
Ed of HHH	7.00	1.28	-3.38	0.92	0.95	0.92
Ed*Gender of HHH	2.91	0.56	-2.64	0.82	0.91	0.92
Nr literate in HH	2.07	0.52	3.02	1.06	1.02	1.01
Nr English speakers in HH	-0.84	-3.24	2.86	1.21	1.05	1.17
HHH speaks English	-2.33	-0.26	1.08	1.07	1.01	0.97
Muslim	-36.56	-4.39	1.77	2.78	1.13	0.97
Nr climate shocks	-1.66	-0.91	-2.24	1.07	1.02	1.05
Productive asset index 2014	9.04	-4.48	1.78	1.92	1.33	1.86
Household asset index 2014	2.33	-2.46	3.26	1.12	0.96	1.16
Catchment area	-28.01	0.00	0.65	1.20	1.00	1.00
Upazila	4.73	1.46	5.00	0.99	1.03	1.16
Distance to market	18.02	4.08	-3.42	2.44	1.66	2.40
Average (in absolute terms)	9.46	2.11	2.52	1.24	1.05	1.14

[†] These are interaction terms whereby two variables are multiplied together to incorporate their combined effect (Baser, 2006).

3. Profile of the household questionnaire sample

a. Household characteristics by division

CCRIP is spread across three of Bangladesh's seven divisions: Barisal, Dhaka and Khulna. There is a high level of diversity across these divisions that is likely to have an influence on the impact of the project (Ahmed et al., 2013). For instance, as can be seen from Figure 3, the districts sampled for Barisal and Khulna are located along the coastal areas and char zones, whilst the districts sampled for Dhaka are located further inland. As noted, households living in the char zones face specific challenges to their livelihoods, most salient of which is the more intense seasonal flooding in the area, as well as being more remote (Sarker et al., 2003). There is also disparity in wealth, with Dhaka the wealthiest of the three divisions, followed by Khulna (Ahmed et al., 2013).

Table 8 presents socio-economic statistics of the household sample for the three project divisions. The divisions are similar in terms of average household size (around 4.5 members), average age of the household head (around 49) and average age of household members (around 31). The gender of the household head and the religion of households are similar in the Barisal and Khulna divisions—with between 90-94 per cent of households having a male head, and between 93-96 percen belonging to the Muslim faith, and the remainder belonging to the Hindu faith. Households in Dhaka district are quite different in these characteristics, however, with a higher proportion of female-headed households (around 23 per cent), a lower proportion of Muslims (76 per cent) and more Hindus (21 per cent) and Christians (3 per cent) compared to the other divisions. It is well-documented that female-headed households face specific livelihood barriers, including higher poverty, lower access to productive assets and capital, and constraining social norms, thus, we interpret the impact findings with this background in mind (World Bank, 2001).

The households sampled from Dhaka are the wealthiest, whilst Barisal and Dhaka have similar, lower levels of income. This wealth distribution is also reflected in the poverty levels of the three divisions, with 82 per cent of households above the income poverty threshold in Dhaka, compared to 71 per cent in Barisal and 76 per cent in Khulna. The national poverty rate is reported to be around 15 per cent in the country,[7] which indicates that CCRIP has effectively targeted areas with higher levels of poverty and lower average incomes compared to the national average of BDT127,255 per capita (around US$1,604[8]) (World Bank, 2017b).

The project's targeting of households most exposed to climatic shock risk is also reflected in the livelihood distribution statistics. In none of the divisions does a single income source provide more than a third of total income, with households in all three regions showing signs of livelihood diversification, which is a common form of ex-ante risk management in the face of persistent shock threats (Jones et al., 2010).

[7] http://povertydata.worldbank.org/poverty/country/BGD

[8] Conversion made on 31 January 2019 from the following source: https://www.reuters.com/finance/currencies/quote?srcAmt=127255&srcCurr=BDT&destAmt=&destCurr=USD

Although the households sampled from the three divisions all have diversified livelihoods, there is variation in how they diversify. In the Barisal division, around 18 per cent of household income is derived from the sale of crops, whilst 24 per cent of households do not cultivate any crops at all. In Dhaka, crop sales provide 13 per cent of income and 34 per cent of households do not cultivate any crops. In Khulna, just 5 per cent of income is from crop sales and 53 per cent of households do not cultivate any crops. In this division, fish and livestock production play a more prominent role.

Across the divisions, formal wage labour and household enterprises are the major sources of income for the households in the sample, although casual wage labour provides around 33 per cent of income for households in Khulna, as expected given that housheolds in this division have the lowest average income per capita. Household enterprises provide around 20 per cent of income in Barisal and Khulna, and more than 30 per cent in Dhaka. The prominent role played by remittances is evident everywhere, providing at least 10 per cent of total income, and they are especially important in Dhaka providing around 27 per cent of household income, most likely coming mainly from those working in the capital city. From these statistics it is clear that our impact analysis must focus on all aspects of households' livelihoods, rather than simply agriculture, with improved access to waged labour opportunities and demand for household enterprise services being key potential impact mechanisms for CCRIP.

Although the contribution of wage employment to household income is high in all regions, there is variation in the types of employment. In Barisal, only nine per cent of the formal employment is on the farm, whilst 53 per cent is professional work (most commonly either office work or technical jobs such as a mechanic), and 37 per cent is other off-farm work (such as construction). In Khulna, professional work accounts for 86 per cent of formal employment, with nine percent constituted by other off-farm work, and just five percent on-farm work. Finally for Dhaka, the largest share of formal employment is provided by other off-farm work (44 per cent), with on-farm waged labour accounting for a much larger share compared to the other regions (30 per cent).

Regarding household enterprises, in all divisions the majority (around 30-40 per cent) consist of non-agricultural businesses such as small shops or services such as carpentry or barbering. In all districts, taxi or pick-up services account for around 20 per cent of businesses, and in Dhaka, enterprises offering professional services such as midwifery or tutoring are also common (around 30 per cent).

Table 8: Socio-demographic and livelihood characterisitcs of household sample by division

	-1- Barisal	-2- Dhaka	-3- Khulna
Household characteristics			
Household size	4.56	4.55	4.46
Age of h'hold head	48.97	48.56	49.48
Average household age	31.08	30.37	31.30
Household dependency ratio (%)	63.27	77.65	60.75
Religion (%):			
– Muslim	93.26	76.43	95.81
– Hindu	6.74	20.71	4.19
– Christian	0.00	2.86	0.00
Gender of household head (%):			
– Male	90.01	76.60	94.93
– Female	9.99	23.40	5.07
Per cent of adults who are literate (%)	65.27	68.54	72.06
Per cent of school-age children in school (%)	70.20 (1,408)	69.46 (505)	72.17 (371)
Livelihood characteristics			
Total income per capita (BDT)	69,307.87	95,006.85	62,135.35
Above $1.90 per day poverty line (%)	70.62	82.66	76.43
Land owned with title (ha.)	0.26	0.33	0.16
Proportion of income from (%):			
Agriculture	17.60	13.40	5.24
Fish	1.30	0.67	4.17
Livestock	9.09	5.64	4.30
Formal wage labour	24.76	14.06	17.43
Casual wage labour	8.37	1.92	32.98
Household enterprise	21.22	30.25	22.78
Land rental	1.03	2.25	0.52
Remittances	11.79	27.40	9.03
Other (pension, etc)	4.29	4.38	3.08

Note: Unless otherwise stated in parentheses, the numbers of observations for these values are as follows: Barisal = 1,692; Dhaka = 594; Khulna = 454.

Table 9 presents statistics on the agricultural practices of the households in the sample by division. The more prominent role played by crop production in Barisal is reflected in the much larger harvest value compared to the other two regions, both in terms of the volume produced, and the productivity of production per hectare. Despite this, the largest average income from crop sales is for households in Dhaka, followed by Barisal and Khulna, which is in line with the average total incomes across the divisions.

The statistics for the dry and monsoon seasons relate only to the production of seasonal crops. In the case of Barisal and Khulna, a larger proportion of households cultivated seasonal crops in the monsoon season than in the dry season. Conversely, in Dhaka a larger proportion of households cultivated seasonal crops in the dry season. This variation could potentially be linked to the types of crops produced in Dhaka, as well as differences in seasonal demand for other income generating activities (wage labor and household enterprises, both of which are more important in this division).

The importance of perennial crops is highlighted for Barisal in that a much smaller proportion of crop production (in terms of value) is accounted for by seasonal crops, whilst seasonal crops provide the main contribution in Dhaka and Khulna. The climate-related production issues in the project area are reflected by the seasonal productivity statistics for the divisions, with total productivity higher in all cases for the dry seasons, even in Dhaka where total production volume is higher during the dry seasons.

In terms of income from crop sales, there are important differences in the selling practices of the three divisions. In Barisal and Dhaka, around 70 per cent of crop-producing households sold some of their harvest, while this figure is 50 per cent in Khulna. In terms of seasonal crops, in Barisal and Dhaka the income per hectare from selling these crops is higher in the monsoon season. In total, households in Dhaka sold the highest proportion of their crops (37 per cent), compared to 29 per cent in Barisal and 22 per cent in Khulna. As is common for smallholders across the country, the majority of households' harvest is dedicated to home consumption in all divisions (Anderson et al., 2016). However, this is most prominent in Khulna (69 per cent of harvest), likely linked to the higher poverty level in this division and also the higher production of rice, which is more likely to be consumed at home than other crops (ibid). Households in Barisal lose the highest proportion of their harvest to pests and shocks, although this percentage is low in all cases.

In terms of the types of crops that are grown, the main crop in all three divisions is rice, which is grown by between 72 per cent and 85 per cent of the sample in the three divisions. In Barisal, beans are an important crop, although not so in the other two divisions. Other divisional differences are the importance of khesari in Khulna, and of coconuts and betel nut in Barisal.

Table 9: Agricultural production and marketing practices of household sample by division[9]

	-1- Barisal	-2- Dhaka	-3- Khulna
Total value of harvest (BDT)			
– Annual (incl. perennials)	933,839.50 (1,274)	54,899.21 (390)	34,478.86 (212)
– Dry seasons	23,508.84 (807)	52,820.32 (336)	14,707.32 (48)
– Monsoon season	22,188.45 (937)	18,129.56 (139)	28,407.84 (188)
Total value of harvest per ha. (BDT/ha)			
– Annual (incl. perennials)	97,499.74 (1,274)	81,867.56 (390)	49,568.06 (212)
– Dry seasons	63,743.00 (807)	104,188.80 (336)	87,722.70 (48)
– Monsoon season	60,909.70 (937)	48,724.83 (139)	59,631.42 (188)
Total income from crop sales (BDT)			
– Annual (incl. perennials)	60,073.53 (890)	75,782.55 (272)	28,104.85 (107)
– Dry seasons	18,904.40 (616)	39,581.44 (250)	14,508.33 (12)
– Monsoon season	27,266.45 (667)	51,603.67 (137)	27,498.93 (95)
Total income from crop sales per ha. (BDT/ha)			
– Annual (incl. perennials)	34,071.75 (890)	87,590.46 (272)	26,418.81 (107)
– Dry seasons	44,689.18 (616)	63,191.68 (250)	50,061.43 (12)
– Monsoon season	62,481.47 (667)	163,600.20 (137)	38,874.06 (95)
Total area cultivated (ha.)			
– Annual (incl. perennials)	3.30 (1,274)	1.92 (390)	3.13 (212)
– Dry seasons	0.39 (867)	0.54 (337)	0.29 (68)
– Monsoon season	0.40 (937)	0.41 (142)	0.53 (188)
Crops grown (% of sample):			
– Rice	75.59	76.41	90.57
– Beans	37.91	1.79	0.94
– Khesari	3.61	24.87	0.47
– Coconut	19.31	9.49	12.74
– Betel nut	22.45	3.59	8.96
Harvest uses (% of total value):			
– Home consumption	60.47	52.35	68.89
– Sold	28.95	36.50	22.17
– Lost	1.19	0.73	0.37
– Used for feed	0.20	0.13	0.66
– Used for seed	1.15	1.43	1.35
– Used for other purposes	8.04	8.86	6.56

Note: Unless otherwise stated in parentheses, the numbers of observations for these values are as follows: Barisal = 1,274; Dhaka = 390; Khulna = 212.

[9] Average statistics for annual, and seasonal indicators are compiled only for those households who cultivated during each period. This is why the number of observation vary across indicators and why the annual average amounts are not always above the seasonal average amounts.

b. Household characteristics by catchment area

Table 10 presents statistics of the sampled households separated by their location within the 2km radius from the treatment or control market. The first column contains statistics for the full sample, covering all those within a 2km radius of the market; the second is for all households located within a 1km radius of the market, the third is for households located within 2km of the market but not within 1km of the connecting road; and the fourth is for households located within 2km of the market and also within 1km of the connecting road. For the treatment group, these different groupings represent different levels of exposure CCRIP's support, with those located closer to the market (Column 2) and those located closeer to both the market and the connecting road (Column 4) having the highest level of exposure and thus being expected to receive the highest benefit.

From the table we see that the highest average income is amongst households located closer to the connecting road, whilst there does not seem to be a difference in income for households according to their distance from the market (based on statistics for columns 1 and 2). The lowest average income is for households who are located within 2km of the market but not within 1km from the road, suggesting that proximity to the connecting road is a key determinant of income variation. This difference in wealth is not reflected by land ownership, however, with this figure averaging around 0.25 ha. for all groups.

One may expect that households located closer to the road would have higher school enrolment due to better access, but this averages around 70 per cent in all cases. This may be due to the existence of local schools in the area that do not require main connecting roads to access. The higher income of people closest to the road is definitely highlighted, however, by the value of harvest, which is over double the amount for some of the other groupings. Interestingly for this statistic, the value is not higher for households located closer to the market.

In terms of income composition, households are similar across the different groupings, suggesting that there is little variation in livelihood practices according to location in the catchment area. In all cases, the majority of income is provided by household enterprises, followed by formal wage labour, with income from crop sale providing around 13-16 per cent in all cases.

Table 10: Household and livelihood characteristics of the household sample by catchment area

	-1- 2km from market	-2- 1km from market	-3- 2km from market only	-4- 2km from market and 1km from road
Total income per capita (BDT)	73,690.67	73,045.28	69,638.25	78,528.26
Land owned with tenure (ha.)	0.26	0.25	0.26	0.26
School-age children in school (%)	70.36 (2,284)	69.59 (1,096)	69.75 (1,248)	71.10 (1,036)
Value of harvest per ha. (BDT/ha)	88,833.39 (1,876)	48,939.31 (866)	46,025.22 (985)	136,157.80 (891)
Total area cultivated (ha.)	3.00 (1,876)	2.84 (866)	2.83 (985)	3.18 (891)
Proportion of income from (%)				
– Agriculture	14.64	13.12	13.76	15.69
– Fish	1.64	1.22	1.57	1.73
– Livestock	7.55	7.34	6.54	8.76
– Formal wage labour	21.23	20.24	22.68	19.50
– Casual wage labour	11.05	11.90	12.79	8.97
– Household enterprise	23.44	24.62	23.01	23.94
– Land rental	1.21	1.11	1.17	1.26
– Remittances	14.72	16.33	13.92	15.68
– Other (pension, etc)	4.11	3.83	3.98	4.26

Note: Unless otherwise stated in parentheses, the number of observations for each column are 2,740; 1,312; 1,491; and 1,249, respectively.

4. Results

In this section we present and discuss the results for CCRIP's impact on the set of indicators listed in Table 6. We first present the results for CCRIP's impact according to households' proximity to the CCRIP market, presenting results for the full sample from the 2km catchment area along with the results for households located within 1km of the market. We then present results for CCRIP's impact according by geographic location; by households' proximity to both the market and the connecting road; and according to households' livelihood activities. The results we present are from the primary NN model, whilst the results from the secondary IPWRA model are presented in Appendix III.

It is important to note that for the impact on specific sources of income (such as crop sales, fish sales, or wage labour), the results apply only to those households, who were participating in these activities. For instance, the impact we report on income from crop sales refers only to those households who actually cultivated crops, and that for the impact on wage labour only applies to those who actually worked as wage labourers during the study period.

a. Overall impacts of CCRIP

i. Agricultural production

Table 11 presents the impact of CCRIP on agricultural productivity and crop sale. For the whole sample, we do not find a statistically significant impact on agricultural production for the 2km catchment area for the whole 12 month cropping period. We find significant variation in impact by season for seasonal crops, however, with a statistically significant increase in crop production of 94 per cent for the dry seasons (Kharif I and Rabi), but a negligible impact in the monsoon season (Kharif II). In terms of gross margins, which is a measure of production efficiency, the project did not have a significant impact for the full 2km catchment area. We also do not find that the project increased the number of crop varieties grown by beneficiary households within the 2km catchment area.

For the 2km catchment area, the results for crop sales differ from the crop production results. We find that, for the full 12 month cropping period, income from crop sales increased by 104 per cent, with a significant impact being achieved both in the dry and monsoon seasons—although the dry season impact is slightly higher. We find that this impact is achieved despite the lack of a large signficiant impact on agricultural production, partially due to a larger proportion of harvests being sold amongst beneficiaries rather than being used for home consumption or lost to pests. In addition, we find that beneficiary households were 11 per cent more likely to have sold their crops at a market, rather than from home or at the farm gate, and were eight per cent more likely to have grown high-value crops, impacts which also likely contributed to the total income effect.

For the 1km catchment area, there is evidence in some cases of an intensification of impact in terms of crop production and sales. Although the impact on the value of crop harvest is still not significant, we find a significant increase in gross margins of nine per cent, suggesting that production efficiency

was improved more for households located closer to the CCRIP markets. The effect on crop sale is 108 per cent for households located within the 1km radius as compared to the 104 per cent for those in 2km radius, although the impact on seasonal crop income is not significant for the dry or monsoon seasons, suggesting that impact on crop income came mainly through perennial crops for these households.

The main implication of these findings is that improved market access for the sale of crops has clearly been achieved through CCRIP, and has contributed to a very large increase in on-farm income as a result. The statistically signficiant impact on crop sale income for seasonal crops in the monsoon season is particularly salient with regards to this project, as it shows that, thanks to CCRIP support, farmers were better able to sell their produce despite excessive rainfall which otherwise damages roads and markets.

Insights from the qualitative data support this finding, with widespread reports that households were able to increase their income because the markets were accessible and useable all year round, and the markets were much better attended. In addition, the capacity building support provided to the MMCs by CCRIP was reported to have greatly improved the sustainable management and maintenance of the markets, with the increased attendance also providing higher income for the MMCs to perform its duties.

The improved market access is also reflected by the findings that, although beneficiary households were not growing significantly more than control households, their production was much more market oriented, with improved selling practices. It may also have been the case that improved market access did not stimulate increased production as households did not have to produce more to account for crop losses caused by delays in accessing markets to sell produce. As a result, beneficiary households achieved higher incomes from a similar amount of harvest compared to control households. The fact that this has been achieved without a proportional increase in crop production overall, combined with the finding that gross margins per hectare has improved only for the sample within 1km of the market, suggests that benefits from improved input access due to CCRIP's work may not have applied as much to more remote households compared to the crop sale benefits.

Table 11: Impact of CCRIP on agricultural productivity and sales

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Value of ag. production per ha:				
– Full year	14.2	1,876	9.5	866
– Dry seasons only	93.9***	1,876	16.3	866
– Monsoon season only	-13.0	1,876	15.8	866
Gross margins per ha.	2.0	1,876	8.7*	866
Proportion of harvest sold	4.8***	1,876	2.9	866
Sold at market (% likelihood)	11.0***	1,269	15.2***	598
Income from crop sale per ha.:				
– Full year	104.0***	1,876	108.3***	866
– Dry seasons	130.2***	1,876	67.6	866
– Monsoon season	69.8**	1,876	65.6	866
Nr. crop varieties (count)	-0.02	1,876	-0.1	866
Grew at least one high-value crop (% likelihood)	7.6***	1,876	1.3	866

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

Table 12 presents the impact of CCRIP on agricultural input use. For the 2km catchment area, we do not find any significant impacts on the volume of inputs used, including for the amount of land cultivated, or the amount of seeds, fertiliser, crop protection or labour used during the 12 month cropping period. As shown in Table 12, we find that gross margins were not significantly improved amongst beneficiary households for the 2km area, and this is reflected by a lack of a significant impact on the input productivity (the amount of output produced by one unit of input) of fertiliser, crop protection, and labour. Only in the case of seed use do we find a positive and signficiant effect on efficiency, with an increase of 11 per cent in the units of output produced by a unit of input.

As with the results from Table 11, the project's impact on input use intensifies in some cases when we focus on households located within 1km of the market. Amongst these households, we find that land use increased significantly, by around 1 hectare, as did the amount of fertiliser and crop protection that was used (by 53 per cent and 65 per cent respectively). In addition, the input productivity of seeds increased significantly by 16 per cent, as opposed to 11 per cent for the 2km area. However, as with the 2km area, there was still no significant impact on the productivity of fertiliser, crop protection or labour.

CCRIP was expected to improve households' access to agicultural inputs. In terms of the amount of inputs that were used, this was not significantly increased for the 12 month period, something which may have contributed to the lack of a significant impact on crop production. Based on the slightly more favourable impacts for the 1km catchment area, this lack of impact particularly applied to more remote

households. It was widely reported in the qualitative data that CCRIP markets improved access to agricultural inputs, but that households often lacked capital to invest in these inputs. Based on this, it may have been the case that physical access to inputs was improved by the project, but additional barriers such as a lack of capital served to curtail impact in this area.

sThrough additional seasonal analysis, we find that input use was significantly increased for seasonal crops during the dry season, which again can be linked to the finding for crop production for this season (where we find a significant positive effect). This additional insight suggests that a lack of impact on the 12 month period is driven by a lack of input access during the monsoon season. Whilst we find that crop sale was significantly increased during this season—suggesting the project was able to solve the barriers to output market access posed by the rains during this season—it is possible that it was not able to solve the barriers to input market access during this season. Although the positive effect on seed productivity suggests that households may have been able to access better seeds, but not other inputs

Table 12: Impact of CCRIP on agricultural input use

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Land cultivated (ha.)	0.5	1,876	0.9*	866
Value of inputs per ha.	12.9	1,876	19.0	866
– Seeds	4.8	1,876	20.4	866
– Fertiliser	10.1	1,876	53.2*	866
– Crop Protection†	8.2	1,876	64.6**	866
– Labour	12.5	1,876	33.6	866
Input productivity of:				
– Seeds	10.9**	1,610	16.1**	750
– Fertiliser	4.4	1,525	-11.2	708
– Crop Protection	9.2	1,409	7.0	636
– Labour	5.9	1,876	-2.6	866

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.
† Crop protection includes following inputs: pesticides, herbicides, fungicides, insecticide

ii. Fish and livestock production

Table 13 presents the impact of CCRIP on fish production and sales (for those who produced fish during the study period), which bare some similarity to the project's impact on crop production and sale. We find that the value of production for fish producers in the 2km sample was not increased, but as with crop sales, we find a large positive impact on income from fish sales of 50 per cent. We do not find a positive impact on the likelihood of fish being sold at market rather than from home or at the farm gate, which may be due to the small proportion of fish-producing households who actually sold fish (18 per cent of fish producers). Likely due to the lack of impact on fish production,

we do not find an impact on the amount of fish harvest used for home consumption. We find similar results in all cases for the 1km sample.

As with crop sales, the results for fish production highlight the effectivenss of CCRIP in improving market access for selling goods. As well as potentially being due to a lack of appropriate inputs, the lack of impact on fish production may have also been due to households not having to produce more to account for losses of their fish harvest due to delays in accesing markets to sell them, an impact that has also been identified for similar IFAD-funded projects (Brett, 2019). One difference from the project's impact on crop production, however, is that the impacts on fish production and sales do not differ by distance to the market, suggesting there are specific barriers to crop production and sales for more remote households that do not apply to fish.

Table 13: Impact of CCRIP on fish production and sale

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Gross value of fish production	-17.8%	1,526	-2.8	708
Net value of fish inputs	-6.6**	1,526	-10.4**	708
Revenue from fish sales	49.5**	1,526	52.5*	708
Sold fish at market (% likelihood)	10.5	272	-8.0	111
Value of fish consumption per capita	-6.2	1,526	-18.8	708

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

Table 14 presents the impact of CCRIP on livestock production and sales (for those involved in livestock production as an income source). We do not find a positive impact on the value of production of livestock for livestock producers, or on income from the sales of livestock and livestock products. However, we do find a significant 62 per cent increase in the milk productivity of cows. This could potentially be due to beneficiaries having better access to inputs that could improve cow's milk productivity, or access to more productive calves and cows themselves. In addition to these results, we also find that households in the 2km sample were more likely to have consumed meat in the past seven days.

These results suggest that the impact of improved markets and roads on the sales of crop and fish produce did not apply to livestock, and thus did not serve to enhance livestock rearing as a livelihood option. Livestock are usually traded at dedicated markets and livestock trading at the community markets that were improved by CCRIP is not very common as they are usually taken to larger markets in more distant locations. In the qualitative data, a common request for future projects was training and other support for livestock rearing, suggesting that low capacity amongst beneficiaries for livestock rearing may have also hindered the project's impact in this area.

Table 14: Impact of CCRIP on livestock rearing and sale

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Gross value of livestock production	10.2	2,171	15.8	1,006
Net value of livestock production	0.9	2,171	1.3	1,006
Revenue from livestock and product sales	12.4	2,171	19.9	1,006
Sold livestock or livestock product (% likelihood)	1.2	2,171	2.0	1,006
Milk productivity per cow	62.0*	888	-9.4	404

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

iv. Total income and livelihood composition

Table 15 presents the impact of CCRIP on household income and livelihood composition. For the 2km catchment area, we find that CCRIP significantly increased household's total income by 11 per cent. In addition, beneficiary households were found to be four per cent more likely to be above the poverty line. We also find that income for wage workers increased by 18 per cent for the 2km catchment area. Despite these improvements, we do not see an impact of the project on net income, which may be due to households investing more in their long term production capacities increasing their expenditures. We also do not find an impact on income from household enterprises or the number of income sources in the 2km sample, indicating that income diversification did not increase.

Looking at the composition of household income in the 2km catchment area, we see that the contribution from fish sales was the only income source whose proportion increased significantly, rising by around 1 percentage point. The only other significant change in income composition is a significant reduction in remittances (by 2 percentage points), thus suggesting that beneficiary households maintained their income generating portfolio while increasing total income, hence needing less remittances.

For households within the 1km catchment area, incomes became more concentrated around crop and fish sales, reflecting the large impact on these sources. Despite these increases, we see a lower impact of the project on total household income compared to the 2km sample due to a significant 4 percentage point reduction in the contribution of income from household enterprises, and a significant 0.8 percentage point reduction in land rental income. In terms of both livelihood diversity and poverty reduction, however, the results for this sample are more positive than for the 2km sample. Households within 1km of CCRIP markets are around 5 per cent less likely to be poor, and there was a slight but significant increase (averaging 0.3) in the number of income sources.

For the 1km catchment area, it is perhaps surprising that total income did not significantly increase based on the positive impacts on crop and fish sale income for these households. This is likely due to the fact that crop and fish sales account for just 14 per cent of total household income for these households, whilst waged labour and household enteprises account for around 38 per cent (see Section 3b, Table 10). The benefits for these households from the project therefore applied to a more

minor area of their livelihoods, whilst the primary areas were not significantly improved, thus leading to a curtailed impact on total income.

Table 15: Impact of CCRIP on income and livelihood composition

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Gross income per capita	10.5**	2,740	9.0	1,312
Net income per capita	0.01	2,740	-1.02	1,312
Income from waged labour per capita	18.3***	1,291	11.2	607
Income from household enterprise per capita	-9.1	847	12.7	423
Nr. income sources (count)	0.1	2,740	0.3**	1,312
Above $1.90/ day pov. line (% likelihood)	4.4**	2,740	5.3*	1,312
Proportion of income from (percentage points):				
– Crop sale	1.4	2,740	5.4***	1,312
– Fish sale	0.9**	2,740	1.4**	1,312
– Livestock sale	-1.4	2,740	-0.9	1,312
– Formal waged labour	2.3	2,740	1.2	1,312
– Casual waged labour	-0.6	2,740	-1.2	1,312
– Household enterprises	-0.7	2,740	-4.3*	1,312
– Remittances	-2.0*	2,740	-2.1	1,312
– Land rental	-0.4	2,740	-0.8**	1,312
– Other sources	-0.2	2,740	0.6	1,312

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

v. Assets, food security and education

Table 16 presents the impact of CCRIP on household assets, food security and education indicators. We find that household durable asset ownership was significantly increased by the project in both catchment areas (the impact is not significant for productive assets only). The impact for ownership of livestock measured in TLU is not significant for the 2km sample, but slightly negative and significant for the 1km sample. Regarding food insecurity experience indicators, we find that the project significantly decreased food insecurity experience both using the full FIES score and components. Beneficiaries were at least 10 per cent less likely to have worried about having enough food, and to have been unable to eat healthy food due to a lack of resources during the past year. Impacts on dietary diversity score and school enrolment are not statistically significant for the 2km sample.

As with other areas, we find some evidence of more favourable impacts for the 1km sample. For these households, there was a larger significant increase in the ownership of household assets and a larger reduction in food insecurity concerns. Although there was also a small and significant decrease in the dietary diversity score, while the impact on proportion of school-age children enrolled in school is not significant.

The increase in household assets suggests that households may be purchasing assets as a form of saving and risk mitigation, as opposed to keeping cash savings, which we found was not improved for the 2km sample. This potentially has positive implications for these households, whose livlihoods are plagued by a variety of shocks. This finding – combined with the finding of increased income diversification for the 1km sample – suggests that, by improving the income of beneficiaries, the project has improved the resilience of households, which has positive implications for the long-term sustainability of the project impacts.

The contrasting results of the project on food security and dietary diversity (a proxy for nutrition) may be explained by the high prevalence of poverty within the sample as highlighted in Section 3. Concerns about having enough food is an issue that applies to the poorest households, who lack sufficient income to provide for their basic needs, whilst dietary diversity is the concern that follows once a household has achieved their basic requirements for sustenance. Based on this, the results suggest that the project was able to help poor households to better meet their basic food needs, but had less success in helping relatively wealthier households, who were already food secure, to enhance their dietary diversity.

Table 16: Impact of CCRIP on assets and food security

	2km from market		1km from market	
	ATE	Obs	ATE	Obs
Asset indices:				
– Household durable assets	0.1**	2,740	0.1**	1,312
– Productive assets	-0.02	2,740	0.04	1,312
– TLU	-0.1	2,740	-0.1*	1,312
FIES score	-13.1%***	2,740	-18.0%***	1,312
Worried about having enough food (% likelihood)	-9.9***	2,740	-14.8***	1,312
Unable to eat healthy food (% likelihood)	-10.7***	2,740	-13.6***	1,312
Dietary Diversity Score	-0.1	2,740	-0.5***	1,312
School-age children enrolled (percentage points)	-0.4	2,204	1.8	1,056

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively

vi. Financial inclusion

Table 17 presents CCRIP's impact on indicators of financial inclusion. Smallholder farmers across the world face substantial barriers to obtaining formal bank accounts for payments or savings, as well as accessing loans (Anderson et al., 2016). Only around 21 per cent of households held a formal account at the time of the questionnaire, and 20 per cent held another type of account. Although the impact on the likelihood of having a formal bank account for the 2km sample is not significant, for the 1km sample we find that the project improved this likelihood by around six per cent. We also find that the likelihood of having an account other than a formal bank account has decreased by around seven per cent for the 2km sample.

The lack of impact on financial inclusion for the 2km sample is perhaps explained by the lack of direct focus by the project on improving financial inclusion. As shown in the Theory of Change, CCRIP's direct impacts were expected through improved market access, and although the results show that this indeed was improved in terms of buying and selling goods, it does not seem to have applied to accessing financial services such as bank accounts, savings and loans. It may perhaps be the case that the institutions that provide these services are based further away than the community markets that were improved by CCRIP, which we cannot test with our data. Nevertheless, a lack of access to credit was cited as a key barrier to improving livelihoods in the qualitative data, suggesting that future projects may benefit from targeting this constraint.

Improved financial inclusion and savings may have also been expected to improve as an indirect result of higher income stimulated by the project. As we have seen above, CCRIP had a significant impact on household asset ownership, which is also a common form of saving amongst smallholders in the country (Anderson et al., 2016). These findings together suggest that households may indeed be saving more as a result of the income improvements induced by CCRIP, but this is in the form of assets rather than cash, potentially as a result of persisting issues of access to formal financial services.

Table 17: Impact of CCRIP on financial inclusion

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Have formal bank account (% likelihood)	2.8	2,740	5.7**	1,312
Have other account (MFI, NBFI, mobile money) (% likelihood)	-6.7***	2,740	-0.8	1,312
Took a loan in past year (% likelihood)	-1.03	2,740	-5.3	1,312
Savings per capita	-6.1	2,740	18.6	1,312

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

vii. Women's empowerment

Table 18 presents the impact of CCRIP on indicators of women's autonomous income generation and their involvement in household decision making. We find that, regardless of the catchment area, the project did not have a significant effect on the proportion of household income contributed by women's activities, or on the likelihood of a female household member owning their own enterprise. We also do not find a significant impact on women's involvement in household decision making regarding household purchases, children's education or agricultural production or marketing.

Regarding decision making on education, around 83 per cent of the treatment sample reported that female household members were involved either individually or jointly with male members, suggesting that there was limited room for improvement in this area. However, there was much-needed improvement in the other areas, with only 40 per cent of households having women involved in household purchase decisions, and 58 per cent in terms of agricultural production. In addition, an average of only two per cent of household income is contributed by women's autonomous activities, and only two per cent of treatment households have a woman owning her own enterprise.

Overall there is little evidence from these results that CCRIP's market and road infrastructure strengthening helped to improve women's empowerment in terms of autonomous income generation and household decision making. This may be because these activities of CCRIP did not specifically target women. The parts of the project that did target women were its use of LCS and the establishment of women's market areas. As these activities were not expected to reach as many households as the market and road infrastructure support, it was not feasible to design the household survey sample to measure the impact of these activities, therefore there may have been an impact of the project on women's empowerment that is not detected by this assessment. From the qualitative data, it was reported that the LCS provided a valuable means of gaining income and training for its members, and served to improve women's standing in the community. However, it was also reported that some women were forbidden from joining the LCS by their husbands, and that after the work with CCRIP had finished, female members had difficulty in obtaining additional employment, and when they did find work their wages were often lower than men's. An additional survey was conducted that focused on LCS members which may detect further an impact in this area, but the results from this survey have not yet been produced.

To further investigate the project's impact on women's empowerment, we conducted an additional analysis that separated the sample into Muslim and non-Muslim households. Interestingly, we found that the project had a significant positive effect on women's autonomous income generation and their decision making involvement for agricultural production and sales for the non-Muslim sub-sample.

This suggests that women from Muslim households in these areas may be facing barriers that the project was unable to overcome. The project has not targeted these potential barriers, as the project's theory of change assumed that these would not hinder the project's impact (see Section 1b), which is an assumption that did not hold as these results suggest. Past research has found that, due to patrilineal and patrilocal kinship systems and traditional gender norms, women face specific barriers related to their freedom of movement and role in the household, as well as lack control over economic resources such as assets and credit (Goetz and Sen Gupta, 1996; Donno and Russett, 2004; Ambler et al., 2017). These findings underline the importance of a thorough understanding of the

general social context surrounding women's participation in the economy and the society in order to provide improved support to women in similar settings through future projects.

Table 18: Impact of CCRIP on women's empowerment

	2km from market		1km from market	
	ATE	Obs	ATE	Obs
Household income from women's activities (percentage points)	0.6	2,730	0.3	1,308
Women own enterprise (% likelihood)	0.4	2,730	-0.2	1,308
Women involved in decision making (joint or individual) for (% likelihood):				
– Household purchases	1.5	2,730	1.8	1,308
– Children's education	-0.2	2,730	-0.4	1,308
– Crop or livestock prod.	-1.6	1,894	1.3	859
– Crop or livestock sales	-4.7*	1,894	-2.1	859

b. Impact heterogeneity

Impact by geographic location

Table 19 presents CCRIP's impact on key indicators by geographic location, showing results for households based in the Barisal, Patuakhali, Bhola and Barguna districts of the Barisal division (the main area covered by the project), and for households located in the Khulna and Dhaka divisions. The districts of Khulna and Dhaka could not be analyzed separately due to the smaller sample sizes for these divisions.

We find that CCRIP's impact varied significantly across these areas. In terms of total income, there was a significant impact of 60 per cent in Bhola district of Barisal, and a significant impact of 21 per cent in the Dhaka division. In these areas we also find that households are significantly less likely to be poor (by 18 and 13 per cent). However, the impact on total income in other areas was not significant.

These differences in impact on total income are shaped by varying impacts on the main income components. For instance, in Barisal and Patuakhali districts, income from wage labour increased significantly, as did income for those selling fish in Patuakhali, but a lack of impact in other income components meant that there was no impact on total income. Income from wage labour significantly increased also in Khulna, as did income for those selling fish or livestock, but a lack of impact on crop income or income from household enterprises meant again that total income did not increase. For Barguna, very large impacts were achieved for those selling crops, fish, and livestock, but a large significant decrease in income from household enterprises curtailed the project's impact on total income in this district. In Dhaka, the significant increase in total income, and reduction in poverty, was driven by a large increase of 209 per cent in livestock income. For Bhola, where the largest impact on

total income was found, the impact was driven by large increases in income from fish sales and wage labour.

Households in Barguna have the lowest average income at the district level, followed by households in Khulna and Patuakhali, whilst households in Bhola, Barisal district, and Dhaka have relatively higher incomes. Whilst we find significant increases in total income in Bhola and Dhaka, the promising findings for Barguna suggest that factors other than wealth may have served to shape the income effect across these geographic groups. For instance, the improvements in livestock income that drove the income impact in Dhaka may have been due to an existing facilitating environment for livestock marketing in this area. This is supported by secondary data showing that livestock ownership in Dhaka is higher than in Khulna and Barisal (BBS, 2008). Dhaka is also located further inland, so may have faced less vulnerability to climatic shocks compared to the coastal areas. In Barguna, better access to markets seem to have pulled households away from household enterprise activities towards crop, livestock and fish production and sales. The resulting reduction in income from eneterprises, however, was not fully accounted for by improvements in income from these other sources. Finally for Khulna, the poorest of the three divisions, there were clearly barriers to improving income from crop sales that the project was unable to fully overcome, and which hindered the impact on total income as a result.

Table 19: Impact of CCRIP by districts of Barisal and Khulna and Dhaka divisions

	Barisal		Patuakhali		Bhola		Barguna		Khulna districts		Dhaka districts	
	ATE*	Obs	ATE	Obs	ATE	Obs	ATE	Obs	ATE	Obs	ATE	Obs
Gross income per capita	-9.1	427	-11.9	432	60.1***	407	15.3	426	-1.7	454	21.0**	594
Above $1.90/ day pov. line (% likelihood)	-6.0	427	2.9	432	18.3***	407	-3.8	426	-0.8	454	12.6**	594
Income from crop sale per ha.	-58.8	334	34.2	286	15.4	338	363.7***	320	-13.8	212	20.4	390
Income from fish sale	-55.4	173	170.1**	214	158.7***	298	124.9***	373	164.1**	345	-88.4	123
Income from livestock sale	-76.5	138	-110.7*	358	12.3	344	107.7**	395	120.8*	341	208.7***	398
Income from waged labour per capita	75.1***	138	38.4***	255	52.1***	218	-5.5	194	26.6***	304	3.3	182
Income from household enterprise per capita	-19.9	114	-25.5	130	61.6	142	-108.6***	93	24.9	139	-24.6	229

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

ii. Impact by catchment area

Table 20 presents CCRIP's impact on key indicators for households located within 2km of the CCRIP market but not within 1km of the connecting road, and for households who are located both within 2km of the market and within 1km of the connecting road. Somewhat surprisingly, we find a larger impact on total income for those not located close to the road (13 per cent), and a non-significant impact for those located closer to the road. We also find that households that are only within a market catchment area (i.e. further than 1km of a road) were less likely to be poor. These impacts on those located further from the road were driven by a larger impact on income from selling crops, which averaged 150 per cent compared to 81 percent for those located closer to the road, and a 69 per cent increase in income from livestock sales. Housheolds located closer to the road observed a larger increase in income from fish sales and wage labour, but no significant increase in total income.

Households who are located close to both the CCRIP market and the connecting road were theorectically expected to benefit the most from the project as they were receiving two types of support. However, our results show that those located further from the connecting road benefitted more in terms of total income. Given that households located further from the road are poorer (see Section 3b), it may be the case that within the market catchment area, the impact of the project was more pro-poor. Unlike previous studies of infrastructure investments that found a lack of impact on the poorest households, in the case of CCRIP poorer households starting from a lower base of income, and facing more barriers, seemingly experienced larger increases thanks to the project's support (Khandker et al., 2010). In addition, these results also suggest that the connecting roads were perhaps more important for certain livelihood activities, such as the fish sales and wage labour, than for the sale of crops or livestock products.

Table 20: Impact of CCRIP by catchment area

	Market only		Market and road	
	ATE*	Obs	ATE	Obs
Gross income per capita	12.7*	1,491	7.5	1,249
Above $1.90/ day pov. line (% likelihood)	5.3*	1,491	3.8	1,249
Income from crop sales	150.4***	985	81.2**	891
Income from fish sales	59.6*	865	70.7**	661
Income from livestock sales	69.3**	1,170	-32.9	1,001
Income from wage labour per capita	17.0	768	18.4**	523
Income from household enterprise per capita	-26.6	457	5.7	390

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

iii. Impact by livelihood activities

The whole sample used for this analysis includes households that are primarily farm households, and those that rely primarily on other income generating activities. In order to assess whether CCRIP impact varied by these two household groups, Table 21 presents impacts on the income of households who were involved in farming (those who sold any crops, produced any fish, or kept any livestock during the 12 month study period), and for those households not involved in farming. We find that the project's impact is driven by improvements amongst farming households, with their total income increasing significantly by 16 per cent, compared to a negligible impact for non-farming households. Along with increased farm income, the impact on total income for farming households was also driven by higher income for wage labourers. As a result of these impacts, farming households were 6 per cent less likely to be poor, while no impact was found for non-farming households.

The average income for farming households is around 30 per cent lower than the average income of non-farming households, and farming households also are more likely to be below the poverty line. The fact that the project only impacted farming households provides further evidence that the project was more beneficial for poorer households within the market catchment area. It should also be considered, however, that project activities may not have been suited to the livelihood needs of non-farming households in the project areas, with markets seemingly being beneficial for sales of crops, fish, and in rare cases livestock, but not for providing opportunities for household enterprises and, in some cases, wage labour. This insight is also supported by the income impacts for households located within the 1km catchment area (see Section 4a-iv).

Table 21: Impact of CCRIP by livelihood activities

	Farm households		Non-farm households	
	ATE*	Obs	ATE	Obs
Gross income per capita	15.9***	2,163	-6.7	577
Above $1.90/ day pov. line (% likelihood)	5.5**	2,163	-0.9	577
Wage income per capita	14.2**	991	14.03	300
Household enterprise income per capita	3.0	648	-20.9	199

5. Conclusion

The Coastal Climate Resilient Infrastructure Project aimed to improve the livelihoods of poor and remote households in Southwest Bangladesh through improved markets and roads. In particular, the project aimed to improve the access and useability of community markets during seasonal flooding. Using data from an in-depth household questionnaire combined with qualitative interviews, we have rigorously assessed the project's impact on a range of impact indicators relating to income; crop, fish and livestock production and sales; assets, food security and education; financial inclusion; and women's empowerment. We have assessed impact on the whole sample, as well as for a range of sub-groups, including by geographic location, location within the market catchment area, and by livelihood activity, integrating findings from the qualitative data to help to explain the mechanisms that shaped the project's impact.

Overall, we have found that this type of focused infrastructure project can improve the climate resilience and accessibility of local markets, leading to significant improvements in income, assets and food security. This is achieved by improving households' market access in both the dry and monsoon seasons, and thus the marketing practices of beneficiaries, particularly in terms of crop and fish sales. As well as infrastructure support, we find that these impacts were facilitated through capacity building support to the local institutions managing the markets, which contributed to the sustainable management of the project markets. Through sub-group analyses we find that this type of project can be particularly beneficial for poorer, more remote households, although some impacts, such as on livestock income and wage labour vary depending on facilitating conditions.

A number of lessons can be drawn from these findings to improve the impact of future climate resilient infrastructure projects. First, future projects should pay special attention to ensuring households have access to high-quality agricultural inputs, as improved access to output markets does not necessarily improve access to inputs especially for capital constrained households.. In addition to improving input access, agricultural productivity and income could also be improved by providing complementary training and technology support.

Second, future projects should consider different components of beneficiaries' livelihoods and provide activities to stimulate the main sources of income, which may vary for different areas. In some cases for CCRIP, there was a lack of impact on the main income sources for some households (mainly wage labour and household enterprises), leading to a lack of impact on total income. Impact on income could thus be enhanced by offering complementary support for the livelihood activities that are the most important in each local context. In the case of wage labour, this could involve a redesign of the LCS activities to ensure that the valuable employment and training provided does not remain short-term in nature and includes support to establish linkages with local labor market for sustained impacts. In terms of household enterprises, these activities could be improved by facilitating easier entry into local markets for small shops and traders, as well as providing credit and training for setting up and managing these businesses.

Finally, future projects should provide more extensive support to improve the income generating opportunities and overall empowerment of women, especially in countries such as Bangladesh where women face ingrained barriers to their mobililty and autonomy. Although the LCS impacts for CCRIP were promising, these activities combined with market and road support that did not explicity target these barriers were largely insufficient for improving women's empowerment, particularly in Muslim households. Based on the success of initiatives such as BRAC's Empowerment and Livelihood for Adolescents program in Bangladesh (as well as Afghanistan,

Haiti, Sierra Leone, South Sudan, Tanzania and Uganda - see Bandiera et al. 2018) future projects could provide multi-faceted support to improve the hard and soft skills of women, provided within a safe space environment, and involve the wider society to ensure sustainability of impacts.

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Appendix I: Mean values for impact indicators

I.A: Treatment and control means for impact indicators of agricultural productivity and sales

	Treatment		Control		Diff.
	Mean	Obs	Mean	Obs	
Value of ag. production per ha (BDT):					
– Full year	149,466	806	43,160	1,070	106,306*
– Dry seasons only	59,452	806	39,944	1,070	19,508***
– Monsoon season only	38,666	806	41,020	1,070	-2,354
Gross margins per ha (BDT).	111,945	806	10,632	1,070	101,313*
Proportion of harvest sold (%)	33.2	806	27.1	1,070	6.1***
Sold at market (%)	50.3	586	41.6	683	8.7***
Income from crop sale per ha. (BDT):					
– Full year	40,879	806	22,455	1,070	18,424***
– Dry seasons	31,577	806	17,267	1,070	14,310***
– Monsoon season	48,351	806	26,926	1,070	21,425***
Nr. crop varieties (count)	2.6	806	2.6	1,070	0
Grew at least one high-value crop (%)	43.9	806	38.3	1,070	5.6**

Note: *,** and *** indicate that the difference between the treatment and control means is statistically significant at the 10, 5 and 1% levels, respectively.

I.B: Treatment and control means for impact indicators of agricultural input use

	Treatment		Control		Diff.
	Mean	Obs	Mean	Obs	
Land cultivated (ha.)	3.3	806	2.8	1,070	0.5*
Value of inputs per ha. (BDT)	37,522	806	32,528	1,070	4,994**
– Seeds	6,457	806	3,606	1,070	2,851**
– Fertiliser	4,653	806	4,054	1,070	599
– Crop Protection†	3,519	806	3,717	1,070	-198
– Labour	27,543	806	25,585	1,070	1,958
Input productivity of (BDT):					
– Seeds	66.9	710	40.4	900	26.5
– Fertiliser	774.3	671	29.5	854	744.8
– Crop Protection	25,970	629	119.6	780	25,850
– Labour	329.6	806	201.9	1,070	127.7*

Note: *,** and *** indicate that the difference between the treatment and control means is statistically significant at the 10, 5 and 1% levels, respectively.

I.C: Treatment and control means for impact indicators of fish production and sale

	Treatment		Control		Diff.
	Mean	Obs	Mean	Obs	
Gross value of fish production (BDT)	33,181	626	26,746	900	6,435
Net value of fish inputs (BDT)	241,260	626	235,708	900	5,552
Revenue from fish sale (BDT)	18,573	626	5,429	900	13,144
Sold fish at market (%)	55.0	129	41.3	143	13.7**
Value of fish consumption per capita (BDT)	2,390	626	2,201	900	189

Note: *,** and *** indicate that the difference between the treatment and control means is statistically significant at the 10, 5 and 1% levels, respectively.

I.D: Treatment and control means for impact indicators of livestock rearing and sale

	Treatment		Control		Diff.
	Mean	Obs	Mean	Obs	
Gross value of livestock production (BDT)	40,477	944	31,490	1,227	8,987
Net value of livestock production (BDT)	410,993	944	404,329	1,227	6,664
Revenue from livestock and product sale (BDT)	30,734	944	22,811	1,227	7,923
Sold livestock or livestock product (%)	52.4	944	50.3	1,227	2.1
Milk productivity per cow (BDT)	8,342	356	6,218	532	2,124***

Note: *,** and *** indicate that the difference between the treatment and control means is statistically significant at the 10, 5 and 1% levels, respectively.

I.E: Treatment and control means for impact indicators of income and livelihood composition

	Treatment		Control		Diff.
	Mean	Obs	Mean	Obs	
Gross income per capita (BDT)	79,588	1,188	69,177	1,552	10,411
Net income per capita (BDT)	55,658	1,188	45,277	1,552	10,381*
Income from waged labour per capita (BDT)	51,328	554	35,901	737	15,427
Income from household enterprise per capita (BDT)	98,508	369	98,628	478	-120
Nr. income sources (count)	7.9	1,188	7.6	1,552	0.3**
Above $1.90/ day pov. line (%)	75.3	1,188	73.3	1,552	2.0
Proportion of income from (%):					
– Crop sale	16.1	1,188	13.3	1,552	2.8***
– Fish sale	2.1	1,188	1.3	1,552	0.8**
– Livestock sale	6.2	1,188	6.6	1,552	-0.4
– Formal waged labour	22.2	1,188	20.5	1,552	1.7
– Casual waged labour	10.0	1,188	11.8	1,552	-1.8*
– Household enterprises	23.5	1,188	23.4	1,552	0.1
– Remittances	12.7	1,188	16.2	1,552	-3.5***
– Land rental	1.1	1,188	1.2	1,552	-0.1
– Other sources	4.1	1,188	4.1	1,552	0

Note: *,** and *** indicate that the difference between the treatment and control means is statistically significant at the 10, 5 and 1% levels, respectively.

I.F: Treatment and control means for impact indicators of assets, food security and education

	Treatment		Control		Diff.
	Mean	Obs	Mean	Obs	
Asset indices:					
– Household durable assets	1.2	1,188	1.2	1,552	0
– Productive assets	0.6	1,188	0.6	1,552	0
– TLU	0.8	1,188	0.8	1,552	0
FIES score	2.2	1,188	2.6	1,552	-0.4***
Worried about having enough food (%)	51.7	1,188	62.8	1,552	-11.1***
Dietary Diversity Score	10.5	1,188	10.6	1,552	-0.1
School-age children enrolled (%)	70.0	952	71.1	1,252	-1.1

Note: *,** and *** indicate that the difference between the treatment and control means is statistically significant at the 10, 5 and 1% levels, respectively.

I.G: Treatment and control means for impact indicators of financial inclusion

	Treatment		Control		Diff.
	Mean	Obs	Mean	Obs	
Have formal bank account (%)	20.6	1,188	17.8	1,552	2.8*
Have other account (MFI, NBFI, mobile money) (%)	19.6	1,188	24.4	1,552	-4.8***
Took a loan in past year (%)	51.0	1,188	52.5	1,552	-1.5
Savings per capita (BDT)	2,060	1,188	2,018	1,552	42

Note: *,** and *** indicate that the difference between the treatment and control means is statistically significant at the 10, 5 and 1% levels, respectively.

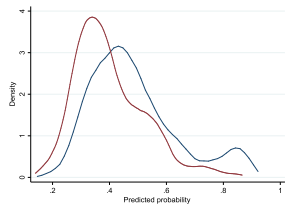
I.H: Treatment and control means for impact indicators of women's empowernment

	Treatment		Control		Diff.
	Mean	Obs	Mean	Obs	
Household income from women's activities (% of total income)	1.6	1,182	1.3	1,548	0.3
Women own enterprise (%)	2.1	1,182	2.0	1,548	0.1
Women involved in decision making (joint or individual) for (%):					
– Household purchases	39.8	1,182	37.7	1,548	2.1
– Children's education	82.9	1,182	85.7	1,548	-2.8**
– Crop or livestock prod.	57.8	778	61.1	1,043	-3.3
– Crop or livestock sales	52.3	778	57.2	1,043	-4.9**

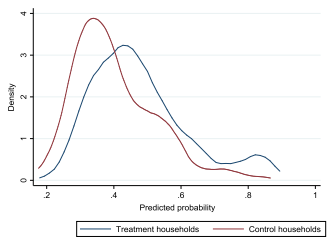
Note: *,** and *** indicate that the difference between the treatment and control means is statistically significant at the 10, 5 and 1% levels, respectively.

Appendix II: Distribution of Propensity Scores before and after trimming

Before trimming



After trimming



Appendix III: Results from the secondary IPWRA model

III.A: Impact of CCRIP on agricultural productivity and sales

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Value of ag. production per ha:				
– Full year	15.8	1,876	14.8	866
– Dry seasons only	148.7**	1,876	122.4**	866
– Monsoon season only	-24.4	1,876	-4.4	866
Gross margins per ha.	6.0	1,876	5.6	866
Proportion of harvest sold	6.9**	1,876	3.8	866
Sold at market (% likelihood)	6.7	1,269	15.3**	598
Income from crop sales per ha.:				
– Full year	114.3**	1,876	134.1***	866
– Dry seasons	186.0**	1,876	143.8**	866
– Monsoon season	99.2	1,876	79.8	866
Nr. crop varieties (count)	3.1	1,876	-2.3	866
Grew at least one high-value crop (% likelihood)	4.9	1,876	3.0	866

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

III.B: Impact of CCRIP on agricultural input use

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Land cultivated (ha.)	-6.8	1,876	76.2	866
Value of inputs per ha.	13.5	1,876	24.4	866
– Seeds	9.2	1,876	21.5	866
– Fertiliser	5.9	1,876	68.6*	866
– Crop Protection†	32.9	1,876	96.0**	866
– Labour	15.9	1,876	47.2	866
Input productivity of:				
– Seeds	7.0	1,610	26.6**	750
– Fertiliser	8.3	1,525	-1.4	708
– Crop Protection	3.6	1,409	0.8	636
– Labour	6.6	1,876	-4.0	866

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.
† Crop protection includes following inputs: pesticides, herbicides, fungicides, insecticide

III.C: Impact of CCRIP on fish production and sale

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Gross value of fish production	-18.1	1,456	2.0	664
Net value of fish inputs	-1.3	1,456	-1.9	664
Revenue from fish sales	51.0	1,456	47.0	664
Sold fish at market (% likelihood)	8.6	257	-1.24	101
Value of fish consumption per capita	-14.3	1,456	-17.2	664

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

III.D: Impact of CCRIP on livestock rearing and sale

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Gross value of livestock production	9.1	2,171	14.6	1,006
Net value of livestock production	-0.7	2,171	1.2	1,006
Revenue from livestock and product sales	22.3	2,171	2.7	1,006
Sold livestock or livestock product (% likelihood)	2.5	2,171	0.1	1,006
Milk productivity per cow	-31.1	2,267	16.0	404

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

III.E: Impact of CCRIP on income and livelihood composition

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Gross income per capita	6.0	2,740	7.2	1,312
Net income per capita	-0.7	2,740	-2.4	1,312
Income from wage labour per capita	14.8**	1,291	10.5	607
Income from household enterprise per capita	-4.9	847	8.3	423
Nr. income sources (count)	0.2	2,740	0.4	1,312
Above $1.90/ day pov. line (% likelihood)	2.6	2,740	5.5	1,312
Proportion of income from (percentage points):				
– Crop sales	0.6	2,740	5.2**	1,312
– Fish sales	0.6	2,740	0.7	1,312
– Livestock sales	-0.9	2,740	-1.7	1,312
– Formal wage labour	2.4	2,740	2.0	1,312
– Casual wage labour	-1.1	2,740	-2.5	1,312
– Household enterprises	-0.6	2,740	-3.9	1,312
– Remittances	-1.4	2,740	-0.6	1,312
– Land rental	-0.1	2,740	-0.4	1,312
– Other sources	-0.2	2,740	0.9	1,312

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

III.F: Impact of CCRIP on indicators of assets, food security and education

	2km from market		1km from market	
	ATE	Obs	ATE	Obs
Asset indices:				
– Household durable assets	0.1	2,740	15.1**	1,312
– Productive assets	-0.01	2,740	6.3**	1,312
– TLU	-0.1	2,740	-12.6	1,312
FIES score	-13.8%**	2,740	-23.3%***	1,312
Worried about having enough food (% likelihood)	-11.2***	2,740	-17.5***	1,312
Dietary Diversity Score	-0.6	2,740	-39.5	1,312
School-age children enrolled (percentage points)	-1.7	2,204	3.4	1,056

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.

III.G: Impact of CCRIP on financial inclusion

	2km from market		1km from market	
	ATE*	Obs	ATE	Obs
Have formal bank account (% likelihood)	2.2	2,740	2.4	1,312
Have other account (MFI, NBFI, mobile money) (% likelihood)	-4.2*	2,740	0.2	1,312
Took a loan in past year (% likelihood)	0.2	2,740	-3.9	1,312
Savings per capita	-4.2	2,740	5.1	1,312

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.
*Coefficients represent percentage change unless specified otherwise.

III.H: Impact of CCRIP on women's empowernment

	2km from market		1km from market	
	ATE	Obs	ATE	Obs
Household income from women's activities (percentage points)	0.3	2,730	0.5	1,308
Women own enterprise (% likelihood)	0.2	2,730	1.1	1,308
Women involved in decision making (joint or individual) for (% likelihood):				
– Household purchases	3.1	1,821	6.9	1,308
– Children's education	-1.0	1,821	3.1	1,308
– Crop or livestock prod.	-0.3	1,821	3.5	838
– Crop or livestock sales	-2.3	1,821	-0.5	838

Note: *,** and *** indicate that the estimated ATE is statistically significant at the 10, 5 and 1% levels, respectively.

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