Char Development and Settlement Project Phase IV Bangladesh

Agricultural developments

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Implementing Government Agencies:

- **Bangladesh Water Development Board (BWDB)**
- **Ministry of Land (MoL)**
- **Local Government Engineering Department (LGED)**
- **Department of Public Health Engineering (DPHE)**
- **Department of Agriculture Extension (DAE)**
- **Forest Department (FD)**

and NGOs

1. Introduction

The Technical Report describes some of the developments in agriculture that took place during CDSP IV. This report is based on three sources of information:

(a) Case studies of seven farmers (one of whom was a woman) conducted in mid-2018. These case studies were carried out after data was collected for the impact survey and other reports, and provides some new and additional insights on the impact of CDSP IV on agriculture.
(b) An evaluation of CDSP IV by Dr Nowsher Sarder, an agronomist, carried out in March 2018 as part of the preparation of the draft Project Completion Report, particularly crop budgets for use in economic and financial analysis.
(c) An investigation of the sorjon system (integrated vegetable-fish production) involving more farmer case studies

This report shows how a combination of physical improvements in water management and investment in road access and market infrastructure along with improving the knowledge and awareness of farmers about improved farming methods can result in a dramatic increase in crop production and farm income. Case studies also show that market access has not been a problem for farmers selling a greatly increased volume of produce, especially fresh vegetables – improved communications and better public markets attract traders who compete to buy crops, and farmers say they get fair prices for whatever they produce. The sorjon system (integrated vegetable-fish production) is an excellent example of climate smart agriculture but will benefit from further investments in water management to minimise the risk of flood damage, as well as better pest management to reduce the cost of pest control.

2. Impacts of CDSP IV on farming and farm livelihoods

The seven case studies (each one is in Appendix 1) included five from char Nangulia and one each from Noler and Ziauddin chars. All of these farmers say that their crop production has increased by two to three times with considerable reduction (and even elimination) of waterlogging and drainage. The cropping seasons have been extended as it is now possible to grow crops in the rabi/boro season and cropping intensity has increased[1]. For paddy, farmers have switched from local varieties to HYVs and hybrids. HYV yields are between two to four times that of the earlier local varieties (typically 1,250 to 2,000 kg/ha for local varieties and 5,000 to 6,000 kg/ha for HYV). All the case study farmers report growing hybrid boro[2] – including those in Noler and Ziauddin chars, with yields around 6,000 to 7,500 kg/ha[3]) - over five times

Transplanting hybrid boro seedlings as single seedlings – the higher price of hybrid seed is very largely offset by the reduced seed requirement

[1] Data from the baseline and impact survey (Technical Report 22) shows cropping intensity (c.i.) increased from 104% in 2011 to 130% in 2017. Results of focus group discussions conducted in 2018 by Dr Nowsher Sarder show that overall c.i. is now 149%, and in char Nangulia it is 129% compared to only 113% in the neighbouring Char Maximul Hakim which is not part of the CDSP IV project area.

[2] So far hybrid varieties are only being adopted for the boro crop.

[3] Some farmers claim yields of 10 tons per hectare, but inspection of crops suggests that such yields are not yet being achieved. It should also be noted that boro yields are in terms of the weight of freshly harvested grain, and it is reported that grain will dry out and loose about 10% of its weight in the months following harvest.

that of traditional varieties of aman paddy.

The expansion of boro seems to have continued since data was collected for the impact study at the end of 2017. All seven case study farmers reported growing boro, including those on Ziauddin and Noler chars were little or no boro was reported in the impact survey. What is interesting is that four of the seven farmers say they irrigate boro using surface water sources – pumping water from drainage canals. CDSP IV did not encourage expansion of boro because of concerns that irrigation would deplete groundwater from the deep aquifer (at shallow depths groundwater is saline) and so effect the deep tubewells installed for domestic water supplies. Plans for CDSP IV envisaged that some significant areas of fresh water would be created by river closures and sluice gates. Although erosion of embankments means that protection from saline intrusion over the whole empoldered area is not yet fully effective, the farmers in these case studies all talk of very significant reductions in waterlogging and salinity. If significant irrigation can be provided from surface sources, irrigation of boro may be more sustainable and less damaging to domestic supplies than was envisaged in the draft PCR – at least in locations where sufficient surface water is available.

Crop of hybrid boro

Training in improved crop production increased awareness about improved crop varieties and new types of vegetables. Farmers also said that they has learned about recognising contaminated fertiliser which was useful. Apart from the introduction of new varieties (HYVs and hybrids) and vegetables, new techniques that were learned and adopted include the balanced use of fertiliser – farmers say they now use four different types (but this may include organic compost) compared with only one (urea) prior to CDSP IV. Farmers also make and use (and one also sells) vermi compost. In terms of pest control, new practices include perching branches (to attract birds that catch insects in paddy fields), and pheromone traps (to control fruit fly in cucurbits and fruit and shoot borer in aubergine). Farmers also say they were trained on seed selection and preservation – but do not mention adopting new practices in this regard.

Farming has become mechanised – farmers say they now prepare land with power tillers, thresh paddy with peddle threshers and use pumps to lift water. One of the case studies also mentioned a weeding machine – probably a push weeder. Such tools were only reported by 3% of sample farmers in the impact survey – but only 4% reported planting paddy in lines which is a prerequisite for using push weeders, but two other case study farmers reporting line planting, so maybe this is an innovation which is now beginning to catch on.

Preparing land with a power tiller

Farmers say that they have planted a great number of trees around their homesteads and these, together with trees planted along roadsides and canals, provide shelter from storms. The woman farmer interviewed said that she had already sold trees worth Tk300,000.

All of the case study farmers stressed how easy it was to market their produce. They all took their produce to local markets and sold it there – this was easy on roads built by CDSP IV. Farmers said that many wholesale buyers and brokers visited these markets so there was competition to buy their produce, giving them scope to negotiate, and resulting in them getting what they considered to be fair prices. Farmer said it was easy to sell whatever they produced.

Transporting crops to market on a road built by CDSP I (photo SDI)

CDSP IV supported links between market actors (wholesale buyers and brokers) and Farmers' Forums (FF). Some (three out of seven) of the case study farmers said such linkages were not very useful, and thought that FF did not have a real role in marketing. Others (three out of seven) said market actors were useful (although the role of FF in this was not entirely clear), and that these actors provided farmers with loans for inputs through advance sale arrangements (contract farming). Such advance sales are known as "dadon", but one farmer said that, with increased production and improved market linkages there was now no dadon. What he seems to have been referring to was the practice, which was widespread at the time of CDSP IV design, of poor households selling crops (typically paddy) in advance of harvest in order to get cash to buy food and other necessities. Such loans were costly as they were forced to sell their crop at a low price to the lender. In contrast, the advance sales to market actors would be for vegetables with a very reasonable (or even zero) rate of interest – as the buyers are keen to secure their supplies in advance of harvest. Farmers also said that people no longer use moneylenders as loans from NGOs are now available.

Crops being sold in a market (photo SSUS)

Cucumbers and gourds in a market (photo SSUS)

Membership of Farmers' Forums (FF) was reported to be useful, with training opportunities and inputs provided to FF members. A couple of farmers also mentioned the FF meetings were useful as forums to discuss problems and potential solutions. Three farmers mentioned useful contact and assistance for crop production from DAE and its field staff, with PNGOs providing support for livestock and fisheries – although this is not in the context of the FF.

All the case study farmers said that CDSP IV had resulted in considerable empowerment of women. Training women in IGAs and specific awareness raising means women now take a larger role in the home and wider community. In particular women now can earn an income – either through their own non-farm IGAS such as tailoring, though homestead vegetables, livestock and fisheries, and working in the fields alongside men. Women are now able to move around outside their homes – it was not safe for them to do this before. Women have also been empowered through having their names on land title documents. As a result of all this, they now have status in their community and are valued in their homes.

Women have become leaders of CDSP Field Level Institutions and some have been elected to local government.

When asked about the overall improvement to their lives, case study farmers said that before they were "tortured" by bahini (land grabbers, land was unproductive due to frequent intrusion of saline tidal water, there were no roads, farmers lacked knowledge and access to improved crop varieties, and people did not have enough to eat. Now people no longer live in thatched huts but have houses made of corrugated iron, children and now able to go to school. They can now grow enough food to meet the needs of their families and have a surplus to sell. Char families now have a good quality diet from food grown on their own farm, including eggs and fish.

A couple of case study farmers mentioned some problems that still exist. One identified an area that was still waterlogged and needed additional drainage. Another said there was a need for salt-tolerant crop varieties and mentioned the threat of land loss due to coastal erosion.

3. Crop production costs and use of inputs

As crops have become more productive, input use has increased. It is now profitable for farmers to invest in inputs (seed, fertiliser etc.) as crops can utilise higher level of fertiliser as soils have become more productive. At the same time, water management infrastructure means that the risk of loss has fallen. Data in Table 1 shows expenditure on three different categories of inputs: (i) production services of land cultivation ,irrigation and transport (of crops to market); (ii) inputs including seed, fertiliser, manure/ compost, pesticide, crop supports, packing materials; and (iii) labour, both family and hired. The data in this table is taken from calculations of project benefits at the time of project completion (i.e. project year 7) in the draft PCR report – themselves based on focus groups discussions with farmers. The costs are in financial prices, including family labour priced at the cost of hired labour.

Table 1: Production costs for key crops

	Aman local	Aman HYV	Boro hybrid	Soya	Keshari	Cucumber	C. bean
Production costs Tk per hectare							
Cultivation, irrigation, transport	6,986	7,436	23,286	6,917	232	4,168	4,446
Inputs	5,637	15,487	26,596	14,714	6,662	146,781	116,709
Of which pesticide	1,544	5,404	6,948	1,544	772	77,200	46,320
Labour	29,925	36,000	57,375	41,850	27,900	158,400	88,650
Total	42,548	58,923	107,257	63,481	34,794	309,349	209,805
As percent of total costs							
Cultivation, irrigation, transport	16%	13%	22%	11%	1%	1%	2%
Inputs	13%	26%	25%	23%	19%	47%	56%
Of which pesticide	4%	9%	6%	2%	2%	25%	22%
Labour	70%	61%	53%	66%	80%	51%	42%
Total	100%	100%	100%	100%	100%	100%	100%

Paddy growers have switched from growing local varieties of aman to HYV aman. This involves higher costs, with the proportion of cost spent on inputs doubling from 13% to 26% with a fall in the proportion of costs absorbed by labour. Hybrid boro production involves significantly higher costs, with irrigation expenses meaning that the production service cost category increases to 22% of total costs, while labour reduces to 53%. For non-paddy field crops there has been a switch from keshari (grass pea), a low value pulse that is broadcast into aman paddy prior to its harvest, to higher value crops such as soyabean. Crops such as soyabean incur additional costs for land cultivation and inputs, while the cost of growing keshari is primarily labour with a little seed and other inputs.

Figure 1: Production costs for key crops

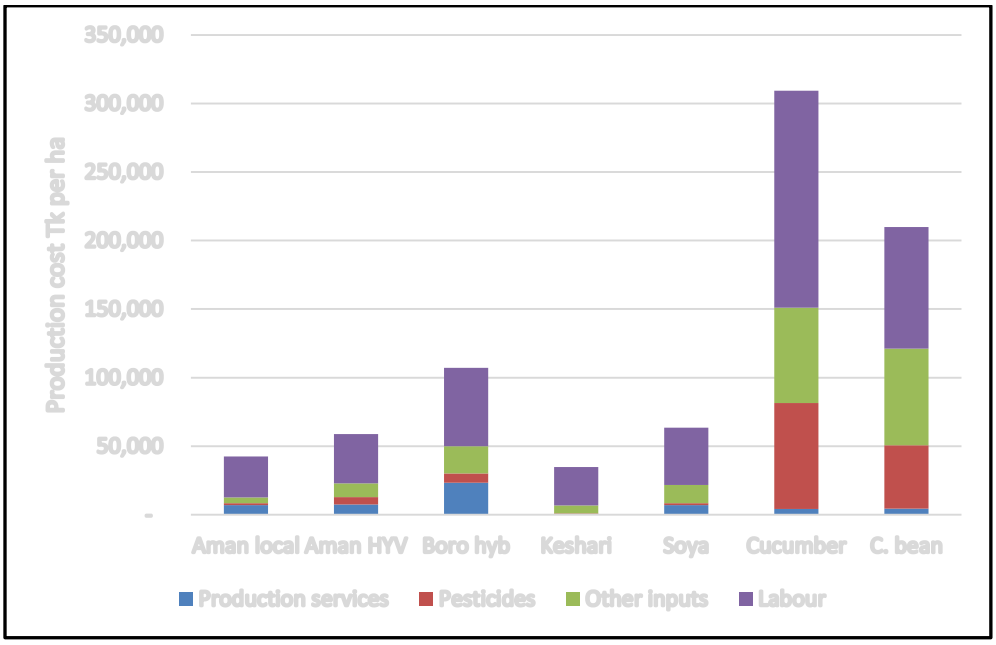

Table 1 and Figure 1 also show production costs for two vegetables - cucumber and country bean, which are widely grown in sorjon plots as well as homesteads. The costs of growing these vegetables is substantially more than that of any field crop, and some farmers have converted all of their land to sorjon production. The cost of inputs accounts for around half of the production cost of these crops, and pesticides account for half of total input cost.

The increased cost of inputs reflect increased use of fertilisers for HYV aman relative to local aman – crop budgets based on FGDs assumed that local variety aman received 124 kg/ha of urea, while HYV aman got a total of 308 kg/ha of urea and TSP, and 519 kg/ha of urea, TSP, MoP, zinc and gypsum was applied to hybrid boro along with organic compost or manure. The yields assumed in these budgets (2,700 kg per ha for local aman, 3,800 kg for HYV aman and 6,500 for hybrid boro) were based on data from the impact survey – the HYV aman yield is significantly lower than that reported in the case studies. Cucumber and country bean receive larger volumes of fertiliser, and significant sums are also spent on crop supports (over Tk20,000 per ha) as well as around Tk4,000 on baskets to take the crops to market.

Shoot borer damage in brinjal (aubergine)

Although CDSP IV made considerable efforts to introduce and promote a range of IPM and biological control pest measures, farmers are spending considerable sums on pesticides. Pheremone traps for fruit fly are used in cucumber and gourd crops, and case study farmers talk about using perching branches to attract birds to catch insects in paddy - where the main pest is stem borer. Interviews with Farmers' Forums (Technical Report 16) revealed that farmers considered pest control to be their major problem. Farmers mainly discuss problems concerning paddy and

vegetable crops (principally country/long beans, cucumber and gourds, also chilli) – and not so much for pulses and oilseeds.

Pheremone trap in gourds (photo SSUS)

However farmers in FGDs said they routinely spray (at fixed intervals of 7 to 10 days) country/long beans for aphids and pod borer, and cucumbers and gourds for aphids, red pumpkin beetle and white fly, and chilli for fungal diseases such as root rot. Although chemical use is limited in sorjon crops by the requirement not to harm the fish in the ditches between the ridges where vegetables are grown, a lot of chemical seems to be used with little regard to the actual likelihood of crop losses. There is clearly potential for a more measured approach to the use of pesticides, with applications aimed at specific pests when they exceed threshold levels identified by pest scouting[4].

4. Sorjon – integrated vegetable and fish production system

4.1 Introduction

Sorjon is a system of integrated vegetable and fish production. It is believed to have originated in Indonesia, where it is known by the same name. Over the last few years it has been adopted at a number of locations in the coastal area of south-western Bangladesh. It is now being widely used in part of the CDSP IV area, having been introduced during CDSP III by Dr S A Sattar, Agricultural Consultant for CDSP III. Part of char Nangulia is relatively poorly drained while being protected from severe flooding, and sorjon has been widely adopted here, with data from the impact study suggesting that it covers 5% of cultivable land and involves 11% of farming households.

This paper describes the system as adopted by farmers in char Nangulia, and assesses the benefits that accrue to farm households. Information on sorjon is based on nine case studies (details in Appendix 2), data from the impact survey (Technical Report 22) and discussions with project staff.

4.2 Description of the system

The sorjon system is the cultivation of vegetables on ridges with fish in the ditches between these ridges. On char Nangulia the ridges are mostly around one metre wide at the top and spaced two metres apart – although in places ridges and spacing can be wider than this. Ridges are about 60 to 90 cm high, which means crops are kept above the water, even during the wet season. The ditches between the ridges hold water for six to eight months per year, and can be used to cultivate fish as well as being a source of water to irrigate the crops.

[4] A recent study by World Vegetable Centre in Cambodia estimated that 92% of expenditure on pesticides for vegetable production exceed the economic optimum. Farmers lack of knowledge on pest management methods is strongly correlated with excessive pesticide use – Safe pest Management in Cambodia, Calling for Impact, World Vegetable Centre, January 2019.

Sorjon with newly planted cucumbers

Sorjon are used for intensive vegetable production, with a framework of bamboo, string and netting being built over the ditches to support a sequence of climbing plants. Before the rains start in March, cucumbers are planted, and these are followed by a variety of gourds (including snake, bottle, bitter and ribbed gourds) in the early monsoon, with yard long bean (asparagus bean) and country bean (lablab bean) in the later monsoon, with country beans continuing to be harvested through the dry season up to the following March. These crops overlap with each other, with relay cropping allowing more or less continuous harvesting for 9 or 10 months per year (early June to March).

Impact survey data shows that the average size of a sorjon plot is 56 decimals (0.225 ha). Around 15% to 20% of sorjon farmers have converted virtually all of their land to sorjon, becoming commercial vegetable and fish producers, and buying rice and other foodstuffs from the market. In locations where drainage is better, sorjon farmers have also been able to improve the productivity of paddy. Case studies 8 and 9 show that improved productivity of paddy means that these households are now more than self-sufficient in rice despite converting some land to sorjon – which is their major source of cash income from farming.

4.3 Benefits

Case studies (see below) and calculations in crop budgets[5] show that one acre of sorjon (on average a sorjon household will have half an acre of sorjon) can give a farmer a net income of about Tk100,000 per year. This land was previously growing a single crop of a low yielding paddy.

Development of sorjon on this large scale has been enabled by the greatly improved road communications that has linked producers to national markets for fresh vegetables. Much of the country bean crop is sold as dried seed. Some of this is grown on contract farming arrangements, including linking farmers to a food processor in Chittagong (it is an ingredient in some snacks). Country bean seed is also exported (including to Japan for use as bean sprouts).

[5] Crop budget calculations show that a combination of 25% cucumber, 25% snake gourd and 50% country bean generates a gross margin of Tk152,387 per hectare (Tk61,695 per acre) – see draft PCR (Technical Report 20). However sorjon can grow all of these crops in succession within a single year so annual income per acre or hectare will be two or three times this figure.

Gourd production in sorjon

Sorjon also generates benefits in terms of household food security and nutrition. Yard long beans are a good source of protein, vitamin A, thiamin, riboflavin, iron, phosphorus, and potassium, and a very good source for vitamin C, folate, magnesium, and manganese. Country bean is one of most nutritious of all pulses, being high in calories, protein, unsaturated fat, vitamins (especially B1), and minerals (iron, copper and zinc). These beans are said to be good for brain and cardiovascular health, prevent cancer, assist respiration, and supports digestion.

The impact survey shows that virtually all (98%) sorjon plots also produce fish. However fish is very much a secondary product with an average production (per plot of 56 decimals) of 52 kg per year (compared with an average of 204 kg for a fish pond household). These fish are worth Tk7,470 – compared with Tk100,000 or more from sorjon vegetables.

Lastly, sorjon has been cited as an example of climate-smart agriculture[6]. Climate-smart benefits are in terms of: (i) productivity (increase vegetable production throughout the year, with an economic return from fallow land); (ii) adaptation (increases farmers' capacity to limit the crop exposure to tidal water submergence; and (iii) mitigation (contributes to increase the above-ground biomass constituting a carbon sink).

4.4 CDSP IV interventions and remaining challenges

CDSP IV has created the physical conditions suitable for sorjon production, along with communications infrastructure to link farmers to markets. Farmers have learned about the sorjon system through technical training, visits to other groups, and membership of Farmers Forums and NGO groups. The project has also introduced some improved technologies into the system. New varieties of sorjon vegetables have been introduced, including hybrid varieties of cucumber and gourd, and new varieties of yard long bean and new varieties of country bean that are more productive for produce an earlier crop of pods at a time when market prices are at their highest. Farmers are making widespread use of pheromone traps to control fruit fly in gourds. To increase fish production, fast growing mono-sex tilapia have been introduced, along with modern fish feeds.

[6]CIAT; World Bank. 2017. Climate-Smart Agriculture in Bangladesh. CSA Country Profiles for Asia Series. International Center for Tropical Agriculture (CIAT); World Bank. Washington, D.C. 28 p.

There are still problems in the sorjon systems. Some case study farmers report periodic losses due to flash floods, especially when a cyclone hits the char. Drainage congestion is also linked to this problem. On some plots, cucumber plants are affected by salinity before the rains start. Sorjon farmers say their production would increase with better water management. Although a number of environmentally friendly systems of pest control have been introduced, farmers say that they still need to use a considerable volume of chemical pesticides to control some insect pests, especially in country bean.

Appendix 1: Case studies on farming and farm livelihoods

Case study 1

A. Respondent Profile	Rahena Begum, wife of late Abul Kalam, Mannan Nagar somaj, Noler char. Mobile: 01737808835 Associated with NGO-SSUS
B1.Major changes in farm activities	She engaged herself in farming after CDSP IV came here. Before CDSP IV, farmers used to cultivate traditional rice-Rajashail and get only 30 maunds per 160 decimals (1,52kg/ha). But, now they are using HYV and hybrid varieties like BR 52, 40 & 41 that yield 80-100 mounds per 160 deci (4,940 kg to 6,175 kg per hectare). In the past they only grew aus and aman. Now they are producing aus, amon and boro.
B2.a Changes in physical conditions	There have been lots of changes. with improvement of flooding, salinity and drainage due to establishment of water control structured. She has received land title to 160 decimals of land s in her own name. Land has been developed through digging ponds for fish culture and irrigation.
B2.b Changes attributed to CDSP IV	CDSP has constructed infrastructure like embankments, drainage canals, sluices, DTWs and latrines, roads and bridges, and plantations. Char dwellers are planting trees in their homesteads (she earned Tk. 300,000 from sales of trees). They are taking fresh water from CDSP IV DTWs (one for every 18 households).
B2c Overall changes and production	They are getting 2-3 times more crop production due to adoption of modernized farming technology provided by CDVSP IV. They can produce crops in all three cropping seasons of the year. In the past they could not do this.
B.3 New crops and new technologies adopted	New crops introduced are BR-52, BR-11, Hira-2, Alom ACI, hybrid-laltir, balia-2, rak kumar. New technologies introduced are use of balanced fertilizer, perching, vermi composting, production of organic fertilizer, pheromone traps.
B4.a Types of training	One training on seed preservation, 4-days training on use of fertilizer, crop production, soil testing and planting of sapling
B4b How useful	Training was useful in selection of hybrid and HYV seeds for different crops, identifying pure and contaminated fertilizers,
B4c New ideas adopted	They have learned and use new technologies. They now use HYV and hybrid varieties of crops, which have replaced traditional varieties due to their higher yields.
B5.a Change in use of inputs	Changes in use of inputs and machinery. Farmers are using agri-implements like power tillers for cultivating land, peddle threshers at harvest, and pumps.
B5.b Factors contributed	Due development of road and market infrastructure, farmers are selling crops that they produce. Produce is now being transported to distant market places. Some farmers have established shops in the markets using their own capital.
B6.a Members of FF	Is an FF member. Being a member, she received training, inputs like seeds & fertilizers, and she also gained knowledge and skills.
B6.b Utilizing FF services	To get services of the FF no money needed to be paid. Farmers borrow from money lender (paying 200% interest per year).
B7. Leasing land	Farmer has taken lease of 240 decimals. She also owns 120 decimals of cultivable land out of the 150 decimal area for which a khatian was received from CDSP IV.
B8.a Farming services expanded/ contracted	She said that she was encouraged to develop her land and benefited a lot due to having assistance from DAE Field Officers and SAAO. Besides this, they got help from the PNGO in regard to rearing poultry and livestock, and fish culture.
B8.b Why have you made changes	Due to development of road infrastructure they can now purchase agri-inputs from local markets and similarly they can sell their produce in the local markets. Besides, saline water cannot enter to their land and currently there is no waterlogging. There exists favourable environment for cultivation of crops and vegetables.
B9. How have sales	More bananas are now cultivated, but cultivation of traditional rice varieties like rajashail or kajolshail has been reduced. They sold paddy for Tk. 52,500 this year, but before CDSP-IV this was not possible. Country bean seeds - they produced 9 maunds and sold Tk. 10,800 this year. Before country bean could be cultivated.

B10. Where and through what	Farmers no longer go to local money lenders as they can get loans from NGOs. They are getting fair prices due to selling products to markets developed by CDSP-IV. The brokers buying produce now come to the market. Now farmers getting 2-3 times more income than before. They can sell whatever they bring to the market.
B11. Examples of changes	Before CDSP traditional paddy yield was only 35-40 maunds per 160 decimals (2,161-2,470 kg/ha). But, now HYV rice 80-100 maunds per 160 decimals (4940 kg to 6,175 kg per hectare)and hybrid rice 120-130 maunds per 160 decimals (7,410-8,028 kg/ha). Production of country bean is 2-3 maunds per decimal (123-185 kg/ha). Before these were not grown. Due to modernised cultivation farmers getting high production.
B12. Role of women during CDSP-IV	In the past women could not work and they were also not safe. In CDSP-IV women have been trained on gender awareness and women empowerment through different IGA training. Now they can move and work outside home participating in IGAs. CDSP-IV has given land titles in the names of both husband and wife ensuring women as the first named. Besides women become member of FLI and LGIs through democratic participation.
B13. Main problems before and now	Before CDSP there was: a) torture by bahinis, b) intrusion of saline water, c) too much waterlogging, d) seeds of HYV and hybrid varieties were not available, e) absence of modern technologies . If a canal is now excavated in 8-dag area, then they will benefited and do farming in even a better way.
C1. Changes in Living Standards	Before they had a tiny thatched hut, now they have a new tin shed house, b) both children are educated - the ender one has graduated, c) they have planted lots of trees around the house, d) social status has increased, e) they are skilled in agri-farming due to training by CDSP-IV.

Case study 2

A. Respondent Profile	Md. Nazimuddin, son of late Shahfuzul Hoque, Miajee Gram somaj. Char Nangulia, associated with NGO-DUS
B1.Major changes in farm activities	Mr. Nazim told that in the past only the farmers used to get 15-20 maunds of paddy per 100 decimals of land (1,482-1,986 kg/ha). Now they are getting 60-70 maunds per 100 decimals (5,928-6,916 kg/ha). The rice varieties are HYV BR-52, 41 and hybrid Hira. The production is high due to absence of saline water as the land id protected by sluices. Quote: "We are very happy now due to development of works done by CDSP-IV".
B2.a Changes in physical conditions	Due to development of embankments, cutting/re-excavation of canals and construction of sluice gates, no saline water can enter into their crop land. Day by day salinity is reducing.
B2.b Changes attributed to CDSP IV	Both fruit trees and timber trees have been planted by farmers in their homesteads. Forest tree species have been planted by social forestry groups on roadsides, bank of canals and in new mangrove plantations.
B2c Overall changes and production	In the past farmers only grow aman paddy, but now they are growing boro and rabi crops. They getting 2-3 times more production.
B.3 New crops and new technologies adopted	New crops are HYV paddy (BR-52, BR-41 & 42) and hybrid paddy (Hira-20. New vegetables are: cucumber, snake gourd, tomatoes, chilis and long beans. New practices are line sowing, using balanced fertilizer methods, vermi-composting, ploughing land using power tillers.
B4.a Types of training	One-day farmers' training on the fundamentals of crop cultivation. Four days of technical training on modernization of agricultural techniques, use of organic fertilizer, conservation of seeds, identification of contaminated fertilizer
B4b How useful	Training was very useful. They are now using modernized agri-implements like power tiller, power driven threshers and water pumps for irrigation. They have been economically benefited by high incomes. Agri-inputs like seeds, fertilizers are available at the door step.
B4c New ideas adopted	They gained knowledge on use of HYV and hybrid types of seeds, planting in lines, use of balanced fertilizer doses, use pheromone traps and perching for pest control.
B5.a Change in use of inputs	Agricultural inputs can be purchased locally. Seeds and fertilizers can be purchased from dealers in local markets. In the past these were not available locally. Poultry feeds, fish feeds are also available locally. Vaccinations for poultry and livestock are supplied on demand.

B5.b Factors contributed	Farmers benefited by high incomes due to higher level of production from fields, and easy access to markets for selling and buying produce. Whatever farmers produce they can sell those in the markets.
B6.a Members of FF	As a member of FF, they share their problems in the meetings, and they get advice on modern techniques and methods of cultivation. They are practicing their knowhow and modern skills gained from FF meetings. They are getting 2-3 times more production than before.
B6.b Utilizing FF services	The role and works of of market actors are very limited. CDSP-IV can look into in this area.
B7. Leasing land	Farmer has taken on lease 80 decimals of cultivable land and is also cultivating 150 decimals of land in his own possession which is under the process of land titling.
B8.a Farming services expanded/ contracted	Rice production increased due to introduction of HYV and hybrid types of seeds. They are getting support from SSAOs (DAE). In case of any problem of poultry and livestock, they can contact the local NGO coordinators for help and advice. Trained poultry vaccinators are available locally.
B8.b Why have you made changes	More boro (HYV & hybrid) rice has been introduced due to no waterlogging and less salinity problem. Due to development of infrastructure like market and roads, bridges, farmers have better opportunity of marketing of produce. Lots of vegetables and other crops like soyabean, groundnuts and water melon are being exported to near-by districts and even capital city of Dhaka.
B9. How have sales	CDSP IV developed embankments, canals, roads, sluices and markets. NGO provided micro-finance to farmers and they invested MF in land development and other IGAs. Farmers sells their products to markets and char dwellers now can sell and buy in these markets. Mr. Nazim has following income structure before CDSP and now. Before, earning from rice-Tk. 25,000, cucumber -Tk.1,000 only = total Tk.26,000. Now earning from rice -Tk. 105,000, cucumber-Tk. 4,000, tomato-Tk. 3,200, beans-Tk. 3,600, bitter gourd-Tk. 5,000, = total Tk.120,800, 4.6 times more than before.
B10. Where and through what	To get better price he carried his products to the markets established by CDSP-IV. Many brokers and wholesalers come on the market days. He has no problem to carry his products due to development of road infrastructure and some linkages with market actors. He is getting very fair prices when selling his produce.
B11. Examples of changes	Now yield of rice is 30 kg/decimal, before 6.6 kg/decimal (increase from 1,630 to 7,410 kg/ha), beans 100-120 kgs/decimal (24.7 to 29.6 tons/ha), cucumber 150-200 kgs/decimal (37 to 49 tons/ha), bitter gourd 100-130 kgs/decimal (24.7 to 32.1 tons/ha), tomato 120-150 kgs/decimal (29.6 to 37.0 tons/ha). No such vegetables were grown before CDSP-IV.
B12. Role of women during CDSP-IV	CDSP-IV organized both farm and non-farm IGA training for women char dwellers through their four partner NGOs. Women participated in homestead agriculture along with male farmers. Besides, women themselves became women entrepreneurs with tailoring houses and cap sewing. Some women become democratically elected member of LGIs, and many become leaders of FLIs like WMG, LCS, TUG, NGO, FF, SFG.
B13. Main problems before and now	Problems before were waterlogging, salinity, intrusion of sea water during high tides, and torture by bahinis etc. Now (with CDSP-IV) problems are lack of knowledge of salinity resistant seeds of different crops, and serious river erosion
C1. Changes in Living Standards	Improved housing, social status improved, increased income, good health for all, children are in school, improved diets. Quote: "We eating very good food from own land better than 100 times when we suffered a lot"

Case study 3

A. Respondent Profile	Md. Kamal Uddin, son of late Mijibul Hoque, age-50 yrs. Muhammedour somaj, Char Nangulia. Mobile: 01828393368. NGO-BRAC.
B1.Major changes in farm activities	Mr. Kamrul informed that before CDSP-IV, they used to grow local rice-"Raja'/"Kajal" shail. Production was 20-35 maunds per 160 decimals (1,235 to 2,161 kg/ha). Now. They are growing rice BR-29, Hira-2, Lalteer varieties. Production very high: 80-100 maunds per 160 decimals (4,940 to 6,125 kg/ha). In the past only aman paddy was cultivated, but now aus, aman and boro paddy are all cultivated. Quote: (In Bangla) "Allahr rahamote tin bela khaoer por bikrio korte pari". In English "Upon the grace of almighty Allah, besides, we can eat three times well and we can sell rice and vegetables also".
B2.a Changes in physical conditions	A) Due to construction of embankments, no water can enter into their land. B) Both salinity and waterlogging reduced. C) They are producing boro crops using stored water from ponds (filled with water from existing canals).
B2.b Changes attributed to CDSP IV	A) Stocking of plants and trees increased. B) Agri crop-production significantly improved due to protection of land by embankment and sluices.
B2c Overall changes and production	Crop production has increased a lot (2-3 times). He got 70 maunds paddy (2.8 tons) from 90 decimals (0.36 ha), country beans produced 9 maunds (360 kg). His land is little bit lower than others and so less productive.
B.3 New crops and new technologies adopted	Mr. Kamal mentioned that he has good production in rice and country bean seeds. Rice production was 70 maunds per 90 decimals (7.78 tons per ha). He produced 9 maunds of country bean seeds.
B4.a Types of training	One day agri-training on modern rice production. A 4-days training on crop production, use of balanced fertilizer, production of composed fertilizer, seed production and preservation, pest and disease control, identification of contaminated fertilizer
B4b How useful	Applying knowledge and skills from training in the field and getting 2-3 times more production. Have better idea of use of agri-inputs and implements, and using balanced fertilizer doses.
B4c New ideas adopted	Cultivation of local varieties has been reduced and use of HYV and hybrids types has increased a lot. They have benefited by high yields of crops and vegetables. Income has increased by 2-4 times than before CDSP-IV.
B5.a Change in use of inputs	Farmers can purchase seeds, fertilizers and pesticides from local markets and local dealers. Poultry and livestock vaccines are available on demand. Poultry feeds, fish feeds are also available in local markets. In the past they collected such kinds of inputs from Khashethat and Maizedi which as very far away.
B5.b Factors contributed	They have good production and income due to new skills and technology training, development of road infrastructure and availability of micro-finance. They can sell their products in local markets easily.
	Very few market actors exists. Farmers borrow money from BRAC and use this capital for crop production.
B7. Leasing land	Kalam family received a land title for 150 decimals. In 90 decimals they cultivate crops and vegetables, and during aman season they do fish culture. (rui, kali carp, tilapia etc). No lease on other land has been taken.
B8.a Farming services expanded/ contracted	In case of crop cultivation they got assistance of FO & SAAO of DAE and in case poultry and livestock they got help from the NGO Coordinator. They are highly benefited by all of them.
B8.b Why have you made changes	Due to infrastructure development, they can collect both agri-inputs and implements very easily. Before CDSP-IV it was not possible. Besides, they can sell their produce and products in the markets. Due to control of flow of saline water through sluice and embankment, favourable conditions for crop cultivation have been created.
B9. How have sales	This year 70 maunds of rice (valued at Tk. 52,500) were produced. Before it was not possible. Country bean seed - they produced 9 mounds (valued at Tk.10,800). Cultivation of HYV and hybrid varieties has increased. Banana production has increased but local rice production has decreased a lot.
B10. Where and through what	Due to construction of roads and market infrastructure, they are selling products in the market very easily. They do not need to go to money lenders because NGOs are providing loans with easy instalments. During market days many brokers and market actors come to the market and they can sell their produce at competitive prices.
B11. Examples of changes	Now, production of HYV-rice is 80-100 mounds per 160 decimals (4,940 to 6,175 kg/ha) and before it was 35-40 mounds per 160 decimals (2,161 to 2,470 per ha). Country bean

	yields 2-3 maunds per decimal (19.8 to 29.6 tons/ha, whereas before they could not grow this at all.
B12. Role of women during CDSP-IV	In the past women could not work in the fields. Due to training in IGAs by CDSP-IV NGOs, they can now work along with men. Provision of land titling equally for women and men, with the woman's name in first, means women are empowered, their status has been improved in the somaj and they are more honoured than before.
B13. Main problems before and now	Before CDSP IV: a) there was waterlogging, b) salinity was high, c) no drainage canals, d) they could not use HYV and hybrid varieties of crops and vegetables due to lack of knowledge, e) frequent torture by so-called bahinis. Now there are no bahinis, no salinity and no waterlogging. They are cultivating HYV and hybrid crops.
C1. Changes in Living Standards	a) Now living in tin-shed nice house replacing huts, b) kids are studying in schools, c) many trees have been planted in homesteads, d) they become knowledgeable in crop cultivation and rearing poultry and livestock., e) women are empowered and socially more accepted than before. Quote "We are passing our days with happiness and good health due to the help of CDSP-IV."

Case study 4

A. Respondent Profile	Md. Abdur Rahman, son of Md. Mustafa, age 38. Uttor Chowdhury Gram somaj. Char Nangulia. Mob: 01862-818329
B1.Major changes in farm activities	Mr. Rahaman told that due to CDSP-IV project they have knowledge about HYV and hybrid type crops. They can now grow crops and vegetables in three seasons: aus, amon and boro. The crops and vegetables are rice, long beans, cucumber, snakegourd, tomato, ridge gourd, bitter gourd. Quote: "Due to CDSP-IV we are very fine now, we can eat three times per day"
B2.a Changes in physical conditions	Due to construction of embankments saline water cannot enter to their land. Waterlogging is reduced. They can cultivate their land using water from canals.
B2.b Changes attributed to CDSP IV	Sanlinity has reduced. They can grow crops and vegetable all seasons: aus, amon and boro.
B2c Overall changes and production	Production of rice and vegetables has increased by 2-3 times than before. Mr. Alam has grown 190 maunds (7,600 kg) of paddy in 360 decimals (1.46 ha). This included both HYV and hybrid types of rice.
B.3 New crops and new technologies adopted	New rice crops are BR-52,BR-11, Asom (ACI) and Hira-2. Used various types of fertilizer: urea, TSP and MoP. Perching etc. for insect control
B4.a Types of training	Farmers have received 1-day and 4-days training. This was on selection of crop varieties, identifying contaminated fertilizer, utilisation of fertilizer and pest control, seed preservation.
B4b How useful	We have gained by use HYV and hybrid varieties of rice. These varieties are now available in the markets developed by CDSP-IV. Besides, in the FF meetings, we were given more details on planting and harvesting of rice. Now, we know which are pure or impure fertilizers.
B4c New ideas adopted	They are getting good production using knowledge and skills received from training. HYV and hybrid seeds are available in the local markets.
B5.a Change in use of inputs	Nowadays land is prepared using power tillers and they use paddle threshers after harvesting. Low-lift water pump is used for irrigation.
B5.b Factors contributed	Construction of embankment, excavation and re-excavation canals helps to remove water logging and reducing salinity. Farmers can grow more crops and vegetables and sell those to brokers, buyers and market actors.
B6.a Members of FF	Being a member of FF he received training, agri-inputs like improved seeds and fertilizers. They are also becoming knowledgeable on how to adopt new technologies and methods.
B6.b Utilizing FF services	The market actors are very useful. They do not take any charges. Market actors provide financial help for production. Farmers act as a contact growers.
B7. Leasing land	Mr. Rahman cultivated 360 decimals of land (120 decimals as own land and 240 decimals as leased land). They got land title of 150 decimals.
B8.a Farming services expanded/ contracted	Out of 150 decimals own land, 120 decimals land is used for farming, and the other 30 decimals for a homestead and a small pond for fish culture.
B8.b Why have you made changes	In the homestead, they cultivate vegetables and in the pond they do fish culture. They are earning a lot more than before.

B9. How have sales	Now vegetables are sold at Tk. 50/kg, before it was only Tk. 15/kg. He grew 190 maunds of rice valued at Tk.133,000, while before he produced only 70 maunds valued at Tk.31,000. Now they can grow aus, aman and boro, but before only aman. Now, production of aman is less, but more boro and aus.
B10. Where and through what	Mr. Rahman mentioned that they directly take their products to markets. There are many brokers/bepari who come from distant districts. So they can sell their products at good prices.
B11. Examples of changes	Now, yield of rice (HYV) per 160 decimals is 80-100 maunds (4,940 to 6,175 kg per ha), before local varieties produced 20-25 maunds per 160 decimals (1,235 to 1,544 kg/ha). Now, yield of hybrid rice is 100-120 maunds per 160 decimals (6,175 to 7,410 kg/ha). Now they have introduced new varieties of rice. Four types of fertilizer and other new technologies are used. There is no saline water intrusion.
B12. Role of women during CDSP-IV	Women char dwellers received training on various IGAs. They work together with males in the fields and homesteads. Women's social status has increased. They are now positively valued in their families.
B13. Main problems before and now	Before CDSP there was a lack of agri-technologies, salinity and waterlogging in the field, lack of road infrastructure and poor quality housing.
C1. Changes in Living Standards	Before their house was very poor (a hut), now they are living in a colourful tin house. They can eat eggs , chicken easily as they rear these. They are eating good foods, much better than before. Quote: "At present we have no crisis like before. CDSP-IV helped us to live in better ways".

Case study 5

A. Respondent Profile	Md. Liton, son of Md. Mabubul Hoque, age -31, Challish Dag Somaj, Char Nangulia, mobile: 01836938458, NGO: SDI
B1.Major changes in farm activities	Mr. Liton told that, due to CDSP-IV's training, they have knowledge on HYV and hybrid types of crops and vegetables. Construction of embankments and canals helps us to grow crops throughout all the seasons- aus, aman and boro. Quote: "If CDSP-IV did not come here then we would not been able live so nicely."
B2.a Changes in physical conditions	A) Saline water now cannot enter due to construction of embankments and sluices, B) they have no more water-logging, C) they are producing boro paddy using water for irrigation from canals
B2.b Changes attributed to CDSP IV	Saline water cannot enter. Salinity of soil is now reduced by 75%. Due to construction of road infrastructure by CDSP-IV, they can transport their produce very easily. Before this could not be done.
B2c Overall changes and production	Production of rice has been increased by 2-3 times. They do not now grow local rice but instead grow HYV and hybrid rice. Similarly, they are producing improved varieties of vegetables.
B.3 New crops and new technologies adopted	In the case of rice the types are BR-52, 40,41, and BR-11. In the case of hybrid rice: Hira-1 and 2. Vegetables: hybrid cucumber, bitter gourd and okra; and improved varieties of vegetables are long beans, and sweet pumpkin. New methods are: line sowing, perching, sorjan, pheromone traps, composting, vermi composting, and balanced fertilizing.
B4.a Types of training	1-day residential practical training on agriculture, 4-training on seed processing and preservation.
B4b How useful	Knowledge on HYV and hybrid rice helps to get high production, identification of contaminated fertilizer was useful, with use of green manure and compost fertilizer, the health of soil improved.
B4c New ideas adopted	Farmers are keeping themselves busy throughout aus, amon and boro season due to availability of new technology and varieties of crops and vegetables.
B5.a Change in use of inputs	a) Now for cultivation many farmers use power tillers in their land. These are available locally on rent, b) all kind of inputs including fertilizers and pesticides are available in local markets developed by CDSP-IV, c) agriculture labour cost has increased by nearly 100% (now Tk. 400 per day, before it was Tk. 200-250).
B5.b Factors contributed	CDSP-IV developed road infrastructure. As a result, farmers are able to carry their produce to the local market by mechanized transport. Besides this, many char dwellers have invested their capital and established different types of shops. They do not need to go to district markets for their household goods and services.
B6.a Members of FF	Due to becoming an FF member, he received training on agriculture and farming technology. If not be a FF member, he would not have a modern technical know-how.

B6.b Utilizing FF services	There are some market actors who provide capital for crop and vegetable farming. After harvesting, farmers supply their products to them directly get payment after payback of the capital they have taken.
B7. Leasing land	They did not get a khatian yet. He has taken 100 decimals of land and 50 decimals as 'cod' i.e. cash rental.
B8.a Farming services expanded/ contracted	He has 1.5 acres of land. In addition he has taken lease on 1.5 acres of land for rearing cattle, fish culture and cultivation crops and vegetables. He has grown vegetables on 90 decimals and rice on 60 decimals.
B8.b Why have you made changes	To grow more vegetables and crops using HYV and hybrid varieties and gets better sale prices.
B9. How have sales	There has been an increase of prices of vegetables and other crops by about 2-3 time more than before CDSP-IV. This positive change due to easy transportation of goods from char areas to distant market places facilitated by development of infrastructure.
B10. Where and through what	He sells his products in the markets where many market players and brokers come. He gets very good prices. There are good demand for their produce.
B11. Examples of changes	Before CDSP traditional paddy types produced 20-30 mounds per 160 decimals (1,235 to 1,852 kg/ha). But, now HYV paddy yields 80-100 mounds per 160 decimals (4,940-6,175 kg/ha) and hybrid rice 160-170 maunds per 160 decimals (9,880 to 10,498 kg/ha). Before they used only one type of fertilizer now they are using 4 types of fertilizers. In case of seeds they use HYV and hybrids.
B12. Role of women during CDSP-IV	Before women were deprived in many ways. CDSP-IV has done lots of training and awareness programmes to empower them. NGOs provided micro-credit and IGA training for them and they are operating many IGAs. They are honoured in their somaj. They work in the fields with men. They now go to market and other community business places alone.
B13. Main problems before and now	Before they many problems: waterlogging, salinity and only local types of rice were produced during the aman season. Now they no such problems as CDSP-IV has constructed lots of water control infrastructure like embankments, canals, sluices, along with roads and cyclone centres etc.
C1. Changes in Living Standards	Before they had a thatched house, rice produced only 20-30 maunds per year, and they were starving with food insecurity. But now they have tin shed house, rice production is 150 maunds per year, and they are having full food security. They now eat eggs, vegetables and fish from their own production. Quote: "If CDSP-IV would not have been here we would have no food security and we have to live in an old thatched house."

Case study 6

A. Respondent Profile	Md. Helal, son of Abdul Hoque, age-48, Raselpur somaj, Char Nangulia, mobile: 01771408083, NGO: DUS
B1.Major changes in farm activities	They are more aware now about varieties of improved crops and vegetables. Now they grow three crops on the same land in three seasons. The main vegetables are cucumber, bitter gourd, long beans, country beans, and sweet pumpkin. The production of vegetables has increased a great deal. Quote" "In the past we used to eat very little due to crisis of food and income, but now we are earning a lot and eating good food, and this is due to CDSP-IV's contribution."
B2.a Changes in physical conditions	Waterlogging is now reduced due to construction of embankments, sluices, roads and bridges and culverts. No saline water can enter into the land. So, salinity is reduced and they can grow crops and get good production.
B2.b Changes attributed to CDSP IV	Salinity is now reduced. Due to plantation of trees in the roadsides and around their homestead, chances of damage due to natural disasters has been reduced.
B2c Overall changes and production	Production of rice has increased by 2-3 times. Similarly, they can grow now hybrid and improved varieties of vegetables and crops. As a result they are earning lots of money.
B.3 New crops and new technologies adopted	Using HYV and hybrid varieties of crops like Hira-2 and swarna rice. Improved varieties of cucumber, bitter gourd, long beans, and okra. Improved methods are line sowing, use of balanced doses of fertilizers, pheromone traps for pest control, and production of compost fertilizer.
B4.a Types of training	1-day residential practical training on agriculture, 4-training on seed processing and preservation.

B4b How useful	They now more knowledgeable than before in regard to HYV and hybrid types of crops and seeds. They are able to identify pure fertilizer and contaminated fertilizer.
B4c New ideas adopted	They have replaced old and traditional varieties with new HYV and hybrid types of rice and vegetables.
B5.a Change in use of inputs	Now, they cultivate their land using power tillers, use paddle threshers after harvesting rice. They also use a mechanized weeding machine in the fields. They purchase easily seeds, pesticides and fertilizers from local markets.
B5.b Factors contributed	Due to improvement of road communications, they selling their produces in local markets and buying necessary all kinds inputs, goods and services from local markets.
B6.a Members of FF	Due to have participation in FF they are getting training and different kinds of inputs from CDSP-IV.
B6.b Utilizing FF services	They are utilizing training opportunities from FF. But FF don't play any role as market actors. They are investing loans from NGOs in land development and crop cultivation
B7. Leasing land	Own land of 112 decimals with khatian/land title. Of this cultivable land is 48 decimals and they also cultivate another 62 decimals of land on lease.
B8.b Reasons for changes in farming	To rear fish, cultivate rice, produce seasonal vegetables and also rear poultry birds and livestock.
B9. How have sales	Production of vegetables increased by 2-3 times. Due to development of roads, markets and other communication infrastructures by CDSP-IV, they now easily transport their products to market places. They are getting very good prices. Whatever they produce, they can sell to buyers who come from distant wholesale centres. In the past, he used to earn Tk. 5000 (@ Tk. 500 x 10 maunds) for rice. Now he is earning Tk. 31,500 (@Tk. 700 x 45 mounds). He earned Tk.2,400 (@ Tk. 800 x 3 maunds) for cucumber, Tk. 2000 (@ Tk. 1000x 2 maunds) for bitter gourd.
B10. Where and through what	He directly carry his crops and vegetables to the local markets and sell those to the buyers and brokers in the markets There is high demands for his produce. He is getting good prices because there are many buyers, so he has scopes to negotiate.
B11. Examples of changes	In the past he could not cultivate his 48 decimals of land. Now he is cultivating rice in 48 decimals of land and getting about 40-50 maunds of rice (hybrid). He is using four types of fertilizer. In the past he used to one type of fertilizer.
B12. Role of women during CDSP-IV	Now a days, both men and women work together in the field and homestead garden. Due to CDSP-IV's different types of awareness and income generating training, women have been empowered. Women are also participating in meetings and democratic election processes of local government institutions. There is a reduction in violence towards women in char areas.
B13. Main problems before and now	Before they have no knowledge and skills on modern agriculture technologies and methods. There were no roads and drainage systems. They have suffered a lot due to waterlogging. There was intrusion of saline water. There was no scope of microcredit before the CDSP-IV project. Now have knowledge and skills on modern technology due to participation of into different training including income generating activities.
C1. Changes in Living Standards	Now there is no hunger. They can eat three times and are taking quality foods and vegetables grown on their own land. They can live for 12 months with their own production and can also sell excess production and pay for the cost of education of children. Quotes: "We live on our food and sell for money and invest for future and are living in quality housing. We thank CDSP-IV"

Case study 7

A. Respondent Profile	Md. Jaber, son of late Abu Taher, age-47, Ziar Bazar somaj, Char Zia Uddin, mobile: 01831425050, NGO: BRAC
B1.Major changes in farm activities	Due to huge development works completed by CDSP-IV, they are getting 80-100 maunds of HYV rice per acre. In the past they used to get only 35-40 maunds of rice per acre (an increase from 2,161 to 2,470 kg/ha to 4,940 to 6,175 kg/ha). Vegetable production has been increased by 2-3 times. Currently vegetables they produce are: cucumber, country beans, okra and sweet cucumber. Quotation "We can eat three times per day and also we can sell excess crops to earn money by which we are improving our livelihood."
B2.a Changes in physical conditions	Saline water cannot enter in their land due construction of embankments and sluices.
B2.b Changes attributed to CDSP	Both husband wife have received land settlement documents provided by CDSP-IV. They are improving their land for farming and developing better housing. They can grow more crops than

IV	before.
B2c Overall changes and production	In the past farmers used to grow only traditional crops like aman paddy rajashail. Now, the are growing HYV and hybrid rice. This farmer produced 55 maunds of rice from 88 decimals of land (2,2 tons from 0.36 ha). Average production: cucumber 3-4 maunds per decimal (29.6-39.5 tons/ha), country beans 1-2 maunds per decimal, long beans 1-2 maunds per decimal (9.9 to 19.8 tons per ha).
B.3 New crops and new technologies adopted	New varieties of rice are: BR-52, swarna, BR-23. Vegetables introduced are cucumber, country beans, long beans, and sweet cucumber. Fertilizer used are: TSP, urea, zinc, compost. Besides, they are producing vermi compost fertilizer and selling this to other farmers.
B4.a Types of training	The types of training by CDSP-IV were: (i) one-day training on awareness, (ii) two-days training on technical issues, (iii) identification of harmful and beneficial pests in agriculture, (iv) seed production and preservation
B4b How useful	They are highly benefited from different technology and methods of agriculture. Higher production due to use of new technology and economically benefited from sale of excess production.
B4c New ideas adopted	The new methods are perching, utilization of four types of fertilizer, line sowing and new planting methods in placing seedlings etc.
B5.a Change in use of inputs	Now, farmers can purchase necessary input materials like seeds, fertilizers and pesticides in the local markets. In the past these types of inputs were not available locally, they had to be collected from the district HQ Noakhali.
B5.b Factors contributed	Now they can sell their produce in the local markets. Sometime they sell vegetables and fish at their doorstep when the byers come to purchase from them directly. Due development of road communications they are getting very good prices.
B6.a Members of FF	Yes, member of FF. The FF meets monthly to discuss problems and solutions thereto. The have received training, inputs like seeds and fertilizers, and they gained knowledge and skills.
B6.b Utilizing FF services	They are utilizing training opportunities from FF. But, FF don't play any role as market actors.
B7. Leasing land	Own land is 150 decimals, for which they have khatian/land title. Of this, cultivable land is 88 decimals and they also cultivate another 62 decimals which is leased.
B8.a Farming services expanded/ contracted	Varieties of rice like HYV and hybrid (e.g. BR-52, swarna, Hira-2) and hybrids of bitter gourd, barboti, etc are increasing day by day.
B8.b Why have you made changes	They can cultivate land in multiple cropping seasons because there is no more waterlogging and salinity. They are using water from for irrigation canals with the help of low lift water pumps. Besides, due to availability of microcredit from NGOs, they are investing loan money in development of their land.
B9. How have sales	Due to development works done by CDSP-IV e.g. market and connecting roads, many brokers and wholesalers come to markets on the markets days. They selling their products and getting better prices.
B10. Where and through what	Production of crops have increased due to no intrusion of saline water into their cultivable land. They can easily sale their all products due to improvement of road infrastructure and improved communication with distant markets. In the market dadon system (advance sale at low prices) is no more existing. In the past they could not sell their products in the traditional markets.
B11. Examples of changes	Rice (paddy) production was 7 kg per decimal (1729 kg/ha), now 25 kg per decimal (6,175 kg/ha), cucumber 180-200 kg per decimal (44.5-49.4 tons/ha), country beans 100-130 kg per decimal (24.7 to 32.1 tons/ha), log beans 120-150 kg per decimal (29.6 to 37.0 tons/ha).
B12. Role of women during CDSP-IV	Due to participation of women in CDSP-IV awareness and other training programs women have been empowered in many ways. They are working in field along males, harvesting crops and also taking roles in post harvest work. Besides this, they are rearing cows and poultry birds.
B13. Main problems before and now	Before main problems areas were serious waterlogging, no roads infrastructure, no embankments, and no sluices,
C1. Changes in Living Standards	Huge developments have taken place, resulting in increased social status. Due plantations on river banks, canals, roads and homesteads, the risk of tidal disaster is now reduced. Housing is improved. Quote "There is no longer any hunger situation, we are very well now. Long live CDSP-IV"

Appendix 2: Case studies of sorjon producers

The following case studies illustrate how nine households have taken up sorjon cultivation, and the benefits that they have obtained.

Case study 1

Md Shiraz migrated here 16 years ago from Bhola. He now occupies two acres of land at somaj (village) 40 Dag in Salim Bazaar, for which the plot-to-plot survey has been completed as part of the land settlement process. In addition, he rents two more acres at a cost Tk33,000 per year (this is for a fixed three year term, which may be renewed by mutual agreement).

He is a member of a CDSP IV Farmers' Forum where he learned about sorjon from the Department of Agricultural Extension (DAE). He was the first farmer to develop a sorjon plot in this somaj. He started in 2011 by developing one acre and now has three acres, including one acre on rented land.

Initial land development costs Tk50,000 to Tk60,000 per acre, but five members of his household did this work over one month (although the cost suggests it took longer than this). Each year the embankments and ditches need to be repaired. Initially these repairs would incur a labour cost of Tk20,000 per acre, but this gradually reduces to around Tk10,000 per acre after six years. The poles (mainly bamboo), sting and netting to support the crop costs Tk30,000 to Tk35,000 per acre, with the annual replacement cost coming to about half of the initial cost.

Cultivating the sorjon crops, including seeds, fertiliser, FYM and pest control costs Tk15,000 to Tk20,000 per acre per year.

Like most other sorjon farmers, Mr Shiraz grows cucumbers, various types of gourd, and country and yard long beans. Income from cucumber is at least Tk100,000 per acre which covers all his costs for the entire year, so the income from other crops - Tk150,000 to Tk200,000 per acre - is all profit. Cucumber is planted in March-April, and harvesting starts after 45 days and continues for another 60 days, snake gourd is planted in May-June, with harvest starting after 45 days, and then yard-long bean is planted slightly later in June, and harvested after 2 months continuing for 60 days. Finally, country bean is sown from August and produces pods used as a vegetable and also seeds that are dried and sold. Green pods start to be picked in September and dried seed harvesting continues up to March, after which it will be time to plant cucumber again.

The ditches hold 60 to 90 cm of water for five to six months and are stocked with carp, sharputi and tilapia, with these being moved to a pond when the sorjon ditches dry up. Another Tk20-30,000 per acre in net income comes from these fish.

Mr Shiraz has used a range of pest control methods including pheromone traps (to control fruit fly in gourd), and sprays made of soap solution, neem leaf and cow urine. However, he says he needs chemical pesticides to control pests in the rainy season, with between five and 10 sprays each costing Tk300 per acre. In particular country bean is sprayed against caterpillar and aphids.

Marketing is not a problem, with traders (pikers) coming to the farmgate to purchase his crop. The farmer uses a rickshaw van to move the crop from field to roadside. Previously (4 to 5 years ago) he needed to take crops to the market himself, but now roads are better, and the pikers come to him. He does not contract the piker in advance, and will bargain with a number of pikers to get the best price. He aims to get the wholesale market price less transport cost (which is Tk2-3 per kg to Noakhali market).

The only real problem with sorjon has been two years when cyclones occurred and flash floods washed away the growing crop. This may be avoided if there was better drainage in this part of char Nangulia.

The new house

Mr Shiraz has re-invested his profits from sorjon in his farm, buying a power tiller cost that cost Tk120,000, and in an irrigation tubewell, which cost Tk150,000 including pump and engine. He now sells water to other farmers, who pay him a charge of Tk5,000 per acre, to irrigate almost 20 acres of boro. He says that he has planted around 2000 fruit and timber trees on his land, and he also rents a shop where he sells farm inputs. This shop is managed by one of his four sons and generates a net profit of Tk150,000 per year. Another son is at university in Noakhali. Mr Shiraz used to keep cows but now only has 15 chickens. He says everyone needs loans and has taken 6 or 7 loans from BRAC, the last one being for Tk65,000. Finally, Mr Shiraz spent Tk150,000 on building a new and more weather-proof house.

Case study 2

Md. Zakar lives at Islampur samaj on char Nangulia and is growing sorjon on all of his 2 acres. He developed the land in 10 strips three years ago at a cost of TkTk100,000, and it costs Tk10-20,000 per year to maintain. This investment came from his own labour earnings, the sale of 0.64 acres of land in another place, and a loan from BRAC of Tk50,000.

Md. Zakar's sorjon

The annual profit is around Tk100,000 with annual costs of Tk50-60,000. There are no problems apart from some salinity in March and April before the rains start. This can affect cucumber plants, but can be offset by mulching the plants with farmyard manure. His wife is a member of BRAC and has a demonstration of single sex tilapia from this PNGO.

Tilapia and country beans

Case study 3

Rehama Begum and her husband Shah Alam migrated from Bhola 2 years ago. Shah Alam used to farm leased land there, but his crop failed. He paid Tk260,000 to get possession of this plot of 0.80 acre at Alamin samaj. The PTPS has now been done so they are hopeful of getting a khatian soon.

Paddy field being converted in sorjon

They have developed 0.70 acres, almost all their land, as sorjon. This cost Tk40,000 in hired labour charges (20 men for 20 days) plus Shah Alam's own labour. He then spent Tk20,000 on stakes and netting to support the crops and Tk20,000 on crop inputs. This was funded via a loan from a moneylender on Bhola. Unusually, Rehama is not an NGO group member and says she was not approached to join.

The sorjon plot in production with the original house

Annual profit from cucumber and gourd is about Tk80,000 and from country bean is Tk25,000. The family has no other income sources, but owns four cattle. They have spent Tk100,000 on a new house, and have four sons – one at college and three at school.

The sorjon plot with the new house

Case study 4

Mrs. Hosnara Begum and her husband, Md. Jaker Hossain, migrated from char Laxmi, part of Subarnachar in Noakhali district, to char Nangulia in 2002. They were a very poor family and had little cultivable land in char Laxmi. Hoping to get a better place to live, they moved to char Nangulia and obtained two acres of land at Islampur samaj from land grabbers (bahini) for a payment of Tk14,000, but still have not obtained a legal title (khatian) to their land.

Feeding the fish *Visit from CDSP IV Project Agriculturalist*

At first the family cultivated local varieties of paddy (such as Rajashail and Kajolshail) using traditional methods, but applying using only urea fertilizer. The yield was only about 760 kg per acre, worth Tk12,000 at market prices. Hosnara joined a micro-credit group organised by BRAC, one of the CDSP IV PNGOs and revved training in vegetable, fish and poultry production, as well as on legal and human rights.

Clearing weeds from the ditch.

After their land was developed for sorjon in 2015, Jaker Hossain cultivated cucumber, ribbed gourds and yard-long bean in the raised ridges, with the ditches stocked with fish. In this year, production costs amounted to Tk45,500, and with sales worth Tk72,500. Seeing this success, their neighbours took up sorjon cultivation. They cultivated the same vegetables in 2016 and 2017, but lost some of the crop in 2016 due to floods, but will continue to use the Sorjon method.

Apart from having a productive and profitable farm, Hosnara and her seven-person family (including 4 daughters) have benefited from the better road communications developed by CDSP-IV, as well as now having their own sanitary latrine and nearby access to drinking water.

Case study 5

Mrs. Marjahan Begum and her husband, Md. Alauddin, migrated from Burichong Union of Hatiya island after they lost their land due to river erosion. The family settled in Char Nangulia and paid Tk60,000 to a landgrabber (bahini) for 1.7 acres of land at Nasirpur samaj.

Feeding the fish

Harvesting gourds

At first, Alauddin cultivated local varieties of paddy, which were low yielding, only producing a single crop worth Tk 4500 each year. With support from DUS, and CDSP IV PNGO, which provided training and credit, that have adopted the sorjon system which has dramatically increased the productivity of their land. In 2013, the first year after developing the land for sorjon, Alauddin cultivated cucumber and bitter gourd in the raised ridges, with fish culture in the ditches. In this year, for an investment of Tk70,000 in production costs, they earned Tk92,000 from sales of vegetables and fish. Alauddin and Marjahan continued to grow various types of vegetables and fish using the sorjon system in 2014, 2015, 2016 and 2017, and earned a good profit, although some were lost in flooding in 2016.

Case study 6

Mrs. Bibi Samiron, along with her husband, Md. Mofijul Islam, and six other family 8 members including 3 daughters migrated to Islampur samaj in Char Nangulia when they lost their land on the nearby Daxin char to erosion. They paid neighbours Tk200,000 for 80 decimals, and developed almost all of it (75 decimals) for sorjon cultivation.

Mrs Bibi with her tilapia demonstration

In 2013, the first year for sorjon production, total costs were Tk22,500, while total income was Tk 60,000. Since then, sorjon cultivation has continued to generate a good income. They did not suffer the losses of other farmers in the floods of 2016.

Case study 7

Mrs. Nurjahan Begum, her husband, Md. Habibullah, and four children (2 sons and 2 daughters) migrated from nearby Lord Hardinge Union in 2002 when they lost their land there to erosion. They paid land grabbers (bahini) Tk5,000 to occupy two acres at Ekram bazaar samaj on char Nangulia.

At first, they cultivated local types of paddy in traditional method using only urea fertilizer. This only produced 2.4 tonnes of paddy, not enough to meet household needs. In 2012 they developed 1.5 aces for sorjon, cultivating cucumbers and beans, along with fish. This generated an income of Tk28,000 while incurring costs of Tk18,000. In the last five years they have continued to grow different types of vegetables and fish, suffering some losses in 2016 due to heavy rainfall.

Mrs. Nurjahan Begum and her husband, Md. Habibullah

Case study 8.

Md. Abdul Haque, a 60 year-old farmer, lives at Islampur somaj on char Nangulia, with his 12 member family. The family migrated from char Loren on Bhola island in 2005, when they paid land grabbers (bahini) for 1.5 acres of land. In those days the family could only live from hand to mouth. For most of the year. the land was waterlogged, and salinity severely hampered crop production. Much of the land was used to cultivate local varieties of paddy, but low yields meant this only enough for 7 to 8 months of the family's rice consumption. The family relied on income from day labour to survive. The law and order situation was very bad and people could not move freely, going out at night only in an emergency. There was no drinking water near their area. They led a measurable life.

Abdul Haque with his sorjon

Once CDSP-IV started there was a dramatic change. Women joined NGO groups and both men and women farmers became members of Farmer Forums organised DAE. Members of these groups got training on a range of agricultural topics. Abdul Haque developed some of his land for sorjon, with the rest being used to grow paddy. He also dug a fish pond. The main source of income from his farm are now vegetables grown using the sojorn system, which earn about Tk300,000 per year, while fish production is worth Tk30,000 per year. Improved (HYV) paddy is now grown, and this production is able to fully meet the household requirement for rice, plus sales of Tk65,000 of surplus paddy. Sales of farm produce are made at both the farm gate and in local markets, which also provide seeds for high yielding varieties of vegetables and paddy.

Abdul Haque says that he is now a skilled farmer and knows about modern farming technologies. With a good income, Abdul Haque is now able to accumulate some capital. He has purchased another 1.5 acres of land. The land titling process is underway and he expects to soon get his khatian in the joint names of his wife and himself. Drinking water is now available, along with many other facilities. Abdul and his family are very happy with the unimaginable change in char livelihoods after CDSP intervention.

Case study 9

Md. Jahir Uddin is a young (28 year-old) farmer. He migrated to char Nangulia from Hatiya island in 2005, obtaining 1.5 acres of land at Akram Bazaar somaj, where he now lives with his six-member family.

Before the start of CDSP IV the law and order situation on the char was very bad. The area was ruled by land grabbers (bahini), to whom they were bound to pay a fixed amount in order to maintain possession of their land. Adolescent girls and women were particularly vulnerable and were often kept away from the char. In fact, during the regular disputes between different bahini, the whole family had to leave home for their own safety. With waterlogged and saline land, crop production was very limited – paddy production only supplied family needs for 5 or 6 months, and their main source of income was day labour. The family was very poor, and did not have enough to eat – sometimes a meal would be only rice with a little salt, and often there was only enough rice for one meal in a day.

With the advent of CDSP IV, the whole situation has changed. Jahir Uddin is happy that he has a legal title (khatian) for his land, with his wife's name is included first on the document ensuring her joint ownership. With 16 decimals being used for their homestead, a fish pond was dug on 20 decimals, and 64 decimals developed for sorjon. The remaining 50 decimals was donated to establish a school. Most farm income now comes from vegetable production from the sorjon area, with annual sales of Tk120,000, with another Tk60,000 from sales of fish. Land is also leased to grow paddy and production has been dramatically increased, with irrigated boro being grown as well as HYV varieties of aman. Enough rice is produced to meet household needs and for sales of Tk30,000 per year.

The skill and knowledge of Jahir Uddin and his wife have been developed through training and membership of their Farmers' Forum and NGO group. They are very happy with the enormous change in their living standards after CDSP has been implemented.