SOLIDARITÉS INTERNATIONAL

Case study

Better farming practices for resilient livelihoods in saline and flood-prone Bangladesh

The experience of SOLIDARITÉS INTERNATIONAL in Satkhira district

May 2017

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List of acronyms

BDT	Bangladeshi Taka (currency)
BINA	Bangladesh Institute of Nuclear Agriculture
BRRI	Bangladesh Rice Research Institute
CBDRR	Community-Based Disaster Risk Reduction
DRR	Disaster Risk Reduction
SI	Solidarités International
RRAP	Reduction Risk Action Plan

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Cover photo: Prince Naymuzzaman Khan

SUMMARY

According to the Climate Change Vulnerability Index 2015, Bangladesh is the **first and most at risk country to the impacts of climate change**. Being located in the largest river delta in the world, the country experiences regular and increasing cyclones and storm surges. During the monsoon, the intrusion of tidal water and heavy rains provoke waterlogging; in the dry season, water evaporates and leaves high levels of soil salinity. These aggravating conditions threaten crop production and now barely allow for small farmers living in the districts along the coast (the 'coastal belt') to **live decently from their agricultural activities**, which represent the main livelihoods in the area. Farmers are therefore compelled to adapt their practices.

SOLIDARITÉS INTERNATIONAL has implemented Disaster Risk Reduction activities in Satkhira District since 2010. It supported communities to **identify hazards** but also **local adaptive capacities**, and to collaborate on the ways to reduce these vulnerabilities through their empowerment.

Based on the **Reduction Risk Action Plans** elaborated with the communities at the Upazila and ward level, it was determined that specific support should be given to farmers in order to launch resilient farming activities and improve livelihood resilience. These included supporting **access to improved seeds** (stress-tolerant crop varieties and hybrid seeds), **improving agricultural practices** and **developing integrated farming** for small vulnerable farmers in Assasuni Upazila. SOLIDARITÉS INTERNATIONAL teams elaborated business plans with the beneficiary farmers and distributed grants for sustainable farming entreprises. In collaboration with Upazila Agriculture Extension Officers, they trained the farmers to reinforce their capacities and knowledge of modern techniques and new crop patterns better adapted to the salinity and waterlogging conditions.

These activities contributed to securing the livelihoods of vulnerable farmers and their families. More specifically, they enabled the **spread of risks of a shock or seasonality** across several sources of income:

- The production of crops and vegetables over the whole year (instead of only during the rainy season) ensures a continuous and more reliable net revenue;
- Better knowledge and access to improved seeds ensures more resilient sources of income;
- The cultivation of resilient cash crops with a potential added value (mat weaving for instance) further intensifies the spread of risks.

Furthermore, they increased **awareness about the importance of using sustainable farming practices**. In this sense, integrated farming, which combines two or more farming and livestock enterprises on one same plot of land, allows to get maximum output through involving minimum input supply. Eco-friendly techniques and inputs were promoted through the trainings and technical support provided to the farmers.

Finally, resilient farming activities **reduced food insecurity** for the beneficiaries and improved their diets. They were able to eat fish and vegetables more frequently and in greater variety. They also reduced the share of food expenditures in their budget as they consumed bigger quantities of products from their own farms.

The reflection that took place internally to SOLIDARITÉS INTERNATIONAL to elaborate this case study enabled us to take stock of our intervention in Satkhira district regarding resilient farming practices to improve livelihoods. Several lessons learned and recommendations were made to improve future interventions:

- **Working in close collaboration with the Agriculture Extension Office** was a great factor of success, especially regarding technical capacity building and the long-term communication between agricultural state authorities and farmers. This can also facilitate the development of markets for transformed products and of new marketing channels.
- The **sustainable access to inputs** must be carefully planned: farmers must be trained on seed storage and on "home-made" simple pest and disease treatments. Resilient seed banks can also play a key role in case of an emergency (if crops are destroyed by a flood for instance).
- **Demonstration plots** were a very efficient method to disseminate good practices.
- The **transformation of agricultural products** should be considered to generate more income and increase the consumption of food products throughout the year.
- If the frequency and intensity of these disasters increase beyond what resilient practices and varieties can bring as a solution, **other non-farming livelihood options must be considered**.
- The **circulation of information** is of prime importance in such a context in which farmers need to perpetually renew their techniques to adapt to changing and aggravating hazards and disasters.

1 INTRODUCTION

1.1 Context

Bangladesh is highly prone and vulnerable to hazards. The UN World Risk Report 2016 ranks Bangladesh as the **5th most at-risk country in the world in terms of disasters**. Climate change adds a new dimension by substantially increasing the frequency and intensity of existing climatic events (floods, droughts, cyclones, etc). Furthermore, its communities and local and national institutions struggle to adapt to these increasingly severe environmental conditions.

Being located in the low lying Ganges delta formed of three important river basins (the Ganges, Brahmaputra and Meghna rivers), most of the country's elevation does not exceed **a few meters above sea level**. 80% of the land is categorised as floodplain and is therefore prone to flooding.

A deteriorating environmental and social situation

The natural tide system on which agriculture traditionally depended was a boon for the fertility of the soil. However, in the 1960's, the government of Bangladesh built a network of polders, embankments and drainage channels as defence against water intrusion. This was intended to reduce the vulnerability of coastal communities and to increase agricultural production, the agricultural sector being the backbone of the economy of Bangladesh. Nowadays, these infrastructures are in poor conditions, the government of Bangladesh and local authorities being unable to carry out maintenance or upgrading works. This has worsened environmental issues such as waterlogging and salinity.

In the 1970's, shrimp farming became extremely profitable and an increasing number of paddy farmers turned to this activity, converting vast areas of previously agricultural land into *ghers* (shrimp ponds). Shrimp farming being done in saline waters, the **salinity levels of the soil have been rising ever since**; this has contributed to **soil degradation**, and more generally, to **environmental decline**.

The poor maintenance of sluice gates, the use of canals to cultivate shrimp, the gradual sedimentation of the canals and the effects of climate change (rising sea-levels, increasing frequency and ferocity of cyclones…), among other factors, have therefore contributed to making the **southwest coastal belt an area extremely vulnerable to hazards and natural disasters** (cyclones, tidal surge, flooding, irregular rainfalls and drought, etc.).

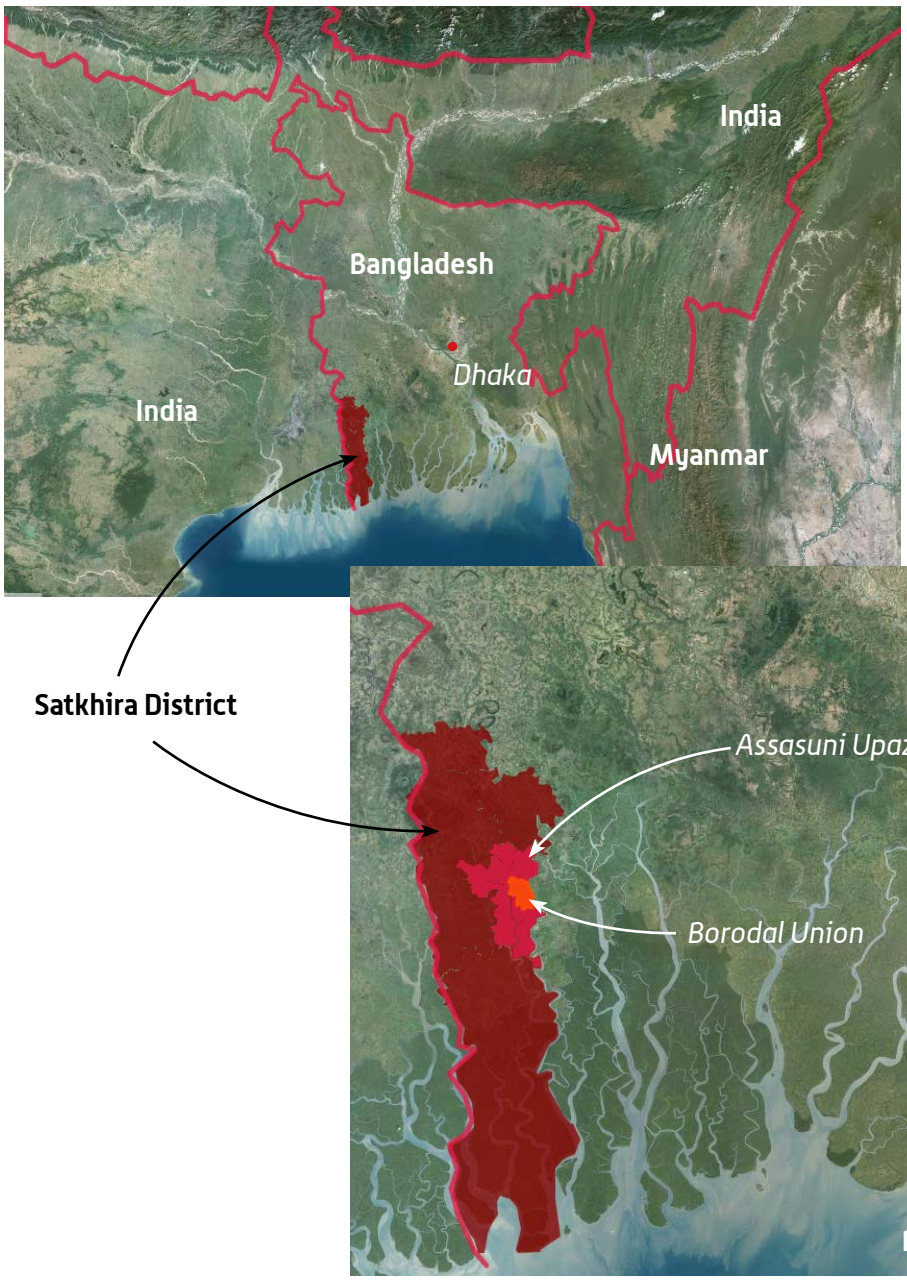
These disasters and their increasing frequency and intensity have a direct bearing on the livelihoods of the population, as agriculture is the main economic activity in Bangladesh, providing employment to over 45% of the population[1]. This situation leads to complex livelihoods, with households migrating to big cities to find work, or trying to diversify their livelihoods into off-farm incomes (van driver, tailoring, small trade…).

1. Bangladesh Bureau of Statistics, Yearbook of Agricultural Statistics of Bangladesh, Statistics and Information Division, Ministry of Planning, Government of the People's Republic of Bangladesh, 2015.

Satkhira District: a symbol of the challenged coastal belt

Satkhira district is one of the 64 districts in Bangladesh and is made up of 7 upazilas. It is one of the poorest and, being located along the Bay of Bengal, **one of the worst victims to chronic waterlogging, high salinity, cyclone exposure and land subsidence**. Elevation does not exceed 3 meters over sea level and salinity levels in the area range from 4.4 to 10.77 dS/m^2. According to the Bangladesh Bureau of Statistics, the net cultivated area in Satkhira has decreased by about 7% from 1996 to 2008 due to salinity intrusion[2].

During the monsoon, excessive rainfalls inundate the land; yet, untimely drainage prolongs the flooding and great portions of the land remain waterlogged for several weeks, sometimes even months (20% of the land was severely affected by waterlogging in 2015). This is aggravated by cyclones and subsequent storm surges. **Hectares of crops are thereby affected, if not destroyed, every year**. Moreover, the population has greatly increased in a few decades, adding ever more pressure on the land and resources.



> Map of Satkhira District within Bangladesh: one of the 19 coastal districts affected by diverse hazards and disasters

> Borodal Union is one of the 11 unions in Assasuni Upazila

Agriculture

Satkhira district is characterised by **small holder subsistence agriculture**. It typifies a saline wet rice ecosystem: farmers generally only cultivate **Aman rice**, a type of monsoon dependent rice sown in June/July and harvested in December/January. The rest of the year, farmers either leave their land fallow due to salinity problems or they cultivate fish and/or vegetables.

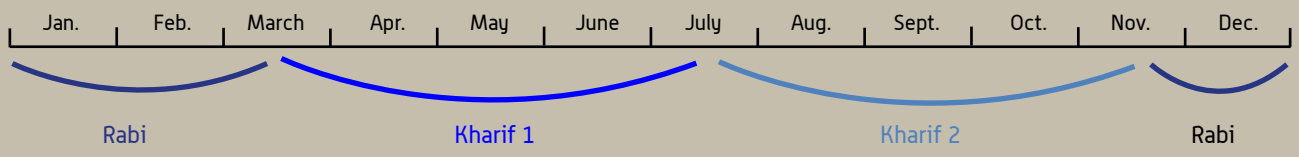
Cultivating other types of rice the rest of the year, such as **Boro**, is too difficult in Satkhira district as it requires too much unavailable irrigation water.

Households own on average between 1 and 1.15 bighas, or 33 and 50 decimals[3] (less than 0.2 hectares). This is insufficient for many farmers, who lease other fields to extend their cultivation capabilities.

2. Hossain, Zahangir Md., Salauddin, Md., *Final report on the impact of adaptative agriculture and aquaculture in waterlogged and saline areas of Bangladesh: a case study on Satkhira district*. SOLIDARITÉS INTERNATIONAL, 2015

3. 1 bigha = 33 decimals = 1,335 m²

There are three cropping seasons in Bangladesh which depend on three rainfall regimes:



Kharif 1: dry season, high temperatures and humidity
Kharif 2: monsoon, high temperatures and rain
Rabi: dry sunny weather, cooler temperatures

> Water is omnipresent in Satkhira district, 2016© SOLIDARITÉS INTERNATIONAL, EM

1.2 SOLIDARITÉS INTERNATIONAL's intervention to support adaptive livelihoods in Satkhira District

SOLIDARITÉS INTERNATIONAL opened its mission in Bangladesh in 2007, following cyclone Sidr. It started working in Satkhira district in 2010 to provide WASH, food security, shelter and livelihood assistance. Communities were deeply affected by Sidr in 2007 and later on by Aila in 2009: approximately 70-80% of crop production was lost[4] and farmers were unable to cultivate their crops for months due to flooding. Many people were displaced and many engaged in negative coping strategies, such as reducing their meal and nutritional intake, migrating for daily labouring, relying on natural resources, selling assets and taking out unsustainable loans.

SOLIDARITÉS INTERNATIONAL mainstreams DRR in all its projects in Bangladesh, through a community-based disaster risk reduction approach (CBDRR[5]). Before implementing activities, a participatory methodology (Climate Risk Analysis) was used with communities to identify hazards and vulnerabilities but also local capacities, and to collaborate on the ways to reduce these through their empowerment. Following this analysis, the risks were prioritised and a Reduction Risk Action Plan (RRAP) was elaborated. SOLIDARITÉS INTERNATIONAL supports the elaboration, update and application of these RRAP in its zones of intervention. The activities it implements are tailored according to the priority actions listed in the plans.

Disaster Risk Reduction

"*The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events*" (UNISDR – the United Nations Office for Disaster Risk Reduction)

4. Macdonald, Caitlin, Peggy Pascal, Dany Egreteau. "Barriers to resilience: chronic poverty, climate change and disasters in the souhtwest of Bangladesh". *Field Exchange*, no. 45, May 2013.

5. CBDRR is an approach that aims at reinforcing community capacities to reduce disaster risks. It is based on the premise that, in the aftermath of a disaster, the first response always comes from the community itself.

> Cash for work activities to rehabilitate embankments, according to the RRAP for Assasuni Upazila, 2016
© SOLIDARITÉS INTERNATIONAL

Based on the RRAP elaborated in 2013, the mission identified as essential the support to **livelihood resilience**, especially relating to farming activities, in order to mitigate the impact of hazards and disasters and to reduce the vulnerability of affected communities.

The ambitions of the projects implemented in Satkhira District are therefore two-fold: they help the most vulnerable households cover their basic needs, whilst setting the foundations for a sustainable and long term livelihood recovery. This approach intends to act as a bridge between short term humanitarian assistance and long term, systemic livelihood recovery intervention. The activities implemented since 2014 are a combination of basic needs and livelihood support, diversification and resilient farming techniques adjusted to the context, the local market and the needs of the local population, as well as disaster risk reduction as mentioned above. SOLIDARITÉS INTERNATIONAL works to enhance both coping mechanisms and adaptation strategies. Both hard and soft mitigation and preparedness techniques

Coping strategies: strategies that an individual, household or community adopts when facing a shock, in order to preserve their livelihoods or basic assets.
Coping strategies can be classified as (i) neutral/ reversible, causing no impact on livelihoods, such as the sale of non-essential goods, temporary migration for labour, changes in livestock migration routes, reduction in the number of meals per day, or (ii) negative/irreversible, causing long term harmful changes on livelihoods such as the sale of productive assets (seeds, livestock), the overexploitation of natural resources, etc.

Adaptation strategies: strategies that try to adjust to actual or expected climate and its effects ("climate change") in order to moderate harm or exploit beneficial.

1.3 Objective and methodology of this case study

This study examines **how SOLIDARITÉS INTERNATIONAL contributed to increasing the resilience of farming populations in Satkhira District**. We will delve into the experience of SOLIDARITÉS INTERNATIONAL in **Borodal Union** more specifically, in order to base our analysis on the practices of beneficiaries who face common challenges and who live in the same environmental and agricultural context.

We will focus on a two-phased project implemented between February 2015 and March 2017 and funded by ECHO, which specifically aimed at supporting households in the implementation of more resilient and diversified agricultural and livestock systems in Satkhira District.

Reinforcing resilience to disasters in farm-based communities implies two strategies, that of spreading the risks across several activities or types of production, and that of reducing the risks of production losses. Through a series of interviews and workshops with the teams, we will demonstrate how SOLIDARITÉ INTERNATIONAL's intervention in Satkhira District since 2014 has contributed to reaching these two objectives.

The beneficiaries we interviewed were picked randomly; we did not follow a strict sampling protocol as this was not the objective of this study. We opted on a reflexion stemming from the teams and bolstered with the testimonies of a few farmers.

2 THE PROJECT

2.1 Goals and objectives

The project we are focusing on in this case study promoted resilience to shocks and stresses by mainstreaming DRR in agricultural activities, cash for work and other community-based activities that foster disaster management. This approach encouraged a proactive rather than reaction standpoint, in order for communities to build upon their capacities to cope with disasters, should they strike.

For this study, we will concentrate on three components that contributed to improve resilient farming, that of:

- supporting access to improved seeds;
- improving agricultural practices;
- developing integrating farming.

These activities were implemented in close collaboration with **Agriculture Extension Officers**, who are commissioned by the Ministry of Agriculture to work with agricultural research institutions and to disseminate the new technologies, inputs and techniques to the field level.

> A farmer with her okra plants in Assasuni Upazila, 2016 © SOLIDARITÉS INTERNATIONAL, Prince Naymuzzaman Khan

2.2 Activities

▶ SUPPORTING ACCESS TO IMPROVED SEEDS

To secure food supply in Bangladesh, the development and use of **high-quality seeds that can adapt to certain unfavourable conditions**, such as waterlogging and salinity, is essential. Research institutes like the Bangladesh Rice Research Institute (BRRI) and the Bangladesh Institute of Nuclear Agriculture (BINA), are continuously creating new varieties of stress-tolerant seeds. However, farmers in Borodal union, especially small isolated ones, were not always aware of the characteristics of the new varieties and rarely knew which ones they were able to use on their land. Moreover, many struggled to access these inputs, as this requires high transaction costs that they did not have with their low purchasing power.

SOLIDARITÉS INTERNATIONAL encouraged the use and facilitated the access to improved seeds[7] by providing cash to vulnerable farmers. Together with Agriculture Officers and SOLIDARITÉS INTERNATIONAL's community mobilisers, beneficiaries identified the stress-tolerant crops that could easily and efficiently be grown on their land. They were informed about high yielding modern varieties of paddy and types of vegetables that can withstand hazards more easily.

▶ IMPROVING AGRICULTURAL PRACTICES

Resilient farming entails using agricultural practices that are better adapted and more sustainable to the pedo-climatic context. Most farmers in Borodal Union had never received trainings on farming techniques and had never been in contact with Agricultural Officers; they applied traditional techniques that have not been adjusted to changing environmental conditions. On the whole, they remained ignorant of new techniques and practices that would enable them to cope better with worsening hazards such as salinity and waterlogging. The project therefore aimed at improving farm management in order to secure farming as a livelihood (see page 13 for more details on the technical trainings).

▶ DEVELOPING INTEGRATED FARMING

Single crop farming is a risky enterprise, especially in a context of high hazard vulnerability and low resilience capacity. There is thus an important need for a continuous and balanced supply of foods that can provide regular food intakes and incomes. Integrated farming, which is the combination of two or more farming and livestock enterprises in a complementary or supplementary way on one plot of land, enables the optimisation of resources and of the land and consequently a maximum production per unit area. It is found to be particularly adapted to the coastal belt of Bangladesh, **a region where the fragility of the environment and of households' economic situations should require environmentally sound and continuous multi-cropping production**.

However, due to socioeconomic (predominance of mono-cropping and inability to invest) and technological (technical knowledge needed) constraints, integrated farming remains marginal in Bangladesh, including in Assasuni Upazila. The most suitable and judicious association in this Upazila was found to be a dual crop system, that of integrated sweet water aquaculture (fresh water white fish and shrimp) and stress resistant agriculture (paddy and vegetables).

Cropping season	Enterprises
Rabi (Oct-March)	Winter vegetables and fruits, fish/shrimp
Kharif 1 (March-July)	Summer vegetables and fruits, pulses, (fish/shrimp)
Kharif 2 (July-Oct)	Rice, summer vegetables and fruits, fish/shrimp

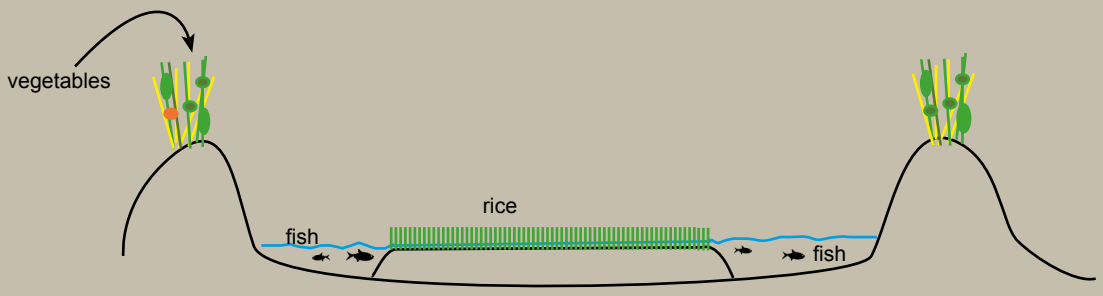
In rice-fish-vegetable farming, the rice paddy is left open to encourage the fish to enter and swim around the paddy. When water levels drop, the fish stay in the ditches surrounding the rice field. The pond is used to water the vegetables growing on the surrounding dykes.

7. SOLIDARITÉS INTERNATIONAL's prohibits the use of Genetically Modified Organisms; the seeds were checked and validated before being distributed.

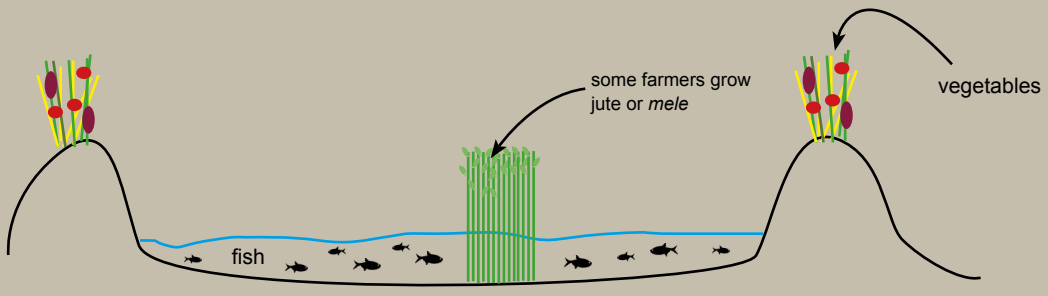
Box 1 – Integrated farming: a sustainable farming system

In an integrated farming system, resource-saving practices are put in place to boost production levels while minimising the negative effects on the environment. Allied activities and beneficial associated varieties enhance the natural biological processes and lessen the degradation of soil quality. On one hand, fish can control aquatic weeds and algae and eat the pests that damage rice fields, thus reducing production costs (less need to buy inputs for pest and weed management), as well as stirring up the soil-water interface, bringing oxygen to the water and enhancing soil fertility. On the other hand, paddy provides shade and organic food for the fish. A recycling cycle is put in place in rice-fish farming systems: if farmers have livestock, they can use the manure to feed the fish or to fertilise the soil. The silt from the fish pond is used to consolidate the dykes and concurrently fertilises the vegetables. This complementary nutrient cycle is environmentally sound and enables an optimised management of the resources available.

> Integrated farming: multiple crops are grown on the same land during the same cropping season. © SOLIDARITÉS INTERNATIONAL, Prince Naymuzzaman Khan



Integrated farming during *Kharif* season (monsoon)



Integrated farming during *Rabi* season

2.3 Who was targeted?

The direct beneficiaries of this intervention were poor marginal farmers and their families. The **notion of vulnerability** was of prime importance when choosing the beneficiaries. In the context of Satkhira, the targeted farmers had to comply with at least three of the following criteria:

- From a vulnerable village (in Borodal, 8 out of 24 villages were identified);
- Household severely affected by waterlogging in the past few years;
- High level of loss of livelihood and slow or no recovery and/or coping strategies; (waterlogging, droughts) and unable to cope with the loss of livelihoods;
- Low level and irregular source of income (monthly income of less than 5,000 BDT);
- Ownership of less than 0.5 acres of land OR farming done on rented land;
- No access to adequate food sources;
- Socially vulnerable households (women or elderly headed households, with young children, disabled, pregnant women or sick persons).

Concerning integrated farming, SOLIDARITÉS INTERNATIONAL began encouraging this farming system with 40 farmers, as a pilot activity. In the second phase of the project, in light of farmers' enthusiasm and of successful results, the activity was scaled-up and extended to 350 households.

> Using participatory rural appraisal tools (social mapping, wellbeing analysis) to identify the poorest households, 2015
© SOLIDARITÉS INTERNATIONAL

2.4 Methodology of implementation

▶ ELABORATION OF BUSINESS PLANS

SOLIDARITÉS INTERNATIONAL teams first trained and accompanied the selected beneficiaries on the development of business plans. These documents were key decision-making instruments to determine what agricultural activities the beneficiaries had the capacity to do, taking into consideration several factors such as the size and elevation of the homestead or of the land, their preferences (continue paddy, diversify crop production, etc.), the inputs available, their financial, loan and investment capacities, the quality of the soil… They were also useful to both farmers and SI to monitor farming progresses and to make adjustments if needed.

▶ CASH DISTRIBUTION TO BUY FARMING INPUTS

Once the document proved the economic sustainability of their new farm enterprises, each beneficiary household was able to receive a grant according to the seasonal calendar.

Water-logging and salinity tolerant quality seeds were bought from identified suppliers located in the city of Satkhira and directly supplied by research institutes.

See the table below for details on the grants provided to the farmers.

	Integrated farming
Grant	18,000 BDT (211 €)
Modality	Mobile money transfer
Conditions	3 instalments: - First instalment: 6,000 BDT in April - Second instalment: 6,000 BDT in June - Third instalment: 6,000 BDT in August
Use	- First instalment: dyke, land and pond preparation - Second instalment: purchase of agriculture and aquaculture inputs (improved seeds, fingerlings…) - Third instalment: purchase of fertiliser and other support inputs

> Paddy fields, 2016 © SOLIDARITÉS INTERNATIONAL, EM

▶ TECHNICAL TRAININGS TO REINFORCE FARMERS' CAPACITIES

To have a sustainable effect, these resilient livelihood activities were supported with technical advice and training dispensed by SOLIDARITÉS INTERNATIONAL in close collaboration with Upazila Agriculture Extension Officers. These trainings intended to reinforce the beneficiaries' farming capacities and knowledge of **modern techniques and of new crop patterns better adapted to the salinity and waterlogging conditions**. They were carried out with individual farmers as well as with farmer groups throughout the implementation area.

The table below provides an overview of the techniques that were taught and promoted:

Domain / issue	Techniques and methods
Seeds and seedlings	- Knowledge of saline and waterlogging tolerant crop varieties o **Transplanted Aman** (*T. Aman*) rice varieties: BR-10, BRRI dhan30, BRRI dhan49 (shorter maturity period) o Vegetables: tomato, eggplant, pumpkin, various types of gourds, okra, long yard bean, water spinach, Indian spinach, amaranth - Recognition of good quality seeds to improve germination rates and yields
Soil preparation and sowing	- Line sowing, bed and furrow system to enhance irrigation efficiency and to reduce salinity - Drainage of the paddy field during Rabi season and preparation of the land (mixing soil with lime and cow dung) - Dosage of manure to fertilise the soil before sowing - Building of ditches for fish cultivation and of dykes for water retention and for protection against tidal water intrusion - Digging small trenches between rice rows to allow the fish to circulate freely (in the case of integrated farming)
Irrigation and drainage	- Digging, consolidation or widening of ponds and/or ditches - Timely irrigation - Sub-surface drainage and irrigation methods: pitcher or drip irrigation on raised planting beds for vegetables, Alternate Wetting and Drying technology to allow the leaching of the salts out of the root zone of the plants - Mulching (covering the soil with straw) for vegetables to prevent evaporation, contribute to moisture conservation and thus reduce salinity
Fertiliser	- Composting with kitchen and household wastes - Use of cow dung
Pest management	- Simple low-cost techniques: sex pheromone traps, bird perching, planting of marigold in between vegetable rows - Manual control of the plants to identify, prevent and heal sick plants - Delicate balance: pest management without damaging the ecosystem put in place
Land management in saline conditions	- Avoidance of fallow land to avoid evaporation and subsequent concentration of salts - Development of seasonal calendars, elaboration of cropping patterns - Knowledge and capacity to recognise signs or symptoms of various hazards (salinity, plant diseases, pests)

The different techniques and practices promoted for integrated crop production are accessible to all farmers, both technically and financially.

Risk and crop calendar for Satkhira District

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Season		*Rabi* - winter			*Kharif 1* - dry season			*Kharif 2* - monsoon				*Rabi* - winter	
Food situation		severe food gap	food gap		food sufficiency			severe food gap		very severe food gap			severe food gap
Hazards	Flood												
	Waterlogging												
	Heavy rains												
	Storm/cyclones					peak					peak		
	Drought and salinity			peak salinity period									
Aman rice								S		G			H
Fish farming		H						S		G			H
Shrimp farming		G			H								S
Summer gourds							S		G		H		
Kohlrabi		G		H									S
Okra					H		G		H				
Eggplant		G		H						S			G
Indian spinach		H								S			G
Tomato		H								S			G
Cucumber							S		G		H		
Papaya		G		H				S			G		
Jute				S			G			H			

S = sowing ; G = growth ; H = harvest

A few examples of techniques promulgated during the trainings:

> Sex pheromone traps: Female sex hormones are diluted in soapy water to attract male insects. This slows down the mating and spreading of pests.

> Mulching: a layer of organic material is placed on the surface of soil to conserve soil moisture, improve fertility and health of soil and thereby reduce salinity.

> Compost: household wastes are kept and turned into compost in order to reduce the use of chemical fertiliser.

> Good quality seeds: farmers were shown how to recognise good quality seeds (certified, clean, without cracks or spotting and of the same colour)

3 RESULTS

The main ambition of promoting resilient farming practices was to augment the adaptive capacities of vulnerable farmers in the face of recurrent hazards and disasters. This, in turn, contributed to securing the livelihoods of farmers and their families. More specifically, the resilient farming activities implemented by SI enabled the following results:

3.1 The spread of risks through the diversification of resilient sources of income

A key feature of livelihood resilience is to **spread the risks of a shock or seasonality across several sources of income**. During the preparation of this study, we were unable to actually assess the impacts of risk-spreading, as there were no major climatic event or disaster; yet, the efficiency of such a strategy is evident and has been demonstrated in numerous studies[7]. If one source of income fails, the others can compensate and allow the household to cope. By diversifying livelihood activities, households therefore spread the risks and reduce their vulnerability to disasters.

The project worked to reach this objective in different ways.

First of all, it aimed at **limiting monoculture paddy** during a few months only (rainy season for *T-Aman* rice), as depending on one sole harvest can be a significant risk in such a context. Farmers were encouraged to **multiply the number of crops cultivated on their land at once**, especially through the integrated farming system. This **diversification over the whole year ensures a continuous and more reliable net revenue** of each type of product. Farmers who do integrated farming are therefore more resilient than farmers who do mono-cropping.

Chanchala Sana

Before the project, Chanchala Sana and her family only cultivated rice (480 kilos of the BR-11 variety in 2014), mainly for household consumption. With the project, they started integrated farming. They now grow 20 varieties of vegetables (okra, striped beans, sponge gourd, pumpkin, bananas, beetroot, spinach, tomato, red amaranth...): they cultivated a total of 1.6 tons and sold 1.2 tons for a total of 41,000 BDT (465 €). In 2016, they sold fish for 110,000 BDT (1,246 €).

"Before, we only had rice and we did one harvest a year. Now, we have diversified and started multiple crops and vegetables. We also do fish farming. The first year [2015] we got a good production; this year [2016] it is even more abundant."

7. Gil Juliana D. B., Avery S. Cohn, John Duncan, Peter Newton, Sonja Vermeulen. "The resilience of integrated agricultural systems to climate change". WIREs Clim Change 2017; Uddin M. T., M. A. Khan, M. M. Islam. "Integrated farming and its impact on farmers' livelihood in Bangladesh". *SAARC Journal of Agriculture*, 2015

Parimal Kumar Mistry

Before 2015, Parimal produced rice and some fish separately, for a total of 69,300 BDT. Today, he has started producing vegetables on the dykes surrounding his pond and paddy field: he obtained 4,590 kg of cucumbers, eggplants, papaya, beans, tomatoes, bananas, okra, Indian spinach and bitter gourd. He sold 3,860 kg at different periods of the year (1,100 kg of cucumbers in August, 800 kg of Indian spinach between September and March, 20 kg of okra in June, etc.), for a total of 80,950 BDT. With these new sources of income and the increase of net revenues, his family was able to start saving money and to face the lean season and hunger gaps more easily.

Secondly, **better knowledge and access to improved seeds ensures more resilient sources of income**. The paddy varieties promoted during the trainings are more resistant to hazards such as salinity and waterlogging and are higher-yielding. Whereas traditional paddy varieties can usually tolerate less than 4 dS/m salinity, hybrid paddy varieties can withstand between 12 and 14 dS/m at the initial stage (when salinity levels are still high as the rainy season has just began) and 6 dS/mf in their entire lifespan (salinity levels decrease as the rainfalls wash away the salt)[8]. The average yield of hybrid seeds such as BR-10 and BRRI dhan 49 is 5.5 tons per hectare, compared to 2.07 tons for traditional Jamaibabu rice. Similarly, cultivating salt-resistant vegetables throughout the year enabled better yields and, consequently, bigger regular surpluses to sell on the markets.

Box 2 - Salinity

According to the Soil Resource Development Institute of Bangladesh, Satkhira District is one of the most saline zones in the country. This same institute asserts that saline areas have increased from 8,330 km2 in 1973 to 10,560 km2 in 2009 (SRDI, 2010). Half of this surface area is affected by salinity levels higher than 8 ds/m.

High salt concentration in the soil harms plants as the water uptake is reduced. More water therefore needs to be applied to the fields in order to compensate for the effects of salinity. For this same reason, salinity levels are higher in the dry season.

Land classification	Salinity (dS/m)	Plants growth
Low saline	2-4	Yield of non-tolerant crops reduced
Medium saline	4-8	Suitable for growing salt tolerant crops
Normal saline	8-16	Poor growth of tolerant crops
High saline	> 16	Difficult to grow except for a few crops

8. "Innovation paves way for food security in Bangladesh", *The Strategic Foresight Group*, Nov 2010. Retrieved from: http://southasia.oneworld.net/news/innovation-paves-way-for-food-security-in-bangladesh#.UbWvRuf7DPY

Chanchala Sana

Chanchala Sana and her husband cultivated 480 kg of BR-11 Aman rice on 1·2 acres of land in 2015· In 2016, they started integrated farming and changed to BR-10 and BRRI dhan49; they yielded 780 kg on the same surface area·

"Before the project, we did BR-11 rice, but we had less production· Now we do BR-10 and BRRI dhan49, which are salt-resistant· Before we made 8 sacks maximum, now we have 13 sacks·"

Thirdly, the spread of risks can be further intensified through **the cultivation of resilient cash crops with a potential added value**. In this sense, some farmers chose to cultivate ***mele*** **and/or jute**, two highly profitable plants. In the case of mele, they chose to process it and transform it into mats in order to generate added value and more revenues. Mat weaving can be done throughout the year, especially during the rainy season, when other farming activities are slowed down.

Nirod Mondol

Nirod Mondol and his wife Sobita-Rani expanded their mele production with part of the grant they received· In 2015, they grew some mele on their 0·33 acres of owned land· In 2016, they rented 0·66 acres of land to augment the production; they made almost 60,000 BDT (over 700 €) from two harvests of mele· Almost half of this income is from selling raw mele, the other half is from mat-weaving· Husband and wife can make two big mats a day for 350 BDT each or three small mats for 200 BDT each·

"Mat weaving is very useful, especially during the rainy and waterlogged season because we cannot cultivate as much·"

> Nirod and Sobita-Rani weaving a mat, November 2016 © SOLIDARITÉS INTERNATIONAL, EM

Box 3 – *Mele* cultivation: a traditional, well-accepted and resilient farming practice to stabilise incomes

Mele is a type of reed that originates from the Sunbardan mangrove forest located along the Bay of Bengal. It grows well in both brackish water and can survive in medium salinity level (EC 4 to 8 ds/m) saline land and water.

Mele cultivation is a traditional practice in the coastal belt of Bangladesh. Its commercial farming was hampered by a lack of proper training, adequate scientific knowledge about cultivation techniques and a lack of irrigation infrastructures. The beneficiaries were therefore trained on techniques of reed management. Although *mele* cultivation does not require a lot of tillage on a year to year basis, farmers need to remove every few years all the panicles and plough the land to prevent decomposition, litter build-up and nutrient enrichment, before planting again the same roots. An adequate water supply at key times of the year is necessary; for *mele*, the beds should be irrigated once a month during the dry season. During the rest of the year, managing the water table is more straightforward, the fields being irrigated by rainwater or by tidal waters.

> *Mele* drying on the side of the road, 2016 © SOLIDARITÉS INTERNATIONAL, EM

Mele can be harvested during three to five consequent years, with two harvests a year. It is normally transplanted during the *Kharif 1* season (between April and June) and harvested a few months later.

Mele cultivation is four times more profitable than paddy and up to ten times if woven into mats.

(Traditional knowledge of agriculture stabilises livelihoods in the coastal region of Bangladesh, report by SI, 2014)

Targeted farmers in Borodal Union confirm having greater and more regular incomes from several sources. **Expanding the portfolio of farming and non-farming activities increases farmers' ability to buffer a shock affecting one activity**. With a range of enterprises that contribute to the family income, such a shock has a limited impact on this incomes. **Coupled with the use of more resistant varieties of rice and vegetables, the diversity of crops and products ensures that the revenues made are more sustainable and resilient**. Through the trainings, the farmers have understood the importance of diversification and association of produce and intend on enhancing this principle further.

Shafiqul Islam

Shafiqul Islam bought a cow and a calf with the savings he was able to make from his integrated farm by the end of 2015. He intends on buying a few more with his future savings and start a small livestock farming activity.

3.2 Increased awareness about the importance of using sustainable farming practices

The pedo-climatic context of Satkhira District and the coastal region more generally is a very vulnerable and changing one. **Natural resources are fragile and must therefore be exploited in a sustainable and reasoned way in order for farmers to keep on living from rural-based livelihood**. The resilient farming activities of the project were designed in this sense and the trainings promoted environmentally friendly principles.

Integrated farming is in itself a viable, low-cost, low-risk and sustainable activity (see box 1 page 10). It encourages **the optimisation of land and space**. The farmers assisted by the project were all vulnerable households with small pieces of land. To increase the yields and subsequent incomes, each parcel of the land is cultivated: the field is used for both rice and fish during *Kharif* season and for fish and other cash crops (jute mainly) during the remaining 6 months, dyke cropping is done throughout the year and rampant vegetables grow on trellis placed over the ponds. **Integrated farming thus allows to get maximum output through involving minimum input supply**. It is better than rice monoculture in terms of resource utilisation, diversity and productivity. This optimisation of the land also contributes to reducing salinity levels: when the land is left fallow, the soil moisture evaporates and this consequently increases the concentration of salts.

Sobita-Rani and Nirod Mondol

"The training we received from SI helped us to improve the management of our land so we can have better yields without damaging it. Now we transplant the rice in rows. We are able to manage weeds and the use of fertiliser. We have increased our visits to the fields and we monitor the crops more frequently, so we have better control of our fields. We also use cow dung as a fertiliser for rice. This has doubled our production: before we made 4 to 5 sacks of rice per year, now we make 11 to 12 sacks."

Shafiqul Islam

"We had no idea about salinity management before. Now we know how to grow in saline conditions. For example, we cultivate very frequently so the salt doesn't come out; if we let the land to rest, it will be more saline."

Moreover, natural fertiliser and pesticide techniques were divulged during the trainings: organic compost or using cow dung, bird perching, sex pheromone traps, nets to capture bugs, light traps, the use of neem leaves, manual control of insects, etc. More generally, the farmers were encouraged to be more vigilant and to recognise signs or symptoms of various hazards (salinity, plant diseases, pests, etc.). They learned how to **mitigate the consequences of these threats** by preparing and managing their fields more carefully. These eco-friendly technologies and the proper care of the land also contribute to avoiding soil depletion.

Nila-Rani Mondol

"Before, we didn't have much knowledge in agriculture. We grew some vegetables for our own consumption, but they were damaged from the water. With the training we received, we made a slope on the side of the pond for drainage. We do year round vegetables to keep salinity away (...). We learned how to do a bed planting system, how to prepare land with organic fertiliser (...)."

Integrated farming is not only adapted to the environmental conditions and the diet of farmers (fish and rice being the basis of their diets), it is also a way of making the most of natural resources in their surroundings without damaging them. The majority of them now cultivate vegetables on dykes, do line sowing and mulching and use organic pesticides and fertilizers. The creation of demonstration plots enabled the dissemination of such practices to non-beneficiary farmers in the area.

> Nila-Rani Mondol cultivates white turnips on dykes, November 2016 © SOLIDARITÉS INTERNATIONAL, EM

3.3 The reduction of food insecurity and improvement of diets

The diversification of crops and increase of production have **great nutritional benefits** and are an important **solution to the situation of food insecurity** in Satkhira District. Not only does it enable regular production and continuous access to food, crop diversification means a range of food items (grains, vegetables, fish...) is provided.

Integrated farming increases food availability and thus contributes to the overall food supply. It enables targeted households to increase the consumption of their own produce.

Ranajat Kumar Montal

Ranajat Kumar Montal did not grow any vegetables before; now he cultivates eggplants, kohlrabis, tomatoes and chili on dykes (approx. 1 acre). His farm can provide enough vegetables for the 6 adults and 3 children in the household: in 2016, they consumed 290 kg out of 410 kg.

"Integrated farming provides vegetables, rice and fish and in enough quantities for us to eat well and to sell surpluses."

Integrated farming and the cultivation of several types of products also resulted in more diversified diets. It is difficult to affirm that the nutritional quality of their diet has increased due to a lack of scientific evidence, but farmers assured that they have been able to consume more vegetables and fish.

Chanchala Sana

"We eat fish everyday now and we have a more diversified diet."

Nila-Rani and Shib-Podo Mondol

Nila-Rani and Shib-Podo Mondol consumed three quarters of their homestead vegetable production before; they were able to eat a lot more the following year, whilst their total production increased five-fold.

"Before we could only take 2 meals a day and we were sometimes hungry. But since we have started growing vegetables, we can eat 3 meals a day, and we don't have to spend so much money on food."

Finally, the targeted households were able to **reduce the share of food expenditures in their budget** as they consume bigger quantities of products from their farm. This means they were able to use this saved amount of money for other family expenditures or to prepare the following agricultural season.

Shafiqul Islam

"We don't need much from the market now, just oil and salt."

> Chanchala Sana and her family on their integrated farm, 2016 © SOLIDARITÉS INTERNATIONAL, EM

4 LESSONS LEARNED AND RECOMMENDATIONS

4.1 Implication of the Agriculture Extension Office

The close collaboration with the **Agriculture Extension Office** was a key factor of success of the project. In Bangladesh, Agriculture Extension Officers are supposed to directly pass on messages and information to farmers through diverse methods: demonstration plots and groups, field days, media, farmer field schools, fairs, motivational tours, farm walks. They however lack human and financial resources to fulfil these tasks in all parts of the country. Integrating them in the project provided them with an application field and put them in direct contact with farmers. The technical trainings were jointly prepared and delivered; they were based on the directives of the Ministry of Agriculture[9] and the recommendations of our technical team.

- *Agriculture governance is much developed in Bangladesh and food security is one of the fundamental objectives of the Government[10]. It is vital to include them in the conception and implementation of agricultural projects that aim at reinforcing capacities and livelihoods linked to agriculture. This is a way to ensure sustainability and communication between farmers and agricultural instances.*

- *To launch new types of crops in an area or develop markets for transformed products (mele, jute...), marketing channels for bigger markets need to be developed, as the local demand might not be sufficient. These initiatives can be considered and conceived with agriculture authorities at local and district levels.*

9. *National Agricultural Extension Policy* (NAEP), Ministry of Agriculture, 2012

10. *Perspective Plan of Bangladesh 2010-2021, Making vision 2021 a reality*, General Economics Division, Planning Commission, April 2012

> An Upazila Agriculture Officer from the Department of Agriculture Extension is visiting farmers, 2015
© SOLIDARITÉS INTERNATIONAL

4.2 Need for a sustainable access to inputs

Research institutions and the Ministry of Agriculture produce and distribute seeds and seedlings but these rarely reach small villages. The remoteness of certain villages and the difficulty for farmers to travel can impede access to inputs (seeds and fertiliser). This has to be taken into account in agricultural projects that focus on farming practices. One way to do this is to create **seed banks**, which is something that was undertaken by SOLIDARITÉS INTERNATIONAL in our project: the Assasuni Department of Agriculture Extension was supported to improve existing storage facilities or to create new ones if needed. Another way to do this is to encourage farmers at household level to secure seed stocks for future seasons.

- *Ensure that seed procuration is secured on the long-term by encouraging farmers to store some seeds in the best storage conditions for the next season and by making sure such expenditures are included in their business plans.*
- *Promote "home-made" simple preventive and curative pest and disease treatments to replace chemical treatments that are costly, not always available locally and can have negative impacts on the environment.*
- *Resilient seed banks can play a key role in case of an emergency: in case of crop destruction, seeds can more easily be distributed.*

4.3 Information is the key

As conditions are changing quite rapidly, farmers vulnerable to hazards and disasters must be regularly informed of new techniques, inputs and varieties. Such a situation requires **strong flexibility and motivation** on the part of farmers and further communication efforts by agricultural instances. The **circulation of information** should therefore be a vital component of agricultural projects, especially in such contexts.

- *Farmers should constantly be kept updated on new techniques and varieties. Links between representatives and Agriculture Extension offices at Upazila and Union levels should be made with research institutes.*
- *Farmers associations can perhaps be a privileged way to connect research and field-level and for the information to trickle down to the grass-root level.*

4.4 Constitution of demonstration plots to disseminate good practices

In the first phase of the project, the 40 farmers that developed integrated farming as a pilot activity used their farms as demonstration plots for the rest of the farming community. In Assasuni Upazila, very few initiatives of this kind had been launched, this farming system had therefore remained under-exploited until then. Demonstration plots provided a **backdrop for new practices and methods** and served as very **powerful tools to disseminate information** to neighbouring farms. As a result, many non-beneficiary farmers took interest in integrated farming and resilient farming practices, and technical discussions were generated around demonstration plots[11].

11. Post Distribution Monitoring report – Cash grant for integrated farming, project ECHO 1446, April 2017

The adoption of new farming practices can take a long time; demonstration plots can be an efficient way to facilitate these changes and a good way to spawn discussions and the sharing of good practices.

> Demonstration plot on bed and furrow system for potato cropping, 2016 © SOLIDARITÉS INTERNATIONAL

> Demonstration plot on aquaculture, 2015 © SOLIDARITÉS INTERNATIONAL

4.5 Development of value chains

To push further the promotion of resilient livelihoods and the diversification of activities, the **transformation of agricultural products can be promoted**. Some farmers in Borodal Union considered cultivating mustard in a near future in order to make their own oil. Jute and mele crops could also be the object of further transformations; the Government of Bangladesh having ordered the use of jute bags for carrying commodities instead of plastic bags, there is a real potential for expanding the cultivation of these types of crops. Dried fruits could also be an option.

- *The promotion of product transformation can contribute to generate incomes and increase the time when these preserved food products are available in comparison to fresh products. Projects that support farming livelihoods can help beneficiaries with this type of activity if it does not require expensive and complex technologies and machines.*
- *Regional or international export trade could be an option if further organisation of farmers is developed (cooperatives for instance). This type of enterprise should be done in collaboration with the Ministry of Agriculture and its district and upazila-level instances.*

4.6 Limitations to resilient farming on the long term?

The consequences of climate change and the occurrences of hazards and disasters are very likely to worsen in the coming decades. If the frequency and intensity of these disasters increase beyond what resilient practices and varieties can bring as a solution, **other non-farming livelihood options must be considered**. According to researchers from Khulna University[12], stress-tolerant varieties have limitations: they might adapt to more adverse conditions, but the yields will be reduced and incomes will consequently decrease. Can resilient farming therefore be a sustainable solution on the long term for securing the livelihoods of vulnerable farmers of coastal Bangladesh?

- *The limits to resilient farming practices and varieties must be taken into consideration and weighed in the future. If pedo-climatic conditions aggravate (rise of salinity levels despite mitigation farming techniques, land subsidence, increase of waterlogging, erratic rainfalls, etc.), projects will need to focus more on non-farm activities.*

12. Interview with the two researchers who wrote the report *Impact of adaptive agriculture and aquaculture in waterlogged and saline areas in Bangladesh* for SOLIDARITÉS INTERNATIONAL

> Integrated farming, 2016 © SOLIDARITÉS INTERNATIONAL, Prince Naymuzzaman Khan

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