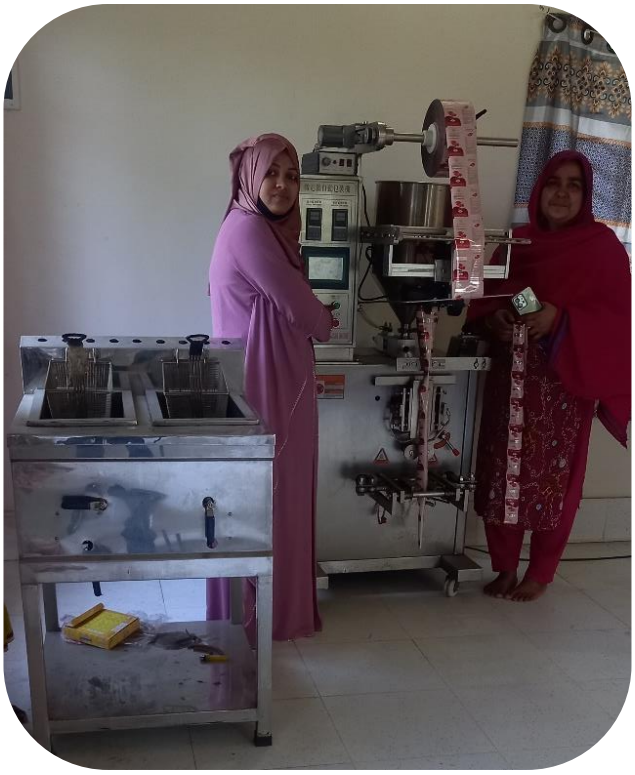
Endline Study Report

on

Livelihood enhancement of the small farmers in SAARC region through small scale agro-business focusing on value chain development



Submitted to

The Director
SAARC AGRICULTURE CENTRE (SAC)
BARC Campus, Farmgate, New Airport Road
Dhaka-1215, Bangladesh

Submitted by

Dr. Nowsher Ali Sarder
Monitoring and Evaluation Consultant

07 July 2024

Acronyms

ac	Acre (100 decimal)
BDT	Bangladesh Currency
Btn	Bhutanese currency
DAE	Department of Agricultural Extension
DAS	Department of Agricultural Services
DLS	Department of Livestock Services
DoF	Department of Fisheries
ETC	Extension and Training Centre
FGD	Focus Group Discussion
GAP	Good Agricultural Practices
GPP	Good Post-harvest Practices
ha	Hectare (10000 square meter)
HS	Household Survey
HSC	Higher Secondary Certificate
HYV	High Yielding Variety
ICAR	Indian Council for Agriculture Research
II	Individual Interview
INR	Indian Rupee
IPM	Integrated Pest Management
Kg	Kilogram
KII	Key Informant Interview
LKR	Sri Lankan Rupee
MP	Muriate of Potash
MSSRF	M.S. Swaminathan Research Foundation
PCR	Project Completion Report
PFA	Project Financial Agreement
RDA	Rural Development Academy
SAARC	South Asian Association for Regional Cooperation
SAC	SAARC Agriculture Centre
SDF	SAARC Development Fund
SSC	Secondary School Certificate
ToR	Terms of Reference
TSP	Triple Super Phosphate
USD	United States Dollar (currency)

Table of contents

Executive Summary

South Asian Region is comprised 1.6 billion people which represents 24.2 % of the World population. The agriculture sector employed 70% of the population and contributes to 24-50% of GDP. Average across the region, almost 60% of the regional population depends on agriculture for their livelihood. By operating only less than 1 hectare landholdings per family, more than 25% population fall below poverty and face acute shortage of food that resulted them vulnerable to malnutrition. Most Member Countries of SAARC in the past several years have been maintaining positive growth in production of fruits and vegetables indicating the increasing role that they are playing in enhancing farmers' incomes, alleviating poverty and improving quality of nutritious diet. In most of the SAARC Member Countries vegetables are obvious priorities as they are less risky to grow as compared to fruits. The agricultural sector in the region encounters some challenges like high post-harvest loss, inadequate processing facilities and skills, poor linkages of supply chain to the specialized markets, lack of modern production and processing technologies, high price of necessary inputs. Considering these facts, this project `Livelihood enhancement of the small farmers in SAARC region through small scale agro-business focusing on value chain development' is designed to test the model in 2 pilot sites per participating countries with the objectives of: a) To identify and replicate successful food processing technologies and models for fruits and vegetables in South and South-East Asia Region b) To increase skill and capacity of smallholder farm families on value addition to the locally produces fruits and vegetables c) To increase income and improve livelihoods of the small holders d) To promote empowerment of rural women and create employment through promotion of agri-businesses and e) To develop value chain of the agricultural produces and products and mainstreaming the locally produced commodities

The project is designed to promote agro-entrepreneurship through agro-processing by the SAARC Agriculture Center for enhancing the livelihoods of small and marginal farm households in SAARC countries. This livelihood enhancement project has been implemented in five SAARC countries: Bangladesh, Bhutan, India, Maldives and Sri Lanka under the funding support of SDF during 2019 to 2024. The present endline impact study is commissioned in January to June 2024 in four countries except Maldives, as the country is yet to be completed the designed activities of the project. The study used designed questionnaire for one to one survey (household survey), and FGD & KII for collecting quantitative and qualitative information against the project's targeted development indicators.

The study generated information from the representative project supported respondents maintaining proper male/female ratio (Bangladesh 60/40, Bhutan 30/70, India 80/20 and Sri Lanka 30/70) and age distribution (majority were from 30-60 years). The education status of 50% sampled respondents exceeded HSC (>12 years of schooling) in Bangladesh, in Bhutan only 10% were above 12 years of schooling while 20% with 10 years of schooling, India more than 50% >12 years schooling and in Sri Lanka 50% with 10 to 12 years of schooling. The family size of the respondent households ranged from 3.4 (Sri Lanka) to 4.3 (Bangladesh) members per family. The size of land holdings ranged from 123 decimal (Bangladesh) to 356 decimal (India), with Sri Lanka 342 decimal/household and Bhutan 219 decimal/household.

This endline survey of the SDF project observed 25% higher family income of project beneficiaries against the sets target of 15% in the Results and Resources Framework (RRF). Similarly, the project achieved 48% reduction of post-harvest loss for the interventional crops than the existing losses against the pre-set target of 10% reduction. Considerable enhancement has also been achieved in some other PDI (Project Development Indicators) like employment generation (54%), incremental sales (47%), access to improved technologies (215%) and in capacity building of beneficiaries through skill development training.

The SDF livelihood enhancement project supported skill development of targeted households to engage them value addition activities of popularly grown crops through organizing different kinds of training programs. As observed India provided training to highest numbers of beneficiaries (536 with 62% male and rest 48% female) followed by Bangladesh (400 with 25% male and 75% female), Sri Lanka (161 with 29% male and rest 71% female) and Bhutan (64 with only 2% male and rest 98% female). After having training, consultation meeting with successful entrepreneurs and attending different motivational trips to processing centers, the members of the producer groups became interested to be an entrepreneur and by the process the processing centers started to produce tomato sauce, pickles, moringa dried leaves, paste, powder and tea. Highest marketable finished products produced by the processing center of Bhutan (650 Kg) followed by Bangladesh (241 Kg), India (214 Kg) and Sri Lanka (155 Kg). The financial transection of the processing centers was measured to assess their operations during the project period and highest transection mentioned by Bangladesh (Total TK 195000/USD 1625) followed by Sri Lanka (Total LKR 201000/USD 691), Bhutan (Total Btn 89500/USD 1058) and India (Total INR 49800/USD 518). Sri Lanka produced finished products of peanut, which possibly not included as it was not included in original plan. Due to practicing value addition of fresh crop products Bhutan achieved highest post-harvest loss reduction (34%) followed by India (9%), Sri Lanka (8%) and Bangladesh (4%).

The project activities ensured two types of manpower employment one directly by the newly project funded constructed processing centers and another by the beneficiaries themselves by intensive cultivation after training and other motivational works of the project. As reported, the processing centers employed total 41 persons of which Sri Lanka shared 21, Bangladesh 14, Bhutan 10 and India 6. Similarly the beneficiaries of all countries engaged an additional of 112 laborers in the farms, of which Sri Lanka engaged 48, Bangladesh 29, Bhutan 19 and India 16. The study measured the indicator `change in family income of beneficiaries'. The change in family income calculated by two ways: one without subtracting the change in income of non-project respondents and another after subtracting the change of family income of non-project respondents. And it has been observed that the real time change i.e. considering time factor and spillover effects of other development projects in the locality, no outstanding change in family income occurred among the project beneficiaries. As observed the highest change (7%) reported by Banglash followed by Butan (5%), Sri Lanka (3%) and India (2%). Without subtracting the change of non-project respondents the highest change in family income observed in Bangladesh (55%) followed by Sri Lanka (28%), Bhutan (22%) and India (18%).

The study assessed the opportunities, limitations, and challenges of the value addition activities incurred under the project by countries and based on observations some recommendations made for each of the countries. With few exceptions, the opportunities, limitations and challenges of the concerned countries are more or less similar. In Bangladesh, one of important opportunity for expanding the business of

promoted models is establishment of one processing center in RDA (Rural Development Organization), Bogura one of the reputed rural business promotion organizations. RDA can help to continue the preparation banana and jackfruit chips through identified potential local entrepreneurs.

The higher levels of disease and insects infestation for the concerned crops is mentions by the beneficiaries of each of the countries and practicing IPM could be one of the solutions. Extension of HYVs is also pointed by the farmers as one of the limitations. For moringa and coconut value chain, difficulty in climbing is focused by the producers. All beneficiaries' complaint about shortage of farm laborers during peak season with very high cost.

Moreover, marketing of value added products are the major problems mentioned by the members of the producer groups in all countries. The continuation of production of value added products of the interventional crops by the members of the producer group would largely be dependent upon developing the market linkage to the large companies of concerned countries. A system is to be developed so that these established/constructed processing centers with its producer groups would act as a production hub, where representatives of large companies will place their production order to them and collect the finished products by their business representatives as per schedule. Only then the project interventions regarding value addition of agricultural products would have light to success.

1. Introduction

This technical report is prepared after completing the Household Survey, Focus Group Discussion and Key Informant Interview with the social representatives in the project implemented countries (Bangladesh, India, Sri Lanka and Bhutan). Primary data on post-harvest losses of project's interventional crops, employment generation due to establishment of processing centers, financial transactions of the established processing centers etc. were collected directly from the project farmers through questionnaire survey commissioned in the countries implemented the livelihood enhancement project. The field survey was done by visiting two sites in India, two sites in Bangladesh, one site in Sri Lanka and one site in Bhutan by the consultant along with the project coordinator in some of the locations. For collecting the secondary information, all available project's reports like baseline reports, project completion reports, annual reports, case studies etc. were thoroughly reviewed and used the necessary information in preparing the present impact study report.

1.1 The SAARC Agriculture Centre (SAC)

The Head of the States or government established the South Asian Association for Regional Cooperation (SAARC) on the 08th Day of December 1985. Seventh Asian Nations: Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka were the founder members of the regional association. Later Afghanistan became the eighth member country in 2007.

SAARC Agriculture Centre (SAC) is the Regional Centre of excellence dedicated to accelerate and promote thematic discussion and capacity building in agriculture and allied sectors for ensuring livelihood, food and nutritional security in South Asia. Realizing the immense contribution of agriculture over the lives and livelihoods of the people of South Asia, the Apex body of the South Asian Association for Regional Cooperation (SAARC) established the SAC as the First Centre to cater the farming-sector needs of its Member States and currently the Centre has earned the prestige and honor to became the "Centre of Excellence in South Asia".

The SAC is relentlessly working to document, disseminate and promote farmers-friendly technologies in the broad field of crops, livestock and fisheries after due contemplation to environment, emerging pest and trans-boundary diseases, food security and safety, climate change and finally the consumer health and wellbeing for the regional growth and prosperity. In this direction, the SAC is currently working hard to mitigate conventional and emerging, challenges programs, project and policy guidelines in the much-needed areas.

Vision: To establish an exploitation and poverty-free society, where justice, good governance, gender-equality and environment concerns will prevail.

Mission: Not relief, but release the potential of the disadvantaged rural communities by ensuring their active participation in resource management towards their sustainable socio-economic development.

Goal: To develop socio-economic status of the poor and extreme poor in view of poverty reduction and livelihood development through systemic management of resources with the emphasis of women empowerment.

1.2 The Project

South Asian Region is comprises one of the higher largest populace regions in the World with 1.6 billion people which represents 24.2 % of the World population. The agriculture sector provides employment to 70% of the population and contributes to 24-50% of GDP. Average across the region, almost 60% of the regional population depends on agriculture for their livelihood. Operating with average land holding of less than 1 hectare more than 25% fall below poverty and face acute shortage of food. This regional population is also vulnerable to malnutrition.

Fruits and vegetables have been contributing significantly to the agricultural economy of the SAARC Member Countries. The SAARC Member Countries produce significant quantities of indigenous and exotic varieties of fruits and vegetables. Most Member Countries of SAARC in the past several years have been maintaining positive growth in the production of fruits and vegetables indicating the increasing role that they are playing in enhancing farmers' incomes, alleviating poverty and improving the quality of nutritious diet. In most of the SAARC Member Countries vegetables are obvious priorities as they are less risky to grow as compared to fruits. The agricultural sector in the region encounters some challenges which include high post-harvest loss, inadequate processing facilities and skills, poor linkages of supply chain to the specialized markets, lack of modern production and processing technologies, high price of necessary inputs. On the basis of the findings, this project "Livelihood enhancement of the small farmers in SAARC region through small scale agro-business focusing on value chain development" is proposed to test the model in 2 pilot sites per participating countries.

Goal of the Project

Promoting modern agri-businesses model in selected sites with a major focus on promoting small agro-processing equipment for quick value addition to fruits and vegetables.

Objectives of the Project

- To identify and replicate successful food processing technologies and models for fruits and vegetables in South and South-East Asia Region
- To increase skill and capacity of smallholder farm families on value addition to the locally produces fruits and vegetables
- To increase income and improve livelihoods of the small holders
- To promote empowerment of rural women and create employment through promotion of agri-businesses
- To develop value chain of the agricultural produces and products and mainstreaming the locally produced commodities

Outputs

- Promoted the culture of Entrepreneurship
- Incremental sales received by farmers and others
- Increased access to improved technologies and good post-harvest practices (GPP)
- Infrastructure facilities established and upgraded as a result of SDF support
- Enhanced Capacity of farmers and others regarding improved technologies and good post-harvest practices (GPP)

Outcomes

- By 2020, at least 75% of the farmers using the new practices and earning at least 15% more income than under the conventional methods (none will be left behind earning less)
- Post-harvest losses for selected vegetables and fruits reduced by 10 % as a result of new practices

Project Information

- Project starting date: 08 October 2018 (As per PFA singed)
- Project cost: 2.15 Million USD including IAs contribution (1.71 million USD from SDF and 0 .43 million in kind contribution from IAs)
- Project duration: 02 Years
- Participating Member Countries : 05 (Except Afghanistan, Nepal and Pakistan)

Funding Agency: SAARC Development Fund (SDF)

Project Coordinating Agency: SAARC Agriculture Centre (SAC)

1.3 Implementing Partners:

- Rural Development Academy (RDA), Bangladesh
- Department of Agricultural Marketing and Cooperatives, Bhutan
- M.S. Swaminathan Research Foundation (MSSRF), Chennai, India
- Ministry of Agriculture and Animal welfare, Maldives
- Department of Agriculture, Sri Lanka

Rural Development Academy (RDA), Bangladesh

The Rural Development Academy (RDA), Bogra was established on 19 June, 1974 as a specialized Rural Development Institution for training, research and action research. It is located at 16 kilometer away from Bogra town by the highway towards Dhaka. The Academy campus covers an area of 48.50 hectares of which 19.00 hectares has been apportioned for office, residence, etc. and remaining 29.50 hectares earmarked for demonstration farm for undertaking research in farming, horticulture, floriculture, tissue

culture, pisciculture, livestock, Poultry etc. The academy executed the `Livelihood enhancement through small scale agro-business focusing on value chain development' project from 2019 to 2024 in Bogura and Gazipur sites through forming producers groups.

Department of Agricultural Marketing and Cooperatives, Bhutan

The Department of Agriculture is one of the oldest Government Departments in the country. It was established in 1961, working towards a self-reliant, productive, diverse, resilient and sustainable agriculture food system in the country.

M.S. Swaminathan Research Foundation (MSSRF), Chennai, India

M S Swaminathan Research Foundation (MSSRF) established in 1988 is a not-for-profit trust. MSSRF was envisioned and founded by Professor M S Swaminathan, agriculture scientist with proceeds from the First World Food Prize that he received in 1987. The Foundation aims to accelerate use of modern science for sustainable agricultural and rural development. MSSRF focuses specifically on tribal and rural communities with a pro-poor, pro-women and pro-nature approach. The Foundation applies appropriate science and technology options to address practical problems faced by rural populations in agriculture, food and nutrition.

Extension and Training Centre (ETC), Department of Agriculture, Sri Lanka

The major task of the unit is to provide services for farmers to enhance agricultural knowledge, improve skills and develop their attitudes in order to increase production. The Agro Enterprise Development works basically done by the Division of Agribusiness Development. The division has undertaken the task of promoting agribusiness and giving necessary guidance required to carry out food crop production adopting Good Agricultural Practices in Sri Lanka (SL GAP).

1.4 Agro-processing and value addition

Agro-processing generally transforms raw agricultural products into processed and value-added goods, such as food, beverages, textiles, and pharmaceuticals. It encompasses a range of activities, including sorting, grading, packaging, preserving, and transforming raw materials into finished products. Agro-processing adds value to agricultural commodities, extends their shelf life, improves their marketability, and opens doors to domestic and international markets. By adding value through processing, we can maximize its agricultural potentials, create employment opportunities, and enhance economic development. Agro-processing allows farmer to ensure higher prices for their products by adding value through processing. For example, raw coconut can be processed into extra-virgin coconut oil, wheat/maize, rice into varieties types of cakes, popped products etc. Value addition increases profitability along the agricultural value chain, benefiting farmers, processors, and other stakeholders too. Agro-processing has significant potential for job creation, generates employment opportunities across various stages of the value chain, including production, processing, packaging, marketing, and distribution.

Agro-processing enhances food security by reducing post-harvest losses and increasing the availability of processed and preserved foods. Value-added products, such as canned fruits and vegetables, fortified foods, and processed grains, have longer shelf lives, ensuring a more stable food supply. Processed foods have higher potential for export than raw agricultural products. Agro-processing enables to diversify export portfolio, reduce reliance on primary commodities, and tap into lucrative global markets. Access to finance is one of the major challenges for small-scale agro-processors in the country. Lack of capital restricts investment in modern machinery, equipment, and technologies necessary for efficient processing. As a whole, agro-processing presents immense opportunities for adding value to agricultural products. However, challenges related to finance, infrastructure, quality control, and market access need to be addressed.

SDF financed livelihood enhancement project supported to establish necessary infrastructures with the supply of desirable machineries for the agro-processing of raw crop products into value added marketable products in Bangladesh, Bhutan, India, Maldives and Sri Lanka as per their demand.

Value Addition Techniques in Agriculture

- **Food Processing:** Food processing is the use of equipment, energy, and tools to safely and efficiently transform food ingredients like grains, meats, vegetables, or fruits with minimal waste into more value-added ingredients It involves converting raw agricultural products into various processed foods.
- **Grading and Sorting:** Sorting is done on the basis of single criteria i.e removal of damaged produce whereas grading is done on quality parameters and involves many criteria like color, size, shape etc.
- **Packaging and Branding:** The packaging reflects your brand and is sometimes the first thing buyers see. It's vital that your packaging corresponds with your company identity and values. Your brand's packaging should convey its values, objectives, and unique selling characteristics.
- **Preservation Techniques:** Freezing the samples is a common preservation procedure. Samples that cannot be frozen or that do not need to be frozen (with nonvolatile matrix and analysts, or stable at ambient temperature) are usually stored at 0–5° C.
- **Ready-to-Use Products:** A ready to use product is a cleaning product sold in its correctly diluted form ready to safely apply and use as it is. Often, ready to use products come in handy-sized trigger spray bottles – making them ideal for use in smaller operations, but less cost effective in larger ones.
- **Secondary Processing:** Secondary processing is when the primary product is changed to another product – for example, turning wheat flour into bread.
- **Nutritional Enrichment:** Food enrichment is the practice of adding micronutrients back to a food product that were lost during processing, while fortification adds additional micronutrients not present (or present in small amounts) prior to processing.

Value Addition of Crop Products

Value addition is the process of changing or transforming a product from its original or primary state to a more valuable state. This could be by changing form, color and other such methods to increase the shelf

life of perishables. It refers to changing raw agricultural products into something new often achieved either through processing, cooling, pasteurization, drying, packaging, extracting or any other process that changes raw agricultural commodity into new product. Value addition to agriculture products need to make farming or enterprise profitable. It reduces post-harvest losses, provide better quality, safe and branded for to the consumers. Value-added agriculture refers most generally to manufacturing/process that increases the value of primary agricultural commodities. Reduction of import and meeting export demands. For increased foreign exchange, Diversity economic base of rural communities, Labor saving and to make more money, To find a better market, To increase the value of their produce and hence a better price.

Value chain

The value chain is the value addition at different stages of transfer. In different stages of value chain, different stakeholders add value to the product to increase the end product's value. Value chains comprise the full range of activities required to bring a product or service from conception, through the different phases of production.

Marketing of crop products

Basically, a market can be defined as a physical place or a platform where buying and selling of goods and services take place. Marketing is a series of activities involved in moving a product or service from the point of production to the point of consumption. Marketing is about finding out what consumers need and then making a profit by satisfying those needs. The activities commonly associate with marketing include cleaning, drying, sorting, grading and storage, as well as things like transport, processing, packaging, advertising, finding buyers and selling the product. There are different types of markets available for agricultural produces:

- **On farm:** A farmers' market is a physical retail marketplace intended to sell foods directly by farmers to consumers. Farmers' markets may be indoors or outdoors and typically consist of booths, tables or stands where farmers sell their produce, live animals and plants, and sometimes prepared foods and beverages.

- **Barter market:** Barter is an act of trading goods or services between two or more parties without the use of money —or a monetary medium, such as a credit card. In essence, bartering involves the provision of one good or service by one party in return for another good or service from another party

- **Assembly market:** Food enrichment is the practice of adding micronutrients back to a food product that were lost during processing, while fortification adds additional micronutrients not present (or present in small amounts) prior to processing These are markets where farmers and small local traders come together regularly to sell their goods to larger traders and consumers. They are good place for farmers to sell either as individuals or collectively such as in farmer cooperatives.

- **Wholesale market:** Wholesale is the business of buying goods in large quantities from manufacturers or producers and selling smaller quantities to retailers, who will then sell smaller quantities to their customers

- **Retail markets:** Marketing is creation of demand for goods and services whereas retailing is selling the goods and services. Retail price is the price that is charged to the customer by the retailer, while the market price is the going rate for a good or service in the marketplace while, retail market Value means what Customer is actually paying.

- **Supermarkets:** A large retail market that sells food and other household goods and that is usually operated on a self-service basis; any business or company offering an unusually wide range of goods or services: a financial supermarket that sells stocks, bonds, insurance, and real estate.

- **Auctions:** An auction is a sales event wherein potential buyers place competitive bids on assets or services either in an open or closed format. Auctions are popular because buyers and sellers believe they will get a good deal buying or selling assets.

SDF Supported Processing Centers

Agro-processing refers to the sub-sector of the manufacturing that beneficiates primary materials and intermediate goods from agricultural, fisheries and forestry based sectors. It is the technology, which deals with various processing operations comprising of threshing, cleaning, grading, drying / dehydration, storage, milling, transportation, handling, packaging, etc. are carried out after the harvest till it reaches the consumer. Considering the importance of agro-processing, SDF supported to establish processing centers in Bangladesh, India, Sri Lanka and Bhutan under the livelihood enhancement project. The livelihood enhancement project established processing centers in all the targeted locations of the project countries, which are found operational and employed numbers of people, provided skill development training for the local entrepreneurs that assisted ensure proper market prices of the agricultural commodities. It is expected that with proper nursing and continuation of financial support for few more years would develop these centers as business hubs of the localities.

1.5 The Endline Study

The endline study is to provide social, economic, and environmental data at the completion of the project. The study acted as an accompaniment to the quantitative and qualitative data that is also recommended at the end of the project. Considering the baseline indicators this study measured/identified major changes in the livelihoods of project farmers from their baseline status. The endline study provided data on the change against the set indicators introduced by the project and demonstrate the possibility of achieving the impact of the project. The study produced information that identified the project gaps and measured the project indicators, participants' knowledge attitude and practice. The major deliverables produced are:

- A detailed comprehensive report with the consideration of collected data and information

- Conducted an end-to-end assessment of input, service, value chain products, and different buyers (formal and informal) and provided a detailed analysis of the value chain and provided recommendations on how the selected target groups were engaged in the value chain in different roles (Supplier of input, producer, processor, transporter, traders and so on)

- Assessed the selected products/fruits/vegetables profitable or not and identified the market constraints.

- Assessed present socio-economic conditions of the farmers

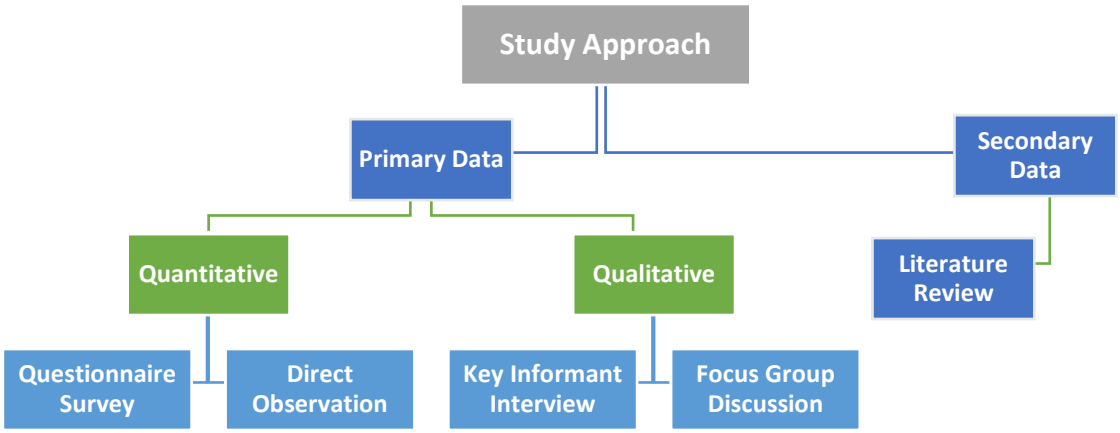
- Identified the suitable technologies on small scale agro processing focusing on strengthening the vale chain development

- Compared the endline survey data against the RRF data

2. Approach and Methodology

Considering the procedures elaborated in the ToR the endline study was carried out physically in SAARC Member States: Bangladesh (Gazipur and Bogura), Bhutan (Chukha and Samtse), India (Dindiggul region of Tamil Nadu and Anuradhapur, Channi) and Sri Lanka (Anuraradhapura and Monaragala) and used a combination of qualitative and quantitative methods mainly post-harvest statistics from the Department of Agricultural Services (DAS). The collection of primary data through questionnaire survey involved consecutive mixed methods: Household Survey (HS) Focus Group Discussion (FGD), Individual Interview (II), and Key Informant Interview (KII). The project's impact assessment collected (quantitative and qualitative information information) precision data through person to person physical interview. The primary and secondary data were collected physically through field visit at India from January 22 – 27; Bangladesh February 06 – 12; Sri Lanka February 18 to 22 and Bhutan March 24 to 27. The qualitative and quantitative data segregated by age, sex, and poverty as per project design. The endline study used a mixed-methods approach of both quantitative and qualitative data collection and analysis. For detailed data generation the study use both quantitative and qualitative tools, attached in **Annex I**.

The following schematic diagram showed the approach used for the study.



The study conducted in the project areas using appropriate statistical sampling and data collection procedures, data analysis and reporting with the final sample size determined through discussions with project professionals. The survey participants were selected randomly for answering the structured questionnaire. For collecting details information, the study:

- Used both secondary and primary source of data collection methods
- Reviewed existing documents including Project documents (Project proposal, PCR of participating countries, Baseline report of participating countries etc.);

- Background Report of study program
- Relevant report of SAC and
- Used descriptive statistics and a basic approach for measuring the indicators to analyze the data to be applied, which assisted to set milestones and have drawn conclusive inferences.

The detailed methodology was also cover the following:

- Employed the relevant evaluation criteria as mentioned above;
- Reviewed of secondary information and relevant studies;
- Sample survey about choice on crops, use of inputs, production and production techniques, technologies applied, food processing, market/marketing etc.;
- Interviewed with producers/farmers and other stakeholders to collect quantitative and qualitative information;
- Considering the data availability challenges, the budget and timing constraints;
- Mixed methods that women and men from different stakeholders groups participated and their expectation from the project;
- Mainstream gender equality and women empowerments;
- The quantitative data collection methods that included key interviews with relevant stakeholders, including- Government officials engaged with value chain development, intermediaries, producers groups, and rural farming community. Additionally, different collaborating organizations, research institutes etc. were targeted for focus group discussion

2.1 Sample Size and Sampling Method

Appropriate sampling technique and the right size of sample for the best estimation of the population characteristics are the two important factors for designing the sampling. The determination of representative sample size is also a challenging issue. In most cases, previous information are required to determine the sample size; particularly the standard deviation of the population is not available. The alternative way is to consider p = q = 0.50 which ensured the size of the sample for specific requirements.

The sample size of the study was estimated in such a way that the obtained result of the study are to be within 5 percent of the true value with 95 percent confidence level. For present study, considering the population size 100 in each country (two sites) the following standard statistical formula was used for determining sample size for field survey.

For the selection of survey respondents in each of the country, the total sample size was calculated using the Cochran (1997) formula:

$$\text{Sample size } (n) = 1 + \frac{Z^2 \times p\,(1-p)}{e^2 N} \times \text{Design effect}$$

N = Population size
E = Margin of error
Z = z score
P = Standard deviation

Considering 95% level of confidence and 5% marginal admissible error in the estimate. The calculation of required sample size of farmers for the present study is given as follows:

For this study,

n = Sample Size
p = 0.5 [Proportion of success indicator (in this case, p is the percentage of success farmers)]
z = 1.96 (at 95% confidence level)
e = 0.05 (amount of admissible error in the estimate)
Design Effect = 2.0

Putting these value, now,

$$\text{Sample size (n)} = 1 + \frac{(1.96)^2 \times 0.5\,(1 - 0.5)}{(0.05)^{21} \times 100} \times 2.0$$

= 1 + 0.9604/0.25 *2
= 1 + 3.8416 *2 (design effect)
= 4.8416 = 5 (rounding) * 2 = 10 (Sample size per country)

So we considered 10 samples for each of the countries to collect quantitative data under this endline study. This samples were distributed among two sites, among male and female farmers. So, 10/2 = 05 farmers were randomly selected from beneficiary groups of each of the sites mentioned below. For better comparison of project output, as of project samples, equal numbers of control samples (non-project) were taken into consideration for data collection following the procedures stated for project samples. So total sample size considered were 40 (project) + 40 (non-project) = 80 households.

Producers/entrepreneurs and stakeholders were interviewed to collect quantitative and qualitative information. Questionnaire was prepared to address the issues on choice of crops, value added products, use of inputs, production and production techniques, technologies applied, market/marketing etc.

In qualitative assessment at the institutional level with the concerned individuals, and KII and FGDs at the community level were also be carried out in each locations using customized checklists. In institutional interviews (Concerned Officials) maximum 1 concerned persons in each selected institution was covered, at the local/headquarter levels. This issue was specifically decided during the course of survey in consultations with the local implementing officials. Altogether 2 KIIs were done in each study site and institution with knowledgeable project implementing persons.

The Focus Group Discussion (FGDs) were held one in each study site. Each FGD comprised 5-7 farmers from the farmers under the groups and others tool were also used for made the survey effective, with the participation of people living in close proximity, not covered by individual structure, interviewed in an available rooms/space. The findings in all these qualitative assessments were critically analyzed both within and in comparison with the quantitative assessment to draw the notable findings and conclusions.

All data, whether qualitative or quantitative, were collected following the project's design parameters, ensuring disaggregation by age, gender, and poverty criteria from the project site. The specified total sample distribution amongst the project site by countries is presented in following Table 2.1

Table 2.1: Sample Distribution by Locations

Sl #	Name of country	Name of site	# Project sample	# Non-project sample	Total number of sample
1	Bangladesh	Bogura	5	5	10
2		Gazipur	5	5	10
Sub-total			10	10	20
3	India	Tamil Nadu	5	5	10
4		Channi	5	5	10
Sub-total			10	10	20
5	Sri Lanka	Anuraradhapura	5	5	10
6		Monaragala	5	5	10
Sub-total			10	10	20
7	Bhutan	Chukha	5	5	10
8		Samtse	5	5	10
Sub-total			10	10	20
Total			**40**	**40**	**80**

Throughout the selection process the study maintained the above mentioned proportion of different types of producers, entrepreneurs, sites and countries. Out of two sites in each of the foreign countries (India, Sri Lanka and Bhutan), the consultant collected primary data through questionnaire survey from one site (in case of Sri Lanka and Bhutan) and another site covered by the Departmental Staff and through virtual meeting of data collection method. Both the sites of India and Bangladesh were surveyed physically and collected primary data using structured questionnaire and necessary checklists.

2.2 Duration of the study and schedule of the reports

The total duration of the assignment fixed by the project authority was 90 days. Considering the area diversity of data collection from different countries, visa complexity and matching of timing of project officials in different implementing sites, the project authority extended the time period for another 90 days till 16 July 2024.

2.3 Preparation of Questionnaire

The one to one survey tool was designed for collecting primary data from the project farmers and non-project farmers from the concerned countries (Bangladesh, Bhutan, India and Sri Lanka). After detailed discussion and several revisions, the SAC (SAARC Agriculture Center) authority approved the field questionnaire for use.

2.4 Preparation of Checklist

Detailed checklists for carrying out the FGDs were designed based on the activities being implemented in the field by SDF project in the four countries. After drafting, the checklists were evaluated by the SAC authority including the program expert (Senior Program Specialist) who worked as focal point of SAC for the endline study. The comments and suggestions made by the SAC authority were incorporated and finalized the checklists for field survey.

2.5 Data Collection and Processing

2.5.1 Secondary Data Collection

Extensive review works on the project documents and on the annual/quarterly reports on the progress of SDF livelihood enhancement project submitted by the coordinators of different implementing countries were analyzed carefully and collected and incorporated necessary information into the report. As part of review works consultations meeting were attended several times with the focal point and with Executive Director of SAC. Clear conception was developed on the project activities especially by reviewing the progress reports of the project.

2.5.2 Primary Data Collection

The focus group discussion (FGD) and one to one interview were used as major tools for collecting primary data from the field. The consultant including the focal point of the study made extensive field visits to the concerned countries from Jan to Mar 2024. For primary data collection purposes the consultant including focal point and in some occasion (during India visit) the Executive Director of SAAR visited research sites and made interview with the respondents as per plan. To make the survey more effective in addition of on-line data collection the consultant physically visited two research sites (Madhurai and Kochin) of India from 22 to 27 January; one research site (Anuraradhapuri) of Sri Lanka from 18 to 22 February 2024; One research site of Bangladesh (RDA, Bogura) from 7 to 9 February 2024, 12 February and 01 April 2024 visited another site of Bangladesh (Kapasia). Finally the consultant collected data from one site of Bhutan (Chuukha) from 22 to 24 Mar 2024 with the help of focal point of SDC. The consultant himself and sometimes the focal point collected the data using designed questionnaire and carried out required numbers of FGDs (10 – 12 producer group members) in each of the research sites visited.

2.6 Data Analysis

Data input and analysis were done by the competent economist. Mostly descriptive statistics are used for analysis data and inferences were made based on the mean data across different locations in different countries. The country data were analyzed separately by the locations and later on the results of country were summarized and described through graphical presentations.

2.7 Reporting

The report was prepared by interpreting the tables with necessary data collected as per direction of ToR and supported the findings with available references. After compiling the draft report the steps were followed:

- Presentation of key finding in SAC, BARC, Dhaka, Bangladesh **(Annex II)**
- Submitted the 1st draft report to the SDC, Dhaka
- Submitted the 2nd draft report after inserting the feedback on 1st drat report
- Finalized the report after incorporating the feedback of coordinators of all project implanting countries and submitted in mid of July 2024

3. Findings

This chapter discussed the observations made against the changes in family income of project farmers, enhancement in skill development, post-harvest loss reduction achieved for the interventional fruit crops, improvement in marketing systems of crop products and other farming activities of farming community. The impact assessment of the SDF project is made after compilation of the generated data from all project sites (Bangladesh, Bhutan, India and Sri Lanka). The establishment and on-going activities accomplished during the project period in the processing centers of different countries are also assessed and documented. Inferences are made based on the relevant information provided by the project farmers and non-project households of the project sites. The results of the study discussed based on two types of information:

i. Primary data collected directly from farmers and
ii. Secondary data collected from the concerned officials against the achievement of the processing centers established in project implemented countries.

3.1 Result and Resource Framework (RRF)

The result framework of the SDF project sets to achieve a target of 15% higher income of the farmers after implementing the project. The framework also sets to attain 10% reduction of post-harvest loss of project's interventional crops. Considering the facts the impact study carefully investigated the issues and observed that against the target of 15% higher family income, the project achieved 25% higher family income after completing the project. On the other hand, the project achieved 48% reduction of post-harvest loss of interventional fruit crops than the existing losses against the target of 10% reduction. Considerable enhancement has also been observed in some other sets development indicators like employment generation (54%), incremental sales (47%), access to improved technologies (215%) and in capacity building of farmers through skill development training (Table 3.1). Details of the achievement of result framework by locations (countries) indicators are shown in **Annex table III**.

Table 3.1: Project Results and Resources Framework (RRF)

Outcome indicator	Target	Baseline/ control	Endline survey/ Impact study	Increase over control (%)
Enhancement of annual family income (USD)	15%	3215	4009	25
Post-harvest loss reduction (%)	10%	28	15	48
Employment generation/family/season (#)		6	10	54
Incremental sale by farmers (USD)		0.4715	0.6911	47
Access to improved technology (%)		3	10	215
Capacity building of farmers (%)			290	100

Before detailed discussion on the results of the project, the achievements of implemented countries are compared considering some of the key indicators.

3.2 Comparison of project countries against key indicators

The livelihood enhancement project of the SDF was designed to implement in five SAARC countries: Bangladesh, Bhutan, India, Maldives and Sri Lanka. The present endline impact study is commissioned in four countries except Maldives, as the country is yet to be completed the designed activities of the project. The following section discussed the performances of the SDF livelihood enhancement project considering certain key indicators against the implemented countries.

a) Family size of households

Fig. 1 compared the family size of the project countries highlighting ratio of male and female members per family. Except Sri Lanka, in other countries have family size of sampled households (20 in each country) more than 4. The number of male members per family showed in the graph so that female member can be calculated. However male female ratio in the family is found more or less 50/50 in all project countries.

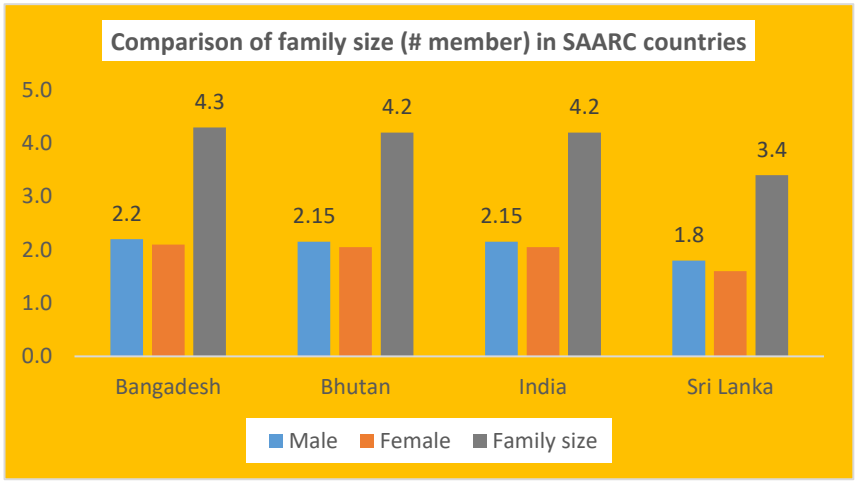


Figure 1: Family size (number member) of project countries with male female ratio

b) Land holdings per households

Size of land holdings per households in the project area is compared using pie graph in fig. 1. The cultivated land area per household is highest with India followed by Sri Lanka, Bhutan and Bangladesh. Considering the population density of countries the data is found representative. The calculation of size of landholdings is made based on 20 households sampled in each of the country. So the data may or may not be matched with the national average figures due to small sample size.

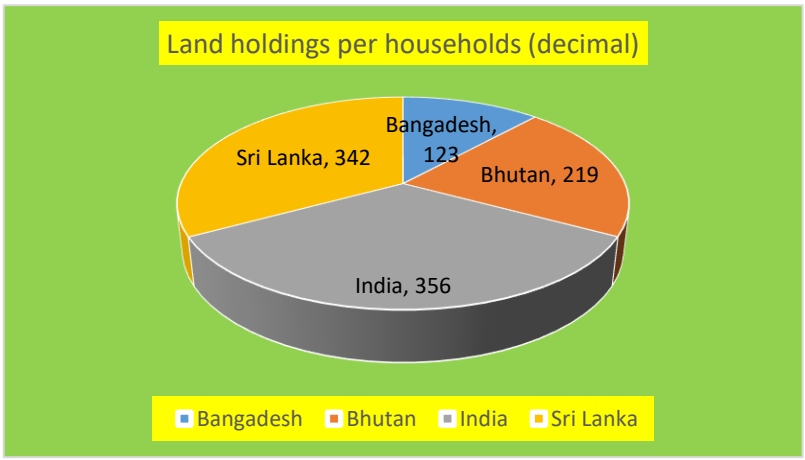


Figure 2: Size of Landholdings per household of project implemented countries

c) Change in family income

The change in family income of sampled farmers is shown in two ways: i) by deducting the change in non-project farmers and ii) without deducting the change occurred in control households. When change in control samples deducted it ranged from 2 to 7 percent only highest with Bangladesh followed by Bhutan, Sri Lanka and India. The sample size was 20 households in each country.

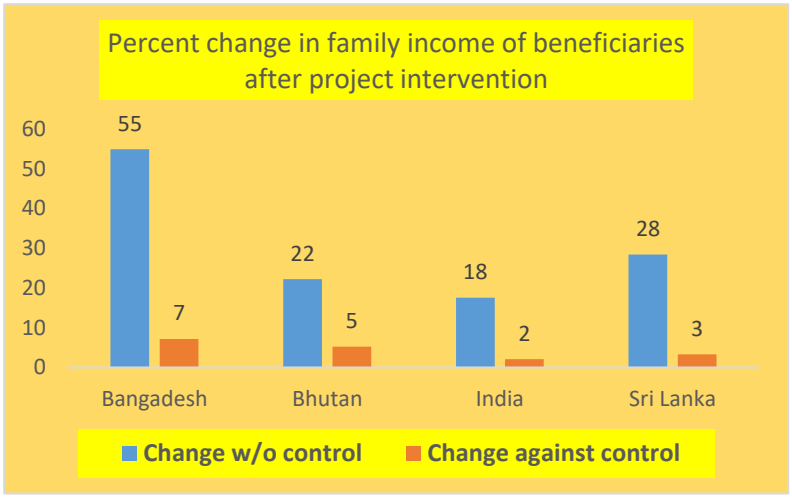


Figure 3: Change in family income of beneficiaries in project implemented countries

d) Employment generation

The fig. 3 showed the employment generation achieved due to the implementation of the project in different SAAC countries. The graph presented the numbers of persons employed under the processing centers and by the farmers. The farmers of Sri Lanka used highest numbers of persons under their production systems after the project followed by Bangladesh, Bhutan and India. The processing centers of Si Lanka also engaged highest numbers of local staff after starting the operation of the processing centers followed by Bangladesh, Bhutan and India. The results indicated that India used least numbers of manpower either in farming or in processing centers.

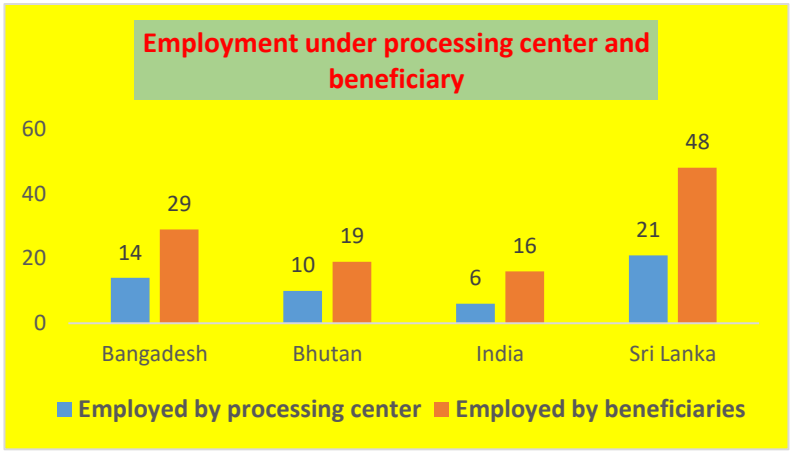


Figure 4: Employment generation by the processing centers and beneficiaries

e) Production of value added products

The amount of value added products produced by the processing centers of project countries is showed in Fig. 5. Highest finished products produced by Bhutan followed by Bangladesh, Sri Lanka and India.

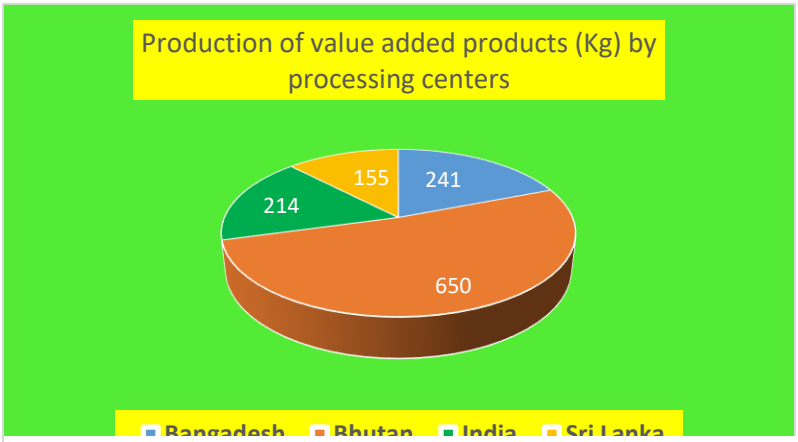


Figure 5: Marketable finished products produced by countries

f) Reduction of Post-harvest loss

The data presented in the Fig. 4 observed that highest post-harvest loss of the interventional crops incurred in Bhutan. Interventional crops are different for different countries. And in Bhutan branding/marketing of moringa tea from its leaf was one of the value addition products, generally leaf had least use so post-harvest loss was higher earlier than present that issue reflected in the results of post-harvest loss reduction in Bhutan. Least post-harvest loss observed in Bangladesh as the interventional fruit crops had other alternative popular use earlier. The targeted value added crop products (vacuum fried chips of jack fruit and banana) has still very low market volume. So the practices had no greater role in reducing post-harvest loss of jack fruit or banana.

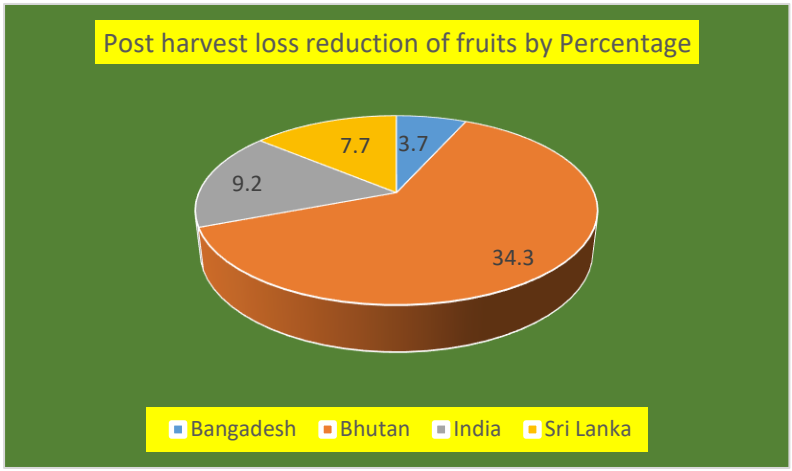


Figure 6: Percent post-harvest loss reduction achieved in different countries

g) Financial transection of processing centers

The financial transection of the processing centers averaged over the operating years is showed in the Fig. 5. It has been observed that highest financial transection achieved by Sri Lanka followed by Bangladesh, Bhutan and India. The financial transaction of processing centers between countries varied widely due to variation in starting time and seasonality of agricultural products.

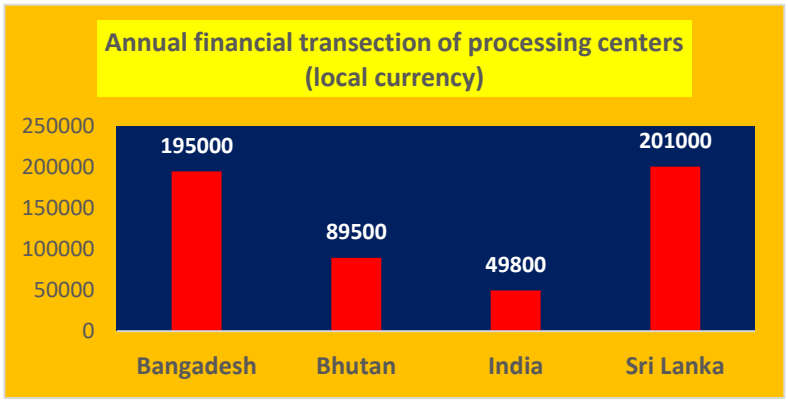


Figure 7: Financial transection of the processing centers of interventional countries

h) Skill development training of beneficiary

The skill development training for farmers conducted by different implementing countries is shown in the Fig. 6. It has been observed that India provided training to highest (large) numbers of farmers followed by Bangladesh, Sri Lanka and Bhutan.

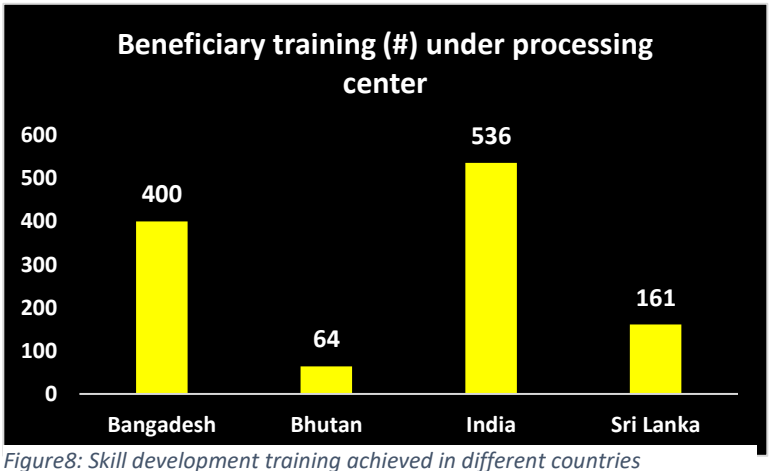


Figure8: Skill development training achieved in different countries

i) Value added products of project's countries

- Bangladesh = Banana chips, Jackfruit chips, Tomato sauce
- Bhutan = Moringa tea, Radish pickles
- India = Virgin coconut oil, Moringa leaf powder, Capsule, Tablet, Soup powder, Rice mix/Dosa/idli mix, Chappati/Atta mix
- Sri Lanka = Banana chips, Peanut processed pack, Cassava

3.3 Detailed discussion of indicators by Countries

The following section discussed the detailed findings of the SDF project as per achievement of the concerned countries by indicators. The country wise discussion started with demography of the participants.

3.3.1 Bangladesh

The SDF project activities were operated in two sites of Bangladesh (Bogura and Gazipur) through forming beneficiary groups with mostly marginal households (landholdings 50 – 150 decimal) under direct supervision of RDA (Rural Development Academy), Bogura.

Demography of the sample households

As customary the study investigated the demographic characteristics of the project farmers to know the representatives of the sampled households used in the study for data generation. The social status of the sampled households are discussed in the following section.

Figure 1: Interaction meeting with producer group at processing center, Gazipur

a) Distribution of households by sex

During selecting the targeted farmers for data generation, the study put equal importance to maintain proper gender balance. On averaged of two sites 60% sampled households were male and 40% female. For individual sites, Bogura represented by 20% female samples and Gazipur with 60% female population. It indicates that in Bogura 80% sampled households were male against 40% male samples in Gazipur (Table 3.2).

Table 3.2: Distribution of sampled Households by sex

Sample	Location/Site (%)		All
	Bogura	Gazipur	
Male	80.0	40.0	60.0
Female	20.0	60.0	40.0
Total	100.0	100.0	100.0

b) Distribution of households by age

None of the sampled farmers were fall below 30 years of age and over 50 years (Table 3.3). It indicates that the sampled households selected for the study were very much within the active age group population of the society. The distribution of samples averaged across sites are found very unique i.e. 50% from 30 to 40 years of age group while the rest 50% are within 40 – 50 years of age group. Considering individual site, in Bogura 60% selected households were from 30 to 40 years of age group and rest 40% from 40 to 50 years of age. While the case was reverse for Gazipur site, 40% from 30 to 40 years of age and rest 60% from 40 to 50 years of age group. Details are showed in the table 3.3.

Table 3.3: Distribution of sampled households by age

Age (year)	Location/Site (%)		
	Bogura	Gaziur	All
30 to 40	60	40	50
40 to 50	40	60	50
50 to 60	0	0	0
Above 60	0	0	0
Total	100	100	100

c) Distribution of households by education

The endline survey examined the education status of the sampled households and showed in the following Table 3.4. It has been observed that the households in both the sites are more or less literate, and none of them were found without schooling. Considering the data collection sites, the households of Gazipur were more literate (60% completed school year up to 12) than the Bogura site (averaged 40% completed school year 12). Considering level of schooling, averaged across sites 30% of the respondents mentioned that their education level up to school year five, of which 40% in Bogura and 20% in Gazipur; 20% have their schooling from five to six years while 50% informed their education level is up to school year 12 or above, of them 40% from Bogura and 60% from Gazipur. The sampled households who provided information for the study are found intelligent and comparatively educated farmers.

Table 3.4: Distribution of respondents by education

Education level	Location/Site (%)		
	Bogura	Gazipur	All
No education	0	0	0
Up to school year V	40	20	30
Up to school year VI to X	20	20	20
Up to school year X	0	0	0
Up to school year 12 or above	40	60	50
Total	100	100	100

d) Family size of households

The family size (number of member per family) of the interviewed households was collected from both Bogura and Gazipur sites. The average family members per household are comparatively higher among the respondents of Bogura than Gazipur (Table 3.5). As informed by the farmers, the average family size of Bogura site is 5.2 members/family against 3.4 members/family in Gazipur. Across locations, the family size is found 4.3 members/family which is found alike with the national average household size 3.4/family[1]. Averaged across locations, within the family the male members are 2.2 against 2.1 female members. In Bogura the male members/family is 2.8 against 2.4 female members while in Gazipur the male members are 1.6 against 1.8 female members per family.

Table 3.5: Family size of the sample households

Family size by sex	Location/Site (number)		
	Bogura	Gazipur	All
Male	2.8	1.6	2.2
Female	2.4	1.8	2.1
Total	5.2	3.4	4.3

e) Distribution of households by family size

After examining the family size of the project farmers it has been observed that across locations, maximum families i. e. 40% have 3 persons per family and 40% have 4 persons per family. Interestingly, none of the families found with 5 members per family while 10% of the respondents reported they have their family size is 6 and another 10% have more than 6 members per family.

[1] Nationally, the average household size is **4.3 people per household**. It is calculated by dividing the household population by total households. Ref: https://www.arcgis.com/home/item.html?id=692cee7e5a5e47dd86531ab0c6a00cff

By segregating locations, it has been observed that in Bogura 20% respondents have their family size 3, 40% 4, 20% informed 6 and rest 20% reported more than 6 members per family. On the other hand, in Gazipur 60% households reported their family size is 3 and other 40% said they have 4 members per family. Details are shown in Table 3.6.

Figure 2: Data collection session at RDA, Bogura site

Table 3.6: Distribution of respondents by family size

Family size (#)	Location/Site (%)		
	Bogura	Gazipur	Mean
3	20	60	40
4	40	40	40
5	0	0	0
6	20	0	10
>6	20	0	10
Total	100	100	100

f) Size of landholdings of project farmers

The following Table 3.7 showed the size of landholdings (considering lands under current cultivation) per family in the SDF supported livelihood enhancement project area by locations and gender. Across locations the average size of landholdings of project farmers is found 122.6 decimal per family without considering gender segregation. On the other hand the size of average landholdings per family of non-project farmers is found 48.9 decimal i.e. 60.2% less than the project farmers. In both locations the size of landholdings in female led households of project farmers (77.5 decimal/family) is less than the male led households (125.3 decimal/family). In case of non-project farmers, the scenario is found similar i.e. women households have less land size than male ones. Considering project farmers, the land size per households in Bogura is 24.8% less than the Gazipur site; while the land size for non-project farmers in Gazipur is 6.1% higher than the Bogura site. It indicated that the non-beneficiary farmers are comparatively poorer (possetion of cultivable land under the family is considered as the key indicator for family income of the rural folk) land size than the project farmers.

Table 3.7: Size of land holdings of project and non-project households

Location/site	Project household (decimal)			Non-project household (decimal)		
	Male	Female	Mean	Male	Female	Mean
Bogura	140.5	70.0	105.3	49.7	45.0	47.3
Gazipur	110.0	85.0	140.0	66.3	34.5	50.4
Mean	125.25	77.5	122.6	57.98	39.8	48.9

g) Distribution of households by landholdings

The following Table 3.8 showed the distribution of project and non-project farmers against their size of landholdings. The land size of farmers are grouped into 0-50 decimal category, 50-100, 100-150, 150-200 and more than 200 decimal holdings to show the distribution of sampled respondents. It has been observed that in Bogura 20% farm households of project farmers fall under the category of 0-50 land holdings, 40% under 100-150 decimal and 40% beyond 200 decimal land holdings. In Gazipur, 20% respondents fall under 0-50 decimal land holdings category, 20 under 50-100 decimal range, and 60% under 100-150 decimal land size. In Bogura 20% farm households of project farmers fall under the category of 0-50 land holdings, 40% under 100-150 decimal and 40% beyond 200 decimal land holdings. In Bogura 40% farm households of non-project farmers fall under the category of 0-50 land holdings, and 60% under 100-150 decimal. In Gazipur, 20% respondents fall under 0-50 decimal land holdings category, and 80% under 50-100 decimal land size.

Table 3.8: Distribution of households by their size of landholdings

Size of land holdings (decimal)	Project household			Non-Project household		
	Site/Location (%)		Mean	Site/Location (%)		Mean
	Bogura	Gazipur		Bogura	Gazipur	
0-50	20	20	20	40	20	30
50-100	40	20	30	60	80	70
100-150	0	60	30	0	0	0
150-200	0	0	0	0	0	0
>200	40	0	20	0	0	0
Total	100	100	100	100	100	100

h) Annual family income of project farmers

The endline survey attempted to measure the changes in family income of project and non-project farmers of both Bogura and Gazipur sites by generating data against before and after project situation through recall methods. To ease the data collection methods the family income of respondents was divided into two main sources like i) crop enterprises that included income from project interventional crops (banana, jackfruit, tomato) and other presently growing crops like rice, maize, oilseeds, pulses etc. and ii) non-crop enterprises that included income from livestock, fisheries, service/daily wage, small businesses and others. The following Table 3.9 summarized the family income from crop and non-crop enterprises and compared them under before and after project situation.

As reported by the respondents, the annual family income of project farmers ranged from BDT 318260 to 351100 with a mean of BDT 334680/annum under before project situation against BDT 536300 to 500660 with a mean of BDT 518480/annum after project situation. The data in the Table 3.8 revealed that in Bogura the income of project farmers from non-crop enterprises are 42% higher than the crop enterprises under before project condition and 25% higher under after project situation. While Gazipur the consequence is reverse i.e. income of project farmers from crop enterprises are 36% higher than the non-

crop enterprises under before project situation and 23% higher under after project circumstances. Averaged by locations the family income of project farmers are 7% and 3% higher from crop enterprises under before and after project conditions respectively. Details are showed in the Table 3.9.

Table 3.9: Annual family income of project farmer

Location/site	Before project (BDT)*			After project (BDT)*		
	Crop enterprise	Non-crop enterprise	Total	Crop enterprise	Non-crop enterprise	Total
Bogura	131460	186800	318260	222760	277900	500660
Gazipur	214500	136600	351100	303500	232800	536300
Mean	172980	161700	334680	263130	255350	518480

*BDT 120 = 1 USD

i) Changes in family income of project farmers

The following Table 3.10 analyze the changes occurred in family income of project farmers after implementing the SDF supported livelihood enhancement project by comparing their present incomes with the earlier incomes (before starting the project). Irrespective of location/sites, the income of the project farmers has invariably been increased by 55-60%. The income has mostly increased in similar fashion from both crop (55%) and non-crop enterprises (60%). Considering the locations, the income-increase from crop enterprises (69%) superseded the income increase of non-crop enterprises (49%) in Bogura. While in Gazipur, the income-increase from non-crop enterprises (70%) exceeded the income increase from crop enterprises (41%). It is noted that this income increase does not necessarily mean due to only SDF project activities, other factors like technology diffusion due to intervention of other agricultural development projects in the locality, usual inflation during this 3 years gap etc. are also contributed to the enhancement of family income.

Table 3.10: Change in family income of project beneficiary under crop and non-crop enterprises

Location/site	Crop enterprise (BDT)*			Non-crop enterprise (BDT)*		
	Before	After	Change %	Before	After	Change %
Bogura	131460	222760	69	186800	277900	49
Gazipur	214500	303500	41	136600	232800	70
Mean	172980	263130	55	161700	255350	60

*BDT 120 = 1 USD

j) Annual family income of non-project farmers

As of family income of project farmers, the endline survey of the SDF livelihood enhancement project also collected the family income of non-project farmers considering both of their present and earlier (before project start) incomes. The family income of non-project farmers ranged from BDT 263800 to 236280 with a mean BDT 250040/annum under before project situation against BDT 376800 to 361940 with a mean of BDT 369370/annum under after project situation. The total annual family income either before or after project situation of project farmers was comparatively higher than the non-project farmers. The annual

income of project farmers was 25% and 29% higher than non-project farmers under before and after project situation respectively. For non-project farmers the income from crop enterprise was less than the non-crop enterprise in both Bogura and Gazipur sites. Not much variation was observed in the annual family income either before or after project situation in Bogura and Gazipur sites. Details are shown in Table 3.11.

Table 3.11: Annual family income of non-project farmer

Location/site	Before project (BDT)*			After project (BDT)*		
	Crop enterprise	Non-crop enterprise	Total	Crop enterprise	Non-crop enterprise	Total
Bogura	74880	161400	236280	125000	251800	376800
Gazipur	131900	136200	268100	160000	201940	361940
Mean	103390	148800	252190	142500	226870	369370

*BDT 120 = 1 USD

k) Changes in family income of non-project farmers

The following Table 3.12 enumerated the changes occurred in family income of non-project farmers by crop and non-crop enterprises due to SDF supported project activities. Averaged across locations, changes in annual income of the families observed higher in non-project enterprises (55%) than the crop enterprises (44%). But in Bogura site changes in family income of farmers were higher under crop enterprises (67%) than the non-crop enterprises (56%). On the other hand in Gazipur sites the changes in family income of non-project farmers was higher in non-crop enterprises (53%) than the crop enterprises (21%). It is noted that this income increase are also related with other factors like technology diffusion due to intervention of different agricultural development projects in the locality, usual inflation during this 3 years gap etc. are also contributed to the enhancement of family income.

Table 3.12: Change in family income of non-project beneficiary under crop and non-crop enterprises

Location/site	Crop enterprise (BDT)*			Non-crop enterprise (BDT)*		
	Before	After	Change %	Before	After	Change %
Bogura	74880	125000	67	161400	251800	56
Gazipur	131900	160000	21	131900	201940	53
Mean	103390	142500	44	146650	226870	55

*BDT 120 = 1 USD

l) Comparison of change in family income of project and non-project beneficiary

The changes in annual family income of project and non-project farmers at before and after project situation is compared in the following Table 3.13. The study/survey measured the enhancement of family income of project farmers due to project activities by subtracting the percentage of increased achieved by the non-project farmers within the same period of time (i.e. before and after project implementation). As identified the changes of family income of project farmers considering before and after project circumstances attained 57% in Bogura against 53% in Gazipur with mean of 55% irrespective of locations. While the changes of family income of non-project farmers considering before and after project conditions accomplished as 59% in Bogura against 37% in Gazipur with mean of 48% irrespective of locations. The analysis of data indicated that the

changes of income of project farmers during the project period reduced by 2% in Bogura site while increased by 16% in Gazipur site and changes averaged across the sites is found 7% only. Actually the changes in family income between project and non-project farmers are found mostly insignificant, possibly because the processing centers established by the SDF project for value addition of crop products are yet to be operated in full swings. In almost all sites the operation of processing centers passed only one cropping season or two, so income of project farmers do not actually reflected. May be with time and by continuation of the operation of processing center with value addition and proper marketing linkage the income of project farmers will supersede the income of non-project farmers soon.

Table 3.13: Change in family income of project and non-project beneficiary

Location/ site	Annual income of beneficiary (BDT)*				Change (%)		% Change of project over non-project farmers
	Project		Non-project				
	Before	after	Before	after	Project	Non-project	
Bogura	318260	500660	236280	376800	57	59	-2
Gazipur	351100	536300	263800	361940	53	37	16
Mean	334680	518480	250040	369370	55	48	7

*BDT 120 = 1 USD

3.3.1.1 Establishment of Processing Center for Production of Value Added Products

By the financial assistance of livelihood enhancement project, Bangladesh established two processing centers, one at Bogura (picture BD 1) and other in Gazipur (picture BD 2) in March 2020. The processing center in Bogura mainly dealt with the manufacturing and marketing of vacuum frying chips of jackfruit, banana and mango. While the SDF processing center in Gazipur dealt with the preparation of tomato sauce using an organized female group (number of 150) at the village Pabur of Kapasia Upazila. The performances of the processing centers since establishment to March 2024 are discussed in the following section.

Figure 3: Processing center at RDA, Bogura

a) Skill development of farmers

The SDF supported livelihood enhancement project supported funding for skill development of targeted farmers for value addition and improved marketing systems of their crop products. During the project period 400 participants attended the training programs on various subjects organized by the project management in Bangladesh. Out of the total training participants 300 (75%) were female and 100 (25%) male. The duration of the training courses organized in different times ranged from 3 – 5 days. Among the training courses organized, the training on `value chain agro-processing' had longer duration (5 days)

followed by orientation and maintenance of equipment' with 4 days duration and on `business management, with 3 days duration. It has been observed that two training courses were organized in 2021 (Apr and Aug) and other two courses in 2022 (Jun and Jul). None of the training courses organized during 2023 and 2024 as it closed in 2022. Details are shown in Table 3.14.

Table 3.14: Capacity building of farmers

Training subject	Number of participant			Duration of training (day)	Time organized
	Male	Female	Total		
Farm and business management	25	75	100	3	Apr 2021
Value chain and agro-processing	25	75	100	5	Aug 2021
Operation and maintenance of equipment	25	75	100	4	Jun 2022
Product handling and marketing of food safety	25	75	100	3	Jul 2022
Total	100	300	400	3.75	

b) Production of value added products

Both of the processing centers at Bogura and Gazipur established in March 2020 and started functioning for preparing value added products like chips and sauce in January 2021. The following Table 3.15 summarized the data on amount of crop produces assembled in the center and the production of value added i.e. finished marketable products by the center in different operational years. In Bangladesh the processing centers produced chips (banana and jackfruit) and sauce (tomato) from raw crops collected from the farmers.

It has been observed that during the operational years, the center gathered total 250 Kg banana, 360 Kg jackfruit and 110 Kg tomato, of which 100 Kg and 150 Kg tomato collected in 2021 and 2022 respectively with no or slight operational evidences in 2023 and 2024 at Gazipur by the women group members. Out of the crop products (in raw forms) assembled, the center produced and marketed 61 Kg banana chips (25 Kg in 2021 and 36 Kg in 2022), 70 Kg jackfruit chips (30 Kg in 2021 and 40 Kg in 2022) and 110 Kg tomato sauce (40 Kg in 2021 and 70 Kg in 2022). Considering the total volume of raw and value added crop products, 620 Kg raw and 241 Kg finished products assembled and marketed by the centers during the project period. The field visit at the processing centers observed that they are well equipped with necessary modern machineries and other physical facilities for preparing the chips and sauce. To facilitate marketing, the processing centers also adopted/printed good quality aluminum foiled packaging. The processing centers in Bogura and in Gazipur need follow up financial and small scale manpower support from the SDF or other donor supported sub-project for next one to two cropping seasons to

Figure4 Preparation of tomato sauce at Gazipur by producer group

continue the production of value added products and to popularize their products in the local and wholesale markets or super markets.

Table 3.15: Establishment and operation of processing center

Establishment year and start of operation	Agricultural product assembled in the center (kg/year)			Total	Finished products marketed (kg/year)			Total (Kg)
	Banana	Jackfruit	Tomato		Banana chips	Jackfruit chips	Tomato sauce	
Establishment in 2020								
Year 1: 2021	100	160	40	300	25	30	40	95
Rear 2: 2022	150	200	70	320	36	40	70	146
Total	250	360	110	620	61	70	110	241

c) Financial Transection of processing centers

The financial transection of the processing centers during the operational years showed in the following Table 3.16 considered only the sale value (gross margin) of the finished products (chips and sauce) without bearing in mind of the on-going expenditures. As informed by the project staff the annual sale of the centers were altogether BDT 75000 in the starting year of 2021 and it increased to BDT 120000 in the following year 2022. But in 2023 no data provided, operation might be ceased due to lack of funding from the project side. Without segregating years the share of income was higher with jackfruit chips (54%) followed by banana chips (28%) and tomato sauce (18%). The results indicated that the prospect of chips either jackfruit or banana is encouraging than the prospect of tomato sauce. One of the reason for less income from tomato sauce could possibly be due to its abundance in the market, so high competiveness, on the other hand banana and jackfruit chips did not faced any market challenges. Continuation of the operation of the processing centers would help to create market for the banana and jackfruit chips.

Table 3.16: Financial transection of processing center

Operational year	Finished products marketed (Tk/Year)*			Total*
	Banana chips	Jackfruit chips	Tomato sauce	
Year 1: 2021	20000 (27)	45000 (60)	10000 (13)	75000 (100)
Year 2: 2022	35000 (29)	60000 (50)	25000 (21)	120000 (100)
Year 3: 2023	00	00	00	00
Total	55000 (28)	105000 (54)	35000 (18)	195000 (100)

Figures in parenthesis are percentage of total. *BDT 120 = 1 USD

d) Employment generation under processing centers

The processing centers employed numbers of workers for its daily operations to prepare the chips and sauces during the project period and the study collected the information on the manpower engaged by the centers. It has been observed that the centers employed only 6 persons of which 4 males and 2 females in the 1st year of operation and in 2nd year it increased the workers from 6 to 8, only 2 additional

male workers engaged. Overall the consumption of manpower by the centers to its operations is not found very encouraging. The centers were run for only two cropping seasons, so the volume of finished products was also not enough, it was related with the supply of raw materials and most importantly the marketing of new products like banana and jackfruit chips in the local or super markets of cities. If the processing centers can continue its operation it will certainly would need manpower for maintenance, production and marketing. As observed in initial stage of operation it only used workers for production of chips and sauce, the results of manpower engagement is not found encouraging. Details are shown in Table 3.17.

Table 3.17: Number of people employed in the processing center

Operational year	Number of person engaged in processing center		
	Male	Female	Total
Establishment in 2020			
Year 1: 2021	4	2	6
Year 2: 2022	6	2	8
Year 3: 2023	0	0	0
Total	10	4	14

e) Employment generation by the farmers

The scenario of employment generation by the farmers after project activities is better than the manpower engagement by the processing centers. In each of the concerned crops like tomato, jackfruit and banana the beneficiary farmers engaged more numbers of workers after the project than the before project situation. Averaged across crops the beneficiary household hired altogether 19 laborers during the cropping season before project time while after project implementation they have recruited 29 Laborers, meaning used 71% additional manpower due to project activities. Among the crops jackfruit consumed highest numbers of laborers followed by banana and tomato. The changes in laborers employed before and after project environment by crops are detailed out in Table 3.18.

Table 3.18: Employment generation by farmers

Sources of employment	Number of person engaged in farming per crop per household								
	Before project			After project			% Change		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Banana	4	2	6	7	3	10	75	50	67
Jackfruit	6	3	9	10	4	14	67	33	56
Tomato	1	1	2	2	3	5	100	200	150
Total	11	6	17	19	10	29	73	67	71

f) Product marketing by processing centers

The following Table 3.19 plotted the data on marketing of finished products by the processing centers through different types of market outlets. It is to be mentioned that marketing of finished products by the

processing centers only done during the project period not before or after project situation. It has been observed that averaged across crops (without considering variation between crops) the highest sale of finished products was made through farm gate (37%), followed by whole sale market 27%, local markets 23% and retailers (retail markets) only 13%. If we consider the variation of product marketing of processing centers by market outlets, it is found that centers has marketed considerable amount of products (27%) through wholesaler, it indicated the skill development training and other technical activities of the projects helped the marketing staff of centers for making good communication with the wholesale market actors. They have also developed good accessibility to the local markets actors too (Table 3.19).

Table 3.19: Marketing of products by processing center

SDF supported crops	Percent crop product sold by market outlets				
	Farm gate	Retailer	Wholesaler	Local market	Total
Banana	30	10	20	40	100
Jackfruit	40	20	30	10	100
Tomato	40	10	30	20	100
All	37	13	27	23	100

g) Marketing of crop products by farmers

The following Table 3.20 compared the market accessibility of project farmers for the concerned crops of SDF supported livelihood enhancement project during before and after project situation. The crops under consideration (Table 3.20), no marketing of tomato was done by the farmers through farm gate outlet either before or after project environment. Under before project situation tomato was mainly marketed through retailers (43%) and in the local markets/hats (30%) but after project implementation the scenario has been found changed to revers like 70% marketed though wholesalers and 30% to the retailers. It indicated that tomato marketing by the farmers has been improved after having skill development training and other technical support provided by the SDF project. In case of jackfruit marketing no visual improvement was found in fruit marketing of the crop, if we compare before after project situation, marketing through farm gate increased by 10%, retailers decreased by 10%, no change observed in wholesale and local marketing. In case of banana marketing some visual improvement was found in fruit marketing of the crop, comparing before after project situation it may be stated that marketing through farm gate decreased by 40% from 80% to 40%, no change occurred in retailers marketing outlets, the farmers reported 10% and 30% finished products marketed through wholesale and local market outlets against no wholesale or local marketing done in before project situation.

Figure 5 Value added ready for sale products from tomato

Table 3.20: Marketing of products by farmers

SDF supported crops	Percent crop product sold by market outlets									
	Before project					After project				
	Farm gate	Retailer	Whole saler	Local market	Total	Farm gate	Retailer	Whole saler	Local market	Total
Banana	80	20	0	0	100	40	20	10	30	100
Jackfruit	20	40	10	30	100	30	30	10	30	100
Tomato	0	70	0	30	100	0	30	70	0	100
All	33	43	3	20	100	23	27	30	20	100

h) Production packages adopted

The endline survey investigated the adoption levels of different production practices promoted by the SDF assisted project into the project farmers. The project activities like formation of producer group, skill development training, establishment of processing plant, arrangement of exposure visits for the farmers to the upgraded technology adopted farms, offices of Government and private extension agencies etc. motivated the farmers to adopt crop production packages in certain levels. The following Table 3.21 enlisted the production practices being adopted by the farmers in both of the research sites.

Table 3.21: New production packages adopted by the project farmers

Banana value chain (Bogura)	Tomato value chain (Gazipur)
Planting of young sword sucker	Staggered planting by using of indeterminate variety
Use of support (bamboo) to the fruit bearing plant and harvesting vegetables (radish, yam spinach etc.) as intercropping	Adopted proper plant protection measures and provided proper support to the fruit bearing plant that ensured good harvest
Integrated pest management and practicing proper cleaning of plantation area	Adopted appropriate grading and packaging to ensure higher market price
Use of polythene to protect bunch from insect damage and to develop good color	Adopted recommended harvesting of fruit by keeping petiole
Practiced grading and packaging to ensure higher market price	Practiced staggered harvesting of crop to ensure good market price
Timely and staggered harvesting	Harvesting of green coconut and coconut following proper timing and market

i) Post-Harvest Loss Management

Post-harvest loss reduction of interventional crops was one of the important objective of the livelihood enhancement project, and considering the fact the impact study assessed the changes of post-harvest loss of banana and tomato crops in Bogura and Gazipur respectively.

As reported by the project farmers, the post-harvest loss of tomato was higher than banana under both before and after project intervention. In case of banana the post-harvest lost reduced from 11.4% to 8.8% (by 2.6%) due to project activities (training and value addition) and in tomato it reduced from 16.8% to 10.4% (by 4.8%). Regardless of crops the post-harvest loss of crops reduced by 3.7% by the activities of project. The edible parts are matured fruits in both the crops, so the improved intercultural management introduced by the project possibly plays an important role in reducing the damage of fruits at or after harvest. Details are shown in Table 3.22

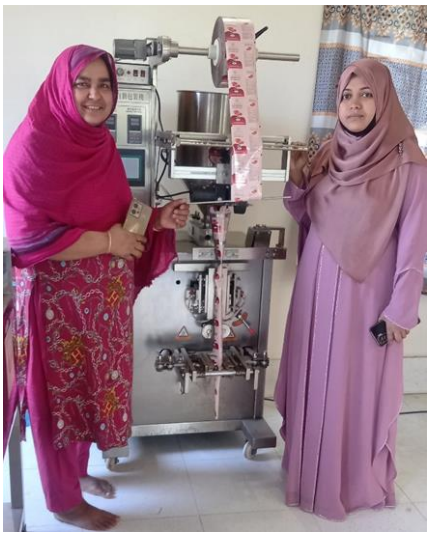


Figure 6: Chips making machineries in processing center of Gazipur

Table 3.22: Post-harvest loss reduction occurred due to SDF project activity

Name of crop	Before project	After project	Difference (% Reduction)
	Post-harvest loss (%)	Post-harvest loss (%)	
Banana	11.4	8.8	2.6
Tomato	16.8	12.0	4.8
All	14.1	10.4	3.7

j) Employment enhancement

The following table enumerated the data on monthly engagement of laborers in the concerned crops (banana and tomato) by the farmers under before and after project situation. After project intervention, the labor use per household in their crop production increased by 47% for banana and 33% for tomato. Regardless of before or after project situation, among the two crops tomato consumed more laborers than the banana cultivation (Table 3.23). The farmers were encouraged to use higher numbers of laborers, possibly due to adopting new technologies promoted by the projects like irrigation or pesticide use, marketing etc. Attending agro-business training in the processing plant and exposure visit of households to processing units also played vital role in employing higher numbers of laborers in their crop cultivation.

Table 3.23: Employment enhancement (#) by farmers/producers due to SDF project activity

Name of enterprise	Before project	After project	Difference (%)
	Number labor engaged/month	Number labor engaged/month	
Banana value chain	7.2	10.6	3.4 (47)
Tomato value chain	11.4	15.2	3.8 (33)
All	9.3	12.9	3.6 (39)

k) Incremental price of crop products

The project activities like exposure visits, training on agro-businesses, use of sorting/grading of edible parts of crops (fruits) by harvesting the crop at proper time might be assisted the households to have higher incremental prices/sales for their marketable crop products. The incremental prices/sales that the farmers received after project interventions is shown in the following Table 3.24. After project intervention, the farmers received higher incremental price for banana than the tomato. Regardless of variation between crops, the changes in prices of marketable products due to time (project period) and project interventions ranged from 31% to 41% with an average of 35%.

Table 3.24: Value of incremental sales received by SDF supported farmers

Name of crop	Before project	After project	Difference (%)
	Market price/Kg/fruit	Market price/Kg/fruit	
Banana	69.0	90.4	21.4 (31)
Tomato	47.8	67.4	19.6 (41)
All	58.4	78.9	20.5 (35)

l) Accessibility to value added technology

The implementation SDF assisted project opened the accessibility of the producer group members to the different new value added products/technologies, modified systems of crop production and marketing for ensuring higher income. Out of many production technologies mentioned by the project staff and farmers, some are enlisted in the following matrix. The table also compared the existing technologies available to the farmers during before starting the project with the availability of technologies to the farmers after project intervention. As reported farmers were happy to know the diversified use of banana especially vacuum fried chips as alternative of popularly consumable potato chips. Another interesting issue for the farmers was grading and packaging of marketable products. They also mentioned about use of banana sword sucker and intercropping of varieties kinds of vegetable and chili in banana field. Similar responses also received from the farmers of Gazipur for tomato sauce making and marketing at the household levels. Details of the technologies the farmers learned after engaging with the project activities are listed in the following table 3.25.

Table: 3.25: Accessibility of SDF supported farmers to technology (post-harvest handling and value addition)

Name of crop	Before project	After project
	Name of post-harvest handling techniques	Name of value addition techniques
Banana value chain	i Marketing of banana by bunch without practicing grading and packaging	i. Dried vacuum fried banana chips
		ii. Practicing sorting and grading before marketing
		iii. Use of polythene cover over the bunch to improve color and protect from insect damage
		iv. Use of IPM techniques to clean the plots and reduce chemical hazards to fresh fruits
		v. Use of sword sucker to ensure good vegetative growth and harvest
		vi. Good quality packaging for marketing of products
Tomato value chain	ii Selling tomato from the plot	i. Use of new indeterminate variety
		ii. Preparation and marketing of tomato sauce

	iii Marketing of ripening tomato	iii. Use of support (staking) for healthier growth of the plant
		iv. Staggered planting and harvesting to protect market price
		v. Harvesting of fruit by keeping the petiole to enhance shelf life of tomato

m) Awareness development to the producers

The SDF supported livelihood enhancement project assisted to build up awareness among the producer groups of interventional crops through skill development training and exposure visits. Awareness were created to the production and value addition technology especially to the post-harvest handling and marketing of the value added products to ensure higher market prices. After project interventions, the producers of banana and tomato in both the project's research sites (Bagura and Gazipur) have been developed their awareness to the following production issues:

i. Planting of sword sucker in case of banana and indeterminate variety for tomato to ensure good vegetative growth and higher yields and income from per unit area of land
ii. Harvesting of mature but not ripen fruits for both banana and tomato to have higher market price
iii. Sorting, grading and quality packaging of vacuum fried banana chips and tomato sauce is very important to enhance market demand and ensure higher price.
iv. Practicing integrated pest management (IPM) techniques to manage insect/pest damage instead of using traditional inorganic chemical to the fresh fruit (ready to eat) products like banana and tomato
v. Use of support to the fruit bearing plants reduce post-harvest loss of banana and tomato and ensure higher market price of the marketable fruits
vi. The project arranged exposure visits for the producer group members to different Government and non-Government agencies and business firms that enhanced their interest to the diversified agricultural production and businesses
vii. Use of polythene cover over the banana bunch improved the quality of fruits (color and size) and reduced insect damage. Very simple good technology to ensure higher market price
viii. Staggered planting by dividing the same plot in different pieces ensured staggered harvesting and good market prices

n) Opportunities

Out of two, one processing center is constructed at RDA (Rural Development Academy), Bogura one of the largest business city in the North Bengal, while the other one established in a well communicated developed village of Pabur at Kapasia, Gazipur, which is famous for jackfruit cultivation. Considering the locations and other available facilities the opportunities of the centers are:

- RDA may assist rural households for improving their livelihoods through business development, who are the partner of SDF livelihood enhancement project in Bangladesh
- RDA has a good market outlets for marketing of chips and other value added products using their own facilities

- As a national reputed organization with highly skilled manpower, the organization can explore the marketing opportunities for the rural households too
- The processing center has established close to the city center, so easy to link the producer groups with the technical staff of DAE
- The intensity of NGO operation is high in the location, so credit facilities are available for business extension of the producer group
- One of the officials who worked with the SDF project for preparing the chips and sauces already have started business of vacuum-frying chips by his own initiatives using the machineries of RDA through contractual arrangement

o) Limitations

The processing centers established in 2020 at the campus of RDA (Rural Development Academy), Bogura and another at the village Pabur of Kapasia Upazila, some 32 Km from the city center of Gazipur. Based on each of the centers 1-3 women producer groups with an average 20 members per group has been organized. The project officials trained the members of the producer groups especially on preparation of different value added products from selected crops like banana, jackfruit and tomato. Some of the limitations observed during the field visit are:

- The processing center at Bogura producing banana and jackfruit chips without tomato sauce where banana and tomato though cultivate as commercial crops but jackfruit not considered as commercial fruit crop
- Intensity of jackfruit trees are not sufficient enough in and around the centers
- The center at Kapasia, Gazipur is producing only tomato sauce in a limited scale without jackfruit or banana chips due to lack of vacuum fryer, whereas jackfruit is commercial fruit crop in the locality
- Farmers are getting less profit from banana production in Bogura due to acute disease infection and became reluctant to cultivate the crop, so the centers would have to assist farmers to develop good linkage with the local agricultural research institutes and extension agencies
- The centers are in operations for only one or two cropping seasons, to be continued with project support for some more season to make the value added products popular in the local and urban markets
- Marketing of values added products is found as great limitations, women group with poor leadership facing acute competition with large commercial companies like Pran, Square, DB Foods ltd. Ahmed Food Products (Pvt.) Ltd. Etc.

p) Challenges identified for production and post-harvest processing of interventional crops

The impact study identified some of the challenges faced by the producer groups. During physical interview the project farmers mentioned the troubles they encountered during crop production and post-harvest handling. Some problems are natural and some are the teething troubles of development projects and human activities. The identified challenges mentioned by the respondent farmers are summarized below:

i. Gazipur is not a tomato producing region of the country, so the group members faced difficulty regarding easy and ample supply of tomato for making the sauce, needed to collect from distant places that add cost to the products
ii. Jackfruit is popularly and commercially grown/produce in Gazipur district, but the processing center established at Gazipur lacked vacuum fried device, the members of the producer group demanded the device for making jackfruit chips
iii. Bogura is a banana growing region but not jackfruit growing area, so preparing huge quantity of jackfruit chips would encounter shortage of supply
iv. Bogura farmers mentioned about the cracking of banana plants immediately after fruit set that drastically reduce the fruit yield
v. Heavy infestation of sigatoka disease in banana reducing the production of banana per unit area and increase post-harvest losses
vi. Labor shortage resulted higher daily wage during pick season of planting and harvesting
vii. Price fluctuation in the market: reduction of prices of crop products during the pick harvesting season
viii. Transportation: shortage transport increase the cost that resulted low profit margin for the producer groups
ix. Marketing of tomato sauce and chips are the major problems mentioned by the members of the producer groups. The continuation of production of value added products of the interventional crops by the members of the producer group would largely depends upon developing the market linkage to the large companies like PRAN, SQUARE, Ahmed Foods etc. A system is to be designed so that these established processing centers with its producer groups would act as a production hub, where representatives of large companies will place their production order to them and collect the finished products as per schedule. Only then the project interventions regarding value addition of agricultural products would have light to success otherwise it will be under dark like other development projects

q) Recommendation

- To assist producer group, RDA is to take lead role in developing business linkage with the large food and beverage companies to upgrade the centers as rural business hub
- The linkage system is to be made in such a way that the women member will produce the value added products in the center for some of the large food/beverage companies, from where the company representatives will collect it in regular weekly basis
- The center at Pabur village of Kapasia, Gazipur is to be equipped with vacuum fryers so that they can produce jackfruit and banana chips in addition of tomato sauce only
- In Bogura the center is to produce tomato sauce also as the area has surplus tomato production
- The project staff at the center will take necessary role so that the producer group members can get credit from the local NGO or banking systems to enhance their production of crops under consideration
- The project activities would have to be continued by mainstreamed/taken over through government organization like RDA for regular use of these established facilities and nursing of the developed business groups
- Linkage between producer groups with extension agencies to be made stronger through motivation and by arranging exchange visit

-

3.3.2 Bhutan

The interventions of the SDF livelihood improvement project were implemented in three sites of Bhutan, one at Chhukha and other two at Samtse by forming beneficiary groups mostly with small farm households under direct supervision of Department of Agricultural Marketing and Cooperatives, Bhutan. The Chhukha site was concentrated to establish value addition through preparing pickle of radish and the Samtse site taken responsibility to develop value chain of zinger and moringa through preparing pickle and dried other products.

Demography of the sample households

The endline study investigated the demographic characteristics of the project farmers to evaluate the representativeness of the sampled households used in the study for data generation. The social status of the sampled households are discussed in the following section.

a) Distribution of households by sex

Gender disparity is still common in the SAARC countries, so during beneficiary selection for data generation, the study put equal importance to maintaining proper gender (male female ratio) balance. Averaged across the two sites, 30% sampled households were male and 70% female. For individual sites, Chhukha site represented by 80% female samples and Samtse site with 60% female samples. It indicates that in Chhukha 20% sampled households were male against 40% male samples in Samtse site. Details are shown in Table 3.26.

Table 3.26: Distribution of sampled Households by sex at SDF project sites in Bhutan

Sample household	Location/Site (%)		All
	Chhukha	Samtse	
Male	20.0	40.0	30.0
Female	80.0	60.0	70.0
Total	100.0	100.0	100.0

b) Distribution of households by age

The distribution of sampled households by their age (years) is showed in the following Table 3.27. Interestingly the investigation observed that in none of the sampled farmers were below 30 years of age and over 70 years (Table 3.27). The distribution of sampled households averaged across sites by their age was found very unique i.e. 40% samples were within 30 to 40 years of age group while the rest 60% were within 40 – 70 years of age group. Considering individual site, in Chhukha 60% selected households were from 30 to 40 years of age group, and the rest 20% from 50 to 60 years and none from above 60 years of age. While the case was almost reverse for Samtse site, only 20% sampled households were from 30 to 40 years of age and the rest 80% from 40 to 50 years of age group, none from 50 to 60 years or above 60

years. The age distribution of sampled households indicated that the selected farmers for study are comparatively older in Samtse site than the Chhukha site. Details are showed in the table 3.27.

Table 3.27: Distribution of sampled households by age in Bhutan sites

Age (year)	Location/Site (%)		
	Chhukha	Samtse	All
30 to 40	60	20	40
40 to 50	40	80	60
50 to 60	0	0	0
Above 60	0	0	0
Total	100	100	100

c) Distribution of households by education

The education status expressed as primary/elementary, secondary, higher secondary and above of the sampled households in the individual project implemented site were carefully examined and shown in the following table 3.28. It has been observed that quite a significant numbers of sampled beneficiary in both the sites are illiterate with 00 schooling. The data plotted in the table below 3.28 observed that across project implementing sites 30% sampled households are illiterate. Considering the data collection sites, the households from Chhukha site were more illiterate (40% no schooling) than the Samtse site (averaged 20% illiterate). Averaged across sites 40% of the respondents mentioned that their education level is up to school year five, of which 00% in Chhukha and 80% in Samtse; 20% have their schooling from school year vi to x while 20% in Chhukha site informed that their education level is as up to 12 years or above level. The education level of the sampled households is found very poor, possible it happened due to inaccessibility of the remote hilly sites of Bhutan. It is noted that the sample size was only 20 households, so may not be representative for the nation.

Table 3.28: Distribution of respondents by education

Education level	Location/Site (number)		
	Chhukha	Samtse	All
No literacy	40	20	30
Up to Class V	0	80	40
Class VI to X	40	0	20
SSC pass	0	0	0
HSC or above	20	0	10
Total	100	100	100

d) Family size of households

The family size of the households in the project area was carefully investigated considering its importance on improving the livelihoods of the project farmers. The family size of the interviewed households was collected from both Chhukha and Samtse sites and observed that the average family members per household are comparatively higher among the respondents of Chhukha site than the Samtse site (Table

3.29). As reported by the farmers, the average family size of Chhukha site is found 5.2 members/family against 4.8 members/family in Samtse site. Across locations, the family size is found as 5.0 members/family which is found higher with the national average household size 4.6/family[2]. Averaged across locations, within the family the male members are 2.7 against 2.3 female members/family. In Chhukha the male members/family is 3.4 against 1.8 female members while in Samtse the male members are 2.0 against 2.8 female members per family.

Table 3.29: Family size of the sample households in Bhutan sites

Family size by sex	Location/Site (number)		
	Chhukha	Samtse	All
Male	3.4	2.0	2.7
Female	1.8	2.8	2.3
Total	5.2	4.8	5.0

e) Distribution of households by family size

As observed from the interview, the average family size in the project sites of Bhutan was found comparatively larger. The numbers of members per family mostly ranged from 4 to 7 persons per family in Chhukha site and 4 to 5 in Samtse site. It has been observed that averaged across locations, maximum i.e. 50% farm families have 5 members/persons per family, 30% have 4 persons per family, 10% have 6 persons/family and 10% with even found 7 persons per family. By segregating locations, it has been observed that 20% respondent families in Chhukha site have their family size 6 members/family while another 20% reported 7 person per family and 40% respondents reported their family size as 4 members per family. On the other hand in Samtse site 80% respondents reported their family size is 5 members per family and only 30 reported 4 members per family and none reported larger family than 5 members. Details are shown in the following table 3.30.

Table 3.30: Distribution of respondents by family size

Family size (#)	Location/Site (%)		
	Chhukha	Samtse	Mean
4	40	20	30
5	20	80	50
6	20	0	10
7	20	0	10
Total	100	100	100

f) Size of landholdings of project farmers

The following Table 3.31 showed the size of landholdings (considering lands under current cultivation) per family in the SDF supported livelihood enhancement project area by locations and gender. Across locations the average size of landholdings of project farmers is found 281.50 decimal per family without

[2] Nationally, the average household size in Bhutan is 4**.6 person per household**. It is calculated by dividing the household population by total households. Ref: https://www.google.com/search?client=firefox-b-d&q=Family+size+in+Bhutan+

considering gender segregation. On the other hand, the size of average landholdings per family of non-project farm farmers is found 233.30 decimal, which is 7% higher than the project farmers. Regardless of locations the size of landholdings in female led households of project farmers (184.10 decimal) is 19% less than the male led households (253.0 decimal). In case of non-project farmers, female households have 17% less land size (215.00 decimal) than female ones (251.50 decimal). Considering project farmers, the land size per households in Chuukha site is 23% less than the Samtse site; while the land size of non-project farmers in Chuukha is 87% less than the Samtse site. It indicated that the non-beneficiary farmers are comparatively richer (possetion of cultivable land under the family is considered as the key indicator for family income for rural folk) than the project farmers.

Table 3.31: Size of land holdings of project and non-project households in Bhutan sites

Location/site	Project household (decimal)			Non-project household (decimal)		
	Male	Female	Mean	Male	Female	Mean
Chhukha	300.0	91.5	195.8	195.0	130.0	162.5
Samtse	206.0	276.7	241.3	308.0	300.0	304.0
Mean	253.0	184.1	218.5	251.5	215.0	233.3

g) Distribution of households by landholdings

The distribution of project and non-project farmers was made against their size of landholdings and shown in the following table 3.32. For convenience of interpretation of results, the land size of farmers are grouped into the category of less than <200 decimal/family, 200 – 300, 300 – 400, and 400 – 500 decimal holdings/family to show the distribution of the sampled households. It has been observed that in Chuukha site 40% farm households of project farmers were fall under the category of less than 200 decimal land holdings per family, 40% under 200-300 decimal and 20% in 300-400 decimal per family, but none of the farmers found under 400-500 decimal land holdings/family. In Samtse site, 20% respondent households of project farmers fall under <200 decimal land holdings category, 40% under 200-300 decimal range, and 60% under more than 400-500 decimal land size/family category but none of the farmers found under 300-400 landholding/family category. In non-project farmers, 20% farm households of Chhukha site fall under the category of <200 decimal land holdings, 40% under 200-300 decimal and 40% under 300-400 decimal land holdings/family. In Samtse site 60% farm households of non-project farmers fall under the category of 300-400 land holdings/family category, and 40% under 400-500 decimal/family category. The data indicated that regardless of project sites maximum households (50%) owned 300-400 decimal cultivated land per family.

Table 3.32: Distribution of households by their size of landholdings

Size of land holdings (decimal)	Project household			Non-Project household		
	Site/Location (%)		Mean	Site/Location (%)		Mean
	Chhukha	Samtse		Chhukha	Samtse	
<200	40	0	20	20	0	10
200-300	40	40	40	40	0	20
300-400	20	0	10	40	60	50
400-500	0	60	30	0	40	20
Total	100	100	100	100	100	100

h) Annual family income of project farmers

The endline impact study attempted to identify the changes in family income of project and non-project farmers of both Chhukha and Samtse sites by generating data through recall methods against before and after project situation. To make it more convenient, the data collection methods against family income was split into two main sources like i) crop enterprises that included project interventional crops (ginger and moringa) and other presently growing crops like cereals, fruits, oilseeds, pulses etc. and ii) non-crop enterprises that included livestock, fisheries, service/daily wage, small businesses and others. The following Table 3.32 summarized the family income of households from crop and non-crop enterprises and compared them under before and after project situation.

As reported by the respondents, irrespective of the project sites, the annual family income of project farmers ranged from Btn 154050 to 297400 with a mean of Btn 225725/annum under before project situation against Btn 195200 to Btn 356000 with a mean of Btn 275600/annum after project situation. The data presented in the Table 3.32 revealed that in Chhukha the income of project farmers from non-crop enterprises was 79% higher than the crop enterprises under before project condition while it is found 74% higher under after project situation. In Samtse site the consequence the income of project farmers from non-crop enterprises was 60% higher than the crop enterprises under before project situation and 53% higher under after project circumstances. Averaged by locations and sources of income the family income of project farmers was found 18% lower than the family income of non-project farmers. Details are shown in the table 3.33.

Table 3.33: Annual family income of project farmer in Bhutan

Location/site	Before project (Btn)*			After project (Btn)*		
	Crop enterprise	Non-crop enterprise	Total	Crop enterprise	Non-crop enterprise	Total
Chhukha	51400	246000	297400	72000	284000	356000
Samtse	44050	110000	154050	62200	133000	195200
Mean	47725	178000	225725	67100	208500	275600

Btn = Bhutanese currency. *1 USD = Btn 84.47

i) Changes in family income of project farmers

The Table below 3.34 analyzed the changes occurred in family income of project farmers after implementing the SDF supported livelihood enhancement project by comparing their present/current incomes with the previous/earlier incomes (before starting the project). Irrespective of location/sites, the income of the project farmers has invariably been increased by 18%-41%. The income has mostly increased by crop enterprise (41%) than non-crop enterprises (18%). Considering the locations, the increase of income from crop enterprises (40%) superseded the increase of income from non-crop enterprises (15%) in Chhukha site. In case of Samtse site, the income-increase from crop enterprises (41%) also exceeded the income increase from non-crop enterprises (21%). It is noted that this income increase

does not necessarily mean due to only SDF project activities, other unseen development factors like technology diffusion due to intervention of other agricultural projects in the locality, the time gap of 03 years etc. might also be contributed to the enhancement of family income expressed by the farmers.

Table 3.34: Change in family income of project beneficiary under crop and non-crop enterprises

Location/site	Crop enterprise (Btn)*			Non-crop enterprise (Btn)*		
	Before	After	Change %	Before	After	Change %
Chhukha	51400	72000	40	246000	284000	15
Samtse	44050	62200	41	110000	133000	21
Mean	47725	67100	41	178000	208500	18

*1 USD = Btn 84.47

j) Annual family income of non-project farmers

The endline survey of the SDF livelihood enhancement project also investigated the family income of non-project farmers by comparing their present and previous (before project start) incomes. The family income of non-project farmers ranged from Btn 72000 to Btn 205000 with a mean of Btn 138500/annum under before project situation against Btn 85000 to 239000 with a mean of Btn 162000/annum under after project situation. The total annual family income of project farmers either before or after project situation was comparatively higher than the non-project farmers. The annual income of project farmers was 54% and 35% higher than non-project farmers under before and after project situation respectively. For non-project farmers, the income from crop enterprise was 26% higher than the non-crop enterprise without considering the project sites of Chhukha and Samtse. In case of non-project farmers, the annual family income was found higher with households of Chhukha site than the households of Samtse site. Details are shown in Table 3.35.

Table 3.35: Annual family income of non-project farmer in Bhutan

Location/site	Before project (Btn)*			After project (Btn)*		
	Crop enterprise	Non-crop enterprise	Total	Crop enterprise	Non-crop enterprise	Total
Chhukha	107500	97500	205000	131500	107500	239000
Samtse	49000	23000	72000	58000	27000	85000
Mean	78250	60250	138500	94750	67250	162000

Btn = Bhutanese currency. *1 USD = Btn 84.47

k) Changes in family income of non-project farmers

The following Table 3.36 enumerated the changes in family income of non-project farmers by crop and non-crop enterprises due to SDF supported project activities. Averaged across locations, changes in annual income of the farm families observed lower in non-crop enterprises (14%) than the crop enterprises (20%). In Chhukha site the changes in family income of non-project farmers was lower under non-crop enterprises (10%) than the crop enterprises (22%). On the other hand in Samtse site the changes

in family income of non-project farmers was lower in non-crop enterprises (17%) than the crop enterprises (18%).

Table 3.36: Change in family income of non-project beneficiary under crop and non-crop enterprises

Location/site	Crop enterprise (Btn)*			Non-crop enterprise (Btn)*		
	Before	After	Change %	Before	After	Change %
Chhukha	107500	131500	22	97500	107500	10
Samtse	49000	58000	18	23000	27000	17
Mean	78250	94750	20	60250	67250	14

*1 USD = Btn 84.47

l) Comparison of change in family income of project and non-project beneficiary

The changes in annual family income of project and non-project farmers at before and after project situation is compared in the following Table 3.37. The study/survey measured the enhancement of family income of project farmers due to project activities by subtracting the percentage of increased achieved by the non-project farmers within the same period of time (i.e. before and after project implementation). As identified the changes of family income of project farmers considering before and after project circumstances attained 20% in Chhukha site against 27% in Samtse with mean of 22% irrespective of locations. While the changes of family income of non-project farmers considering before and after project conditions accomplished as 17 in Chhukha site, 18% in Samtse site with mean of 17% irrespective of locations. The analysis of data indicated that the changes in income of project farmers during the project period is 3% less than the non-project farmers in Chhukha site, 9% higher in Samtse site and the across the sites the change was only 5%. Actually the changes in family income between project and non-project farmers are found relevant with 9% positive changes in Samtse, and 3% in Chhukha site, possibly found because the processing centers established by the SDF project for value addition of crop products are yet to be operated in full swings. In almost all sites the operation of processing centers passed only one cropping season or two, so enhancement of income of project farmers do not have enough time to reflect it. May be with time and by continuation of the operation of processing centers with value addition and proper marketing linkage, the income of project farmers will supersede the income of non-project farmers soon.

Table 3.37: Change in family income of project and non-project beneficiary

Location/site	Annual income of beneficiary (Btn)*						% Change of project over non-project farmers
	Project		Non-project		Change (%)		
	Before	after	Before	after	Project	Non-project	
Chhukha	297400	356000	162500	241000	20	17	3
Samtse	154050	195200	72000	85000	27	18	9
Mean	225725	275600	117250	163000	22	17	5

Btn = Bhutanese currency. *1 USD = Btn 84.47

3.3.2.1 Establishment and Operation of Processing Centers

The SDF project assisted to establish three processing centers in Bhutan, one at Chukha and other two at Samtse. The processing center at Chukha is dealing/working on the radish production and value addition of radish only while the other two sites at Samtse are producing value added products of moringa (moringa tea) and ginger (pickle). The current progress of the processing center dealing radish products is discussed in the following section.

Figure 8: Processing center at Bhutan

a) Skill development of farmers

The SDF supported livelihood enhancement project funded for skill development training for the targeted farmers on different production enterprises in value addition and improved marketing systems of their crop products. During the project period 64 participants attended the training programs on various subjects organized by the SDF project officials in Bhutan. Out of the total 64 participants, 63 (98%) were female and 01 (2%) male. The duration of the training courses organized in different times of different years ranged from 03 – 10 days. Among the training courses organized, the duration of the training course on `bakery products' was 10 days while the duration of other courses like i) `Value addition and post-harvest processing' was 5 days and ii) Preparation noodles, pickles, moringa products, and cassava flour iii) Book keeping and agri-business management iv) Group formation and baseline survey each were 3 days. It has been observed that one training course was organized in Jan 2020, one in Sep 2021, two in 2023 and two in 2024. Details are shown in the Table 3.38.

Table 3.38: Capacity building of farmers

Training subject	Number of participant			Duration of training (day)	Time organized
	Male	Female	Total		
Group formation and baseline survey	0	14	14	3	Jan-20
Value addition and post-harvest processing	0	12	12	5	Sep-21
Preparation noodles, pickles, moringa products, and cassava flour	0	10	10	3	Oct-23
Exposure visit	1	11	12	2	Oct-23
Bakery products	0	6	6	10	Jan-Feb 24
Book keeping and agri-business management	0	10	10	3	Feb-24
Total	1	63	64	26	

b) Production of Value added Products

The processing center was established in 2022. The following Table 3.39 exposed that in 1st year maximum radish crop (350 kg) and finished products i.e. fresh radish roots was assembled in the processing center. Consequently the processing center delivered highest marketable products (radish pickle) in the local markets during the 1st year of its establishment. In the following year (2023), the operation of the processing center in respect of production and marketing of radish pickles was reduced to almost 50% when it produced only 150 Kg pickle for marketing. However, in the current year (2024) the processing center has found regained the activities and the production of finished products (radish pickle preparation) increased to 200 Kg from 150 Kg in last year. The reduction in production of value added products (radish pickle) in the center in 2023 could be related with the engagement of manpower, because in the 1st year the center used 14 workers while in 2nd year it used only 10 workers. Production of value added products (radish pickle) might be reduced due to poor supply of radish, which could be happened by low production or due to communication gap between staff of processing center and radish growers.

Figure 9: FGD session at Bhutan

Table 3.39: Establishment and operation of processing center

Establishment year and start of operation	Assembled of radish in the center (kg/year)	Radish pickles marketed (kg/year)
Establishment in 2022		
Year 1: 2022	350	300
Rear 2: 2023	200	150
Year 3: 2024	250	200
Total	800	650

c) Financial transection of the center

The amount of financial transection made in the processing center followed the trends of value addition of radish accomplished during the concerned years (duration) in the center. In 2022 the amount of financial transaction was highest (INR 40000) as of highest production of radish pickle during the year 2022. The financial transection reduced in 2nd year of operation and again increased in the current year 2024. Details are showed in the Table 3.40.

Table 3.40: Financial transection of processing center

Operational year	Radish pickle production (INR/year)	Radish pickle marketing (INR/year)*	Total financial transection (INR/year)*
Year 1: 2022	35000	5000	40000
Year 2: 2023	20000	2000	22000
Year 3: 2024	25000	2500	27500
Total	80000	9500	89500

*1 USD = Btn 84.47

d) Employment generation in processing center

In 1st year of establishment, the processing center employed 15 person of which one was male and the rest 14 female workers. In 2nd year (2023) the center recruited or continued 10 workers out 15 employed in the 1st year and all were female, no male worker engaged. In 3rd year (2024) 10 female workers are being continued for operation/production of the value added products from radish. The production of radish pickle in processing center per worker per year was 261 Kg and the financial output per worker per year was INR 2539/-. Details are shown in the Table 3.41.

Table 3.41: Number of people employed in the processing center

Operational year	Number of person engaged in operation of processing center			Production of radish pickle/ worker/year (Kg)	Financial output through radish pickle/worker/year (INR)
	Radish pickle		Total		
	Male	Female			
Year 1: 2022	1	14	15	333	2667
Year 2: 2023	0	10	10	200	2200
Year 3: 2024	0	10	10	250	2750
All	1	10	10	261	2539

e) Employment generation by farmers

The technical team assessed the numbers of workers engaged for radish production and processing by the farmers during the project period and earlier. The data plotted in the following table observed that the project farmers used more numbers of laborers during the project period after having skilled training than the earlier years. More male workers were used in radish production during project period. The male laborer engagement in farming of the project farmers increased by 33% against 22% increase in female workers for farming. Details are shown in Table 3.42.

Table 3.42: Comparison of labor engagement by farmers in before and after project situation

Sources of employment	Number of person engaged in farming per crop per household							
	Before project		After project		Difference		% Change	
	Male	Female	Male	Female	Male	Female	Male	Female
Radish	6	9	80	11	2	2	33	22
Others	0	0	0	0	0	0	0	0
Total	6	9	8	11	2	2	33	22

f) Marketing of products by farmers

An investigation was attempted to assess the marketing of the crop products by the individual farmers to different levels/segments of product marketing. It has been observed that after the SDF project activities the farmers started to sell their majority products (50%) to the local traders instead of whole seller (40%) under before project situation. No change is observed in selling products from farm gate (10%) and

retailers (20%) by the project activities. In indicates that the processing center facilitated local marketing by collecting the products directly from the farmers that enhanced marketing through local traders possibly with good prices. Details are shown in Table 3.43.

Table 3.43: Marketing of products by farmers

SDF supported crops	Percent crop product sold by market outlets							
	Before project				After project			
	Farm gate	Retailer	Wholesaler	Local market	Farm gate	Retailer	Wholesaler	Local market
Ginger pickle	0	0	0	0	0	0	0	0
Radish	20	10	40	30	20	10	20	50
All	20	10	40	30	20	10	20	50

g) Product marketing by processing center

The study quarried on how do the processing center marketed the finished products (radish pickle) to the market operators. Marketing of processed products started only after establishment of the processing center by the SDF supported livelihood enhancement project under after project situation. It has been observed that the processing center also marketed their majority finished products (50%) to the local traders. Only 10% of the products marketed directly from the center, 20% to the retailers and 20% to the whole sellers. Details are shown in Table 3.44.

Table 3.44: Marketing of products by processing center

SDF supported crops	Percent crop product sold by market outlets			
	Farm gate	Retailer	wholesaler	Local market
Moringa tea	10	20	20	50
Ginger pickle	0	0	0	0
All	10	20	20	50

h) New business model adopted

The impact survey of the livelihood enhancement project investigated and identified the adoption levels of different new business models promoted by the SDF assisted project into the project farmers. As observed during the field visit and data collection, the project farmers of Chhukha site adopted certain business models for marketing of value added products of radish, while the farmers at Samtse site adopted certain business models moringa value added products like dried leaves of moringa and moringa tea. They have adopted some marketing models of value added products of radish and moringa like sorting/grading/drying, packaging and group marketing. In both the project sites the farmers adopted to prepare value added products from the fresh harvested crops especially they learnt and practicing the marketing of radish paste and pickles in Chhukha site and moringa dried leaves and moring tea in Samtse

site. The major technology packages adopted are: new high yielding variety, planting geometry to maintain desired plant population, staggered planting and harvesting of crops, production and marketing of pickles from radish. The following table enlisted the business models and production practices being adopted by the farmers under the targeted value chain in both of the project sites. The adopted business models are enlisted in the Table below 3.45.

Table 3.45: New business model adopted by the project farmers

Radish pickle value chain	Moringa tea value chain
Collection, sorting, washing, grading and drying of primary products	Sorting, grading and washing of moringa leaves after harvest
Packaging and marketing of processed (value added) products	Drying of moringa leaves
Group marketing to harvest higher price	Moringa powder processing
Quality pickle production from fresh radish	Moringa tea bag processing
Quality production of radish paste for sale	Use of good quality packaging for value addition of products

i) Post-Harvest Loss Management

The post-harvest loss reduction of interventional crops in was set as one of the important objective of the livelihood enhancement project, and considering the fact the impact study assessed the changes of post-harvest losses of radish and moringa crops in both of the project sites of Bhutan. As reported by the project farmers the post-harvest loss of moringa leaves was higher than radish under both before and after project intervention. Considering before and after project environment, the post-harvest loss of radish as reported by the farmers is reduced from 22.4% to 9.8% (by 12.6%) due to project activities (training and value addition practices), while in moringa it reduced from 80% to 24% (by 56%) after project intervention. Irrespective of interventional crops the post-harvest loss reduced by 34.3% due to project intervention. The post-harvest loss reduction was found very high in moringa as the leaves of moringa had no use earlier except very little amount as fodder and the project introduced the use of leaves as dried powder or as tea as part of human food. The edible parts are matured fruits and tubers/roots for the crops under consideration, so the improved intercultural management introduced by the project possibly played an important role in reducing the damage of marketable products at or after harvest. Details are shown in Table 3.46.

Table 3.46: Post-harvest loss reduction occurred due to SDF project activity

Name of crop	Before project	After project	Difference (% Reduction)
	Post-harvest loss (%)	Post-harvest loss (%)	
Radish	22.4	9.8	12.6
Moringa	80.0	24.0	56.0
All	51.2	16.9	34.3

j) Employment enhancement

The following table presented the data on monthly engagement of laborers in the interventional crops (radish and moringa) by the producer group members under before and after project situation. After project intervention, the labor use per household in their crop production and value addition purposes

increased by 100% for radish value chain and 51% for moringa value chain. Considering before and after project intervention, moringa value chain consumed more laborers (11.4 and 17.2 laborers/month/family during before and after project implementation) than radish value chain (3.4 and 11.6 laborers/month/family during before and after project implementation). The farmers/producers encouraged to use higher numbers of laborers in their crop production, possibly due to adopting new technologies promoted by the projects like sorting/grading, radish paste & pickle, moringa leaf power & moringa tea, leveling/packaging, group marketing etc. Attending at agro-business training in the processing plant and exposure visit of households-heads to processing units also played vital role in employing higher numbers of laborers in their adopted value chain. Details are shown in the Table 3.47.

Table 3.47: Employment enhancement (#) by farmers/producers due to SDF project activity

Name of enterprise	Before project	After project	% Increase (after project)
	# Labor engaged/month/hh	# Labor engaged/month/hh	
Radish value chain	3.4	11.6	100
Moringa value chain	11.4	17.2	51
All	7.4	14.4	67

hh = Household

k) Business turnover by interventional crops

The project activities like exposure visits, training on agro-businesses, use of sorting/grading of edible parts and practicing group marketing of crop products to get higher market prices might have been assisted the members of the producer group to have higher business turnover from their marketable crops and value added products. The business turnover incurred by the members of the producers group after project interventions is shown in the following Table 3.48. After project intervention, the farmers received higher business turnover by amount of products and cash benefits from radish and moringa value chain. Regardless of variation between crops, the changes in prices of marketable products due to project intervention and time factor ranged from 71% considering amount of value added products and 76% by considering cash benefit. Details are shown in the following Table 3.48.

Table 3.48: Change in business turnover of the project farmers

Value chain (Location/site)	Business turnover/household/year					
	Product (Kg)		% Change	Earnings (Btn)		% Change
	Before	After		Before	After	
Radish value chain (Samtse)	35.4	60.2	41	11328	24080	53
Moringa value chain (Chhukha)	0	20.2	100	0	21890	100
Mean	35.4	40.2	70.6	11328	22985	76

l) Accessibility to value added technology

The execution of SDF assisted livelihood enhancement project opened wider accessibility of the producer group members to different new value added products/technologies, modified systems of crop production and marketing for ensuring higher income. Out of many value added products and technologies mentioned by the project staff and farmers, some of them are enlisted in the following Table 3.48. The table also compared the existing technologies available to the farmers during before starting

the project with the accessibility/availability of technologies/products to the farmers after project intervention. As reported, the farmers were happy to know the diversified use of fresh radish and moringa especially producing of radish paste & pickle at the Chhukha site and moring leaf powder and moringa tea at the Samtse site. Another interesting issue for the farmers was sorting/grading and packaging of marketable value added products. They also mentioned about use of group marketing for selling the products of radish and moringa to capture higher market price. Details of the technologies/products the farmers learned after engaging with the project activities are listed in the following Table 3.49.

Table 3.49: Accessibility of SDF supported farmers to technology (post-harvest handling and value addition)

Name of product	Before project	After project
	Name of post-harvest handling techniques	Name of value addition techniques
Radish paste	i Harvesting and marketing of radish	i Collection, sorting, washing, grading and drying of primary products ii Group marketing to harvest higher price of the products iii Quality packaging radish paste to establish their own branding
Radish pickle	ii Harvesting, drying and marketing	iv Making quality radish pickle from fresh radish v Packaging and leveling of radish pickle for marketing
Dried moringa leaves (powder)	iii Harvesting of fresh fruits of moringa and sale to the local markets	vi Collection, sorting, washing, grading and drying of moringa leaves vii Group marketing to harvest higher price of the dried leaf powder
Moringa tea	iv Harvesting and sale to the local markets	viii Sorting and washing of leaves of moringa ix Proper drying of moring leaves x Moringa powder production xi Moringa tea bag production

m) Awareness development to the producers

To build up awareness among the producer groups towards interventional crops through skill development training and exposure visits was set as an important objective of the SDF supported livelihood enhancement project. Awareness were developed to the production and value addition technologies especially to the post-harvest handling and marketing of the value added products of interventional crops to ensure higher market prices. After project interventions, the producers of radish and moringa in both the project sites (Samtse and Chhukha) have been accomplished their awareness to the following production and business issues:

i. The project activities assisted to achieve awareness among the farmers towards increased shelf lives of the value added products of radish (paste and pickle) and moringa (dried powdery leaves and moringa tea) due to their post-harvest processing
ii. The farmers improved their capacity to prepare value added products from the fresh crop-harvest in higher end of the value chain
iii. Awareness was developed to have access to services of the line departments and other entitlements (extension, research, development schemes)

iv. Farmers developed awareness to the accessibility of credit from available financial institutions and on market facilities of their value added products
v. To practice cleaning, sorting, washing, drying and grading of marketable products of fresh radish and moringa crops to ensure higher market price and income
vi. Production of value added products like paste and pickle from fresh radish; dried leaves of moringa and moringa tea and marketing to the super markets using contractual vendors
vii. Awareness was developed to the farmers regarding packaging and wrapping of marketable value added products to enhance market demand and ensure higher price.
viii. Practicing integrated pest management (IPM) techniques to manage insect/pest damage instead of using traditional inorganic chemical to the fresh fruit (ready to eat) products like banana and tomato
ix. Production and sale dried powdery leaves of moringa to have higher price and income of the family
x. The project arranged exposure visits for the producer group members to different Government and non-Government agencies and business firms that assist to enhanced their interest (awareness) to the diversified agricultural production and businesses

n) Opportunity

In Bhutan, the processing centers are established one at Chukha and two at Samtse. The Chukha processing center dealt with radish value chain and the Samtse processing centers worked with the value added products of moringa (drum stick) especially promoted moringa tea and ginger pickle. The centers have ample opportunities for producing bulk quantities of value added products from fruits and spices that would ultimately enhance employment and improve livelihoods of the local people. Among others some of the major opportunities of the SDF supported processing centers are stated in the following section.

i. The locations of both the centers at Chukha for improving moringa value chain and at Samtse for promoting value added products of radish and ginger are unique for getting raw material and supply of finished products to the townships
ii. Intensity of farm families in the locations are found enough to supply the raw crop products for further value addition and marketing
iii. The centers are found well equipped with necessary machineries to produce bulk quantity of targeted value added products of the interventional crops
iv. The project farmers have developed enough capacity in pickle processing
v. The centers are being operated with close collaboration with the Government agricultural extension agencies that made extra opportunities in developing good marketing linkage with super shops and local markets

o) Limitation

The endline impact study identifies some of the weaknesses of the processing centers during field visit and interaction with the producer group members and staff of the centers. The limitations of the center as observed during primary data collection are:

i. Moringa cultivation in the project site of Samtse is yet to be expanded to have a commercial crop.
ii. Shortage of farm laborers for staggered harvesting of moringa (drum stick) at tender stage to capture higher market price
iii. Unusual rainfall during the flowering stage of moringa causes reduction of yield even after good cultural management
iv. Shortage of seeds/seedlings of good (HYV) variety of moringa at farm level
v. The drum stick growing farmers facing difficulty due to shortage of skilled laborers for harvesting of green/mature drum stick traditional large plants
vi. Shortage of seeds/seedlings of good (HYV) variety of ginger at farm level
vii. Infestation of insect pest in moringa reducing the yield of fuits/unit area

p) Major challenges for production and post-harvest processing of interventional crops

The endline survey emphasized on identifying some of the challenges faced by the producer groups of interventional crops. During physical interview the project farmers mentioned the troubles they have been faced during crop production and post-harvest handling. Some problems are natural and some are the technical hitches of development projects and human activities. The identified challenges mentioned by the respondent farmers are summarized below:

i. The higher production of radish is weather dependent, so the volume of quality fresh radish production in a particular season is out of control of producers, the supply is not steady in the market that causes/invite price fluctuation
ii. Insect damage in radish is very common, which increases not only production costs but also increases the risks of human health hazards
iii. The producer groups faced difficulty to harvest good/higher market prices of their value added products due to high competition with other branded companies of the country
iv. Fund shortage is very common challenge for women producers for increases their business
v. Population of moringa trees with good variety (having year round production potentiality) is yet to be increased in the project site (Chhukha) of Bhutan to ensure ample supply of moringa leaves for value addition purposes
vi. Climbing trees and harvesting the fruits and leaves is somewhat difficult and laborers demands high cost for harvesting the crop products
vii. Processing (sorting, washing, drying etc.) and making powder of moringa leaves for producing good quality tea is highly laborious
viii. Market size of moringa tea in the project site (Chhukha) of Bhutan is still limited; packaging materials for moringa tea is expensive
ix. The branding of moringa tea as organic tea is yet to be developed in the country so, the producer groups are facing strong competition from other reputed tea brand of the country
xi. Marketing of value added products like radish paste & pickles and moringa leaf powder and moringa tea as well are the major problems/challenges mentioned by the members of the producer groups. The continuation of production of value added products of the interventional crops by the members of the producer group would largely be depended upon developing the market linkage to the large national companies. A system is to be designed and developed, so that these established processing centers with its producer groups would act as a production hubs, where representatives of large companies will place their production order and collect the finished products as per weekly schedule.

Only then the project interventions regarding value addition of agricultural products would have positive chances to success otherwise it will be under dark like other development projects

q) Recommendation

i. Development of high yielding variety radish, multiplication of seedlings and proper extension at the field level is to be promoted with utmost efforts
ii. Good/high yielding variety of moringa with year round production capacity is to be developed, multiplied and to be distributed to the farm level
iii. Improved production systems of moringa by introducing intercropping with high value crops (vegetable, spices oilseeds etc.) is to be developed, so that moringa cultivation can be commercially viable against cultivation of other seasonal field crops
iv. Proper control measures of insect pests are to be developed and adopted by the producers for the interventional crops to have higher financial margin from farming business
v. To assist producer group, the key staff of the processing centers is to be taken lead role in developing business linkage with the large food and beverage companies to upgrade the centers as rural business hub
vi. The linkage system is to be developed in such a way that the women member can produce the value added products in the center for some of the large food/beverage companies, from where the company representatives will collect it in regular weekly basis
vii. The project staff at the center will provide necessary role so that the producer group members can get credit from the local NGO or banking systems to enhance their production of crops under consideration
viii. Linkage between producer groups with extension agencies to be made stronger through motivation and by arranging exchange visit

3.3.3 India

In India, the livelihood enhancement project sites were operated in two distinct environmental regions, one in Madhurai (Tamil Nadu) dealt with the value addition products of moringa (dram stick) and another site was in Kochin (Kerala) dealt with value addition products of coconut. The endline survey was commissioned in both of the sites to identify the changes made in the livelihoods of the targeted farmers after implementing livelihood enhancement project.

Figure 10: Moringa fields at Madhurai,

Demography of the respondent household

The demography/population dynamics of sampled households that mainly included gender, age, education, family size, family income and size of their landholdings. The impact survey studied the demographic characteristics of the project and non-project households and discussed in the following section.

a) Distribution of households by sex

Following the indication in ToR the study collected the information from both male and female farmers and their sample distribution is showed by operational sites in the following Table 3.50. Out of the total respondents, averaged across sites 18.3% were female and the rest 81.7% male. Considering distribution of male and female respondents, 20% was female households in Madhurai against 16.7% female households in Kochin sites. During data collection from both project and non-project farmers the study put due importance to the female farm families too.

Table 3.50: Distribution of sample Households by sex

Respondent	Location/Site (%)		All
	Madhurai	Kochin	
Male	80.0	83.3	81.7
Female	20.0	16.7	18.3
Total	100.0	100.0	100.0

b) Distribution of households by age

The following Table 3.51 showed the distribution respondent households in the survey by their age group. The respondents were grouped as 30-40 years of age, 40-50 years, 50-60 years and above 60 years. It has been observed that irrespective of study sites maximum numbers of participants (45%) in the study are comparatively aged people from 50-60 years of age group. Only 20% respondents belongs to 30-40 years of age group, 35% from 40-50 years of age. Considering the distribution of respondents by sites, in Madhurai 40% respondents belongs to 30-40 years, 20% from 40-50 years 40% from 50-60 years and none from above 60 years. In Kochin site 50% of the respondents were under the age group of 40-50 years and another 50% from 50-60 years, none from 30-40 years or above 60 years of age.

Table 3.51: Distribution of households by age

Age (year)	Location/Site (%)		
	Madhurai	Kochin	All
30 to 40	40	0	20
40 to 50	20	50	35
50 to 60	40	50	45
Above 60	0	0	0
Total	100	100	100

c) Distribution of households by their education level

The study examined the respondents by their education status, it has been observed that averaged across sites, maximum participants had good education levels, 54.5% passed higher secondary level i.e. 12 years of schooling. More than 27% respondents had their education level from school year vi to x and only 18% completed primary (up to 5 years of schooling) level education. Interestingly none of the respondent found as without schooling. Details of the information are showed in the Table 3.52.

Figure 11: Data collection session at Kochin, India

Table 3.52: Distribution of respondents by education

Education level	Location/Site (%)		
	Madhurai	Kochin	Total
No literacy	0.0	0.0	0.0
Up to Class V	20.0	16.7	18.2
Class VI to X	40.0	16.7	27.3
SSC pass	0.0	0.0	0.0
HSC or above	40.0	66.7	54.5
Total	100.0	100.0	100.0

d) Family size of the households

The average family size of the respondents participated in the survey was 4.2 persons per family, which is below the average national family size of India i.e. 4.4 person per household[3]. Considering the study sites the average family size was found higher in Kochin (4.8 person per household) than the Madhurai site (3.6 person per household). As observed the number of female member per household (1.6) is found less than the male members per household (2.0) in Madhurai. On the other hand in Kochin, the number of female member per household (2.5) is found higher than the male member per household (2.3). The data revealed that the information provided by the participants of survey is mostly alike to the national figure regarding their family size. Details are shown in Table 3.53.

Table 3.53: Family size of the respondent households

Family size by sex	Location/Site (number)		
	Madhurai	Kochin	All
Male	2.0	2.3	2.15
Female	1.6	2.5	2.05
Total	3.6	4.8	4.2

e) Distribution of households by family size

[3] https://www.google.com/search?client=firefox-b-d&q=average+family+size+india+2022

The following Table 3.54 showed the distribution of respondents by their family size and it has been observed that out of total participants in the survey 45.5% households informed their family size as 5 while 9% respondents said their family size is larger than 5 members. Average by locations 27.3% have their family size ranged from 1-3 persons per family. And only 18.2 said their family members are 4. Considering sites/locations, in Madhurai 60% respondents informed their family size as 1-3 and 20% said 4 member per family and another 20% have their family size as 5 persons/household. In contrary to Madhurai site the family size in Kochin found much larger where 67% respondents informed their family size as 5 and 17% have their family size more than 5 members per household.

Table 3.54: Distribution of respondents by family size

Family size (#)	Location/Site (%)		
	Madhurai	Kochin	Total
1 to 3	60.0	0.0	27.3
4	20.0	16.7	18.2
5	20.0	66.7	45.5
>5	0.0	16.7	9.1
Total	100.0	100.0	100.0

f) Size of land holdings of farmers

The size of cultivated land per family in Madhurai and Kochin sites for project and non-project households are shown in the following Table 3.55. It has been observed that irrespective of site and gender, the average land size of project farmers is 356 decimal per family against 373 decimal per family in non-project farmers. In general, the land ownership per family in the sites is found more than 3 acres. It indicated that the project personnel selected comparatively small farmers under the project. Considering the sites, the land size of project farmers in Kochin is found larger than the Madhurai site, while for non-project farmers the land size is found larger in Madhurai site than the Kochin site (Table 3.55). The size of land holdings for women farmer is found comparatively smaller than the male farmers in both the sites, though the difference between land holdings of male and female farmers in non-project group is not very wider (Table 3.55).

Table 3.55: Size of Land holdings of respondent households

Location/site	Project household (decimal)			Non-project household (decimal)		
	Male	Female	All	Male	Female	All
Madhurai	262.5	200.0	231.3	400.0	400.0	400.0
Kochin	812.0	150.0	481.0	441.7	250.0	345.8
All	537.3	175.0	356.1	420.8	325.0	372.9

g) Distribution of farmers by land holding

The following Table 3.56 showed the land ownership of respondent farmers by percentage. For convenience of discussion, the land size of the farmers are grouped into up to 150 decimal/family category, 151 – 250 decimal/family, 251 – 350 decimal per family, 351 – 450 decimal per family and more than 450 decimal holdings/family category to facilitate interpretation of the distribution of household by their households. Among project farmers, 27% households are marginal farmers against only 8% in non-project households. Considering the sites in general the people from Kochin have larger land size than the Madhurai site. It has been observed that in Madhurai 20% farm households of project farmers fall under the category of up to 150 decimal land holdings per family, 40% under 251-350 decimal/family and 20% under 351-400 decimal land holdings/family. In Kochin, 33% respondent households of project farmers fall under up to 150 decimal land holdings category, and 67% under more than 450 decimal land size/family category. In non-project farmers of Madhurai site, 20% farm households each fall under 151 – 250 decimal/family and 251 – 350 decimal/family category. In Kochin 14% households of non-project site fall under up to 150 decimal/family category, 29% households fall under 151 – 250 decimal/family category, 14% households under 251 – 350 decimal/family category and 43% households fall under more than 450 decimal landholdings per family category. None of the households in Kochin fall under the land category of 351 – 450 decimal/family category. The data indicated that regardless of research sites maximum households owned more than 450 decimal lands/family followed by 151 – 150 decimal/family category. Details are shown in Table 3.56.

Table 3.56: Distribution of households by their size of landholdings

Size of land holdings (decimal)	Project household (%)			Non-Project household (%)		
	Site/Location		Mean	Site/Location		Mean
	Madhurai	Kochin		Madhurai	Kochin	
Up to 150	20	33	27	0	14	8
151 to 250	20	0	10	20	29	25
251 to 350	40	0	20	20	14	17
351 to 450	20	0	10	40	0	17
>450	0	67	33	20	43	33
Total	100	100	100	100	100	100

h) Annual family income of project farmers

The table below enumerated the annual family income of project farmers by operating sites under before and after project scenario. To facilitate discussion the annual income of project farmers divided into two components, crop enterprise and non-crop enterprises. Before starting the project the annual family income of project farmers was INR 385500/-, which increased to INR 450421/- during after project situation. Regardless of project sites the family income earned from crop enterprises (INR 241250) of the project farmers are found 39% higher than the family income achieved from non-crop enterprises (INR 145917) under before project situation. The similar trends of higher family income (35%) from crop

enterprises (INR 296563) than non-crop enterprises (INR 177192) of the project farmers are also found in after project environment. Overall the total family incomes of project farmers are found higher in after project environment than the before project operations. Details of family income from different sources are shown in the Table 3.57.

Table 3.57: Annual family income of project farmer

Location/site	Before project (INR)*			After project (INR)*		
	Crop enterprise	Non-crop enterprise	Total	Crop enterprise	Non-crop enterprise	Total
Madhurai	344667	161000	505667	409917	172550	582467
Kochin	134500	130833	265333	136542	181833	318375
All	239583	145917	385500	273229	177192	450421

*1 USD = INR 84.56

i) Change in family income of project farmers

The study exercised and measured the changes/increase of family incomes of project farmers from crop and non-crop sources considering before and after project environments. Averaged across operational sites the changes of beneficiary-incomes is found more pronounced under non-crop enterprises (23%) than the crop enterprises (10%). However, the trends of positive changes in family incomes due to project activities behaved reversely by sites; in Madhurai the change/increase of income in crop enterprise observed 19% against only 2% in Kochin. On the other hand, the change in income from non-crop enterprises showed only 7% higher against 39% in Kochin site. It indicated that the farmers selected from Kochin are more oriented towards small businesses than of Madhurai site. The data reflected that the households in Madhurai site concentrated their efforts more to farming than small business. Details of the income changes are shown in the following table 3.58.

Table 3.58: Change in family income of project farmer under crop and non-crop enterprises

Location/site	Crop enterprise (INR)*			Non-crop enterprise (INR)*		
	Before	After	Change %	Before	After	Change %
Madhurai	344667	409917	19	161000	172550	7
Kochin	134500	136542	2	130833	181833	39
All	239583	273229	10	145917	177192	23

*1 USD = INR 84.56

j) Annual family income of non-project farmers

The Table 3.59 plotted the annual family income of non-project farmers during before and after project scenarios by operating sites. For convenient of interpretation of data the annual family income of non-

project farmers divided into two different sources like crop enterprise and non-crop enterprises. Before project starts, the annual family income of non-project farmers was INR 410111/-, which increased to INR 463382/- after project situation. Regardless of project sites the family income earned from crop enterprises (INR 267811) of the non-project farmers are found 58% higher than the family income achieved from non-crop enterprises (INR 122300) under before project situation. The similar trends of higher family income (52%) from crop enterprises (INR 285482) than non-crop enterprises (INR 150900) of the non-project farmers are also found in after project environment. Overall the total family incomes of non-project farmers are found higher in after project environment than the before project operations. Details of family income of non-project farmers from different sources are shown in the Table 3.59.

Table 3.59: Annual family income of non-project farmer

Location/site	Before project (INR)*			After project (INR)*		
	Crop enterprise	Non-crop enterprise	Total	Crop enterprise	Non-crop enterprise	Total
Madhurai	446600	115800	562400	480200	131400	611600
Kochin	129021	128800	257821	144764	170400	315164
All	287811	122300	410111	312482	150900	463382

*1 USD = INR 84.56

k) Change in family income of non-project farmers

The study measured the changes/increase of family incomes of non-project farmers from crop and non-crop enterprises during before and after project environments. Averaged across operational sites the changes of family incomes of non-project farmers are found more noticeable under non-crop enterprises (23%) than the crop enterprises (10%). However, the trends of positive changes in family incomes of non-project households also behaved reversely among sites; in Madhurai the change/increase of income in crop enterprise observed only 8% against 13% in Kochin. On the other hand, the change in income from non-crop enterprises showed only 13% higher in Madhurai site against 32% in Kochin site. It indicated that the non-project farmers who were interviewed in Kochin are more oriented towards small businesses than of Madhurai site. The data reflected that the households in Madhurai site also put their efforts more to small business than farming. It indicated that the non-project farmers are interested in small business than farming in both the project operational sites. Details of the income changes are shown in the following table 3.60.

Table 3.60: Change in family of non-project farmer under crop and non-crop enterprises

Location/site	Crop enterprise (INR)*			Non-crop enterprise (INR)*		
	Before	After	Change %	Before	After	Change %
Madhurai	446600	480200	8	115800	131400	13
Kochin	129021	144764	12	128800	170400	32
All	287811	312482	10	122300	150900	23

*1 USD = INR 84.56

l) Comparison of changes in family income of project and non-project farmers

The following Table 3.61 compared the changes in annual family income between before and after project situation of both project and non-project households. Overall, averaged across operational sites the changes/increase of family income between before and after project implementation is observed as 17% for project farmers against 13% for non-project farmers. The enhancement of income of project households was only 4% higher than the non-project households. The changes or increase of family income for project and non-project farmers in Kochin site is found 20% and 22% respectively. While these increase of annual income in Madhurai site is found 15% and 9% respectively. In Madhurai site only 6% higher annual income achieved by the project farmers than non-project farmers but in contrary 2% negative growth of family income showed by the project farmers than the non-project farmers in Kochin site. The results indicated that the project activities are yet to be showed more positive impact on the family income of project farmers.

Figure 12: Data collection on Moringavalue chain

Considering the implementation status of the project, this minimal or no or negative changes in family income of project farmers over non-project farmers is not very unusual, because the project targeted livelihood improvement of farmers through value addition of crop products, which to be done under the project supported processing centers in the concerned sites. But in practice the project though completed the physical structures of the processing centers in each of the sites but these processing sites started functioning only in Aug to Dec 2022, hardly the centers passed only one or two cropping seasons. The processing centers are yet to be under full swing functioning in regular basis for years together to produce positive impact on the family income of project farmers. The operation of processing centers in India is not very exceptional than other processing centers in other SAARC countries.

Table 3.61: Comparison of change in family income between project and non-project beneficiary

Location/site	Annual income of beneficiary (INR)*				Income increase (%)		% Change (project versus non-project)
	Project		Non-project				
	Before	after	Before	after	Project	Non-project	
Madhurai	505667	582467	562400	611600	15	9	6
Kochin	265333	318375	257821	315164	20	22	-2
All	385500	450421	410111	463382	17	13	4

*1 USD = INR 84.56

3.3.3.1 Establishment and Operation of Processing Center

In India two processing centers have been established under the funding support of SDF project one at Madhurai and another at Kochin in 2022. The processing center at Madhurai is designed and developed to produce value added products of moringa while the center at Kochin is established/ developed for producing value added products of coconut. Both of the centers are found under operations during the field visit in January 2024. The endline study assessed current activities of the processing center at Madhurai. The following section illustrated the activities of processing center at Madhurai.

Figure 13: Processing center at Madhurai, India

a) Skill development of farmers

The SDF supported livelihood enhancement project funded skill development of targeted farmers for preparation of different kinds of value added products like sauce, chips, crackers etc. and on improved marketing systems of their crop products. During the project period the Indian project management provided training to 250 participants on various subjects. Out of the total training participants 165 (66%) were female and 85 (34%) male. The duration of the training courses organized in different months of the year ranged from 1 – 3 days. Among the training courses organized, the training on ` group formation and baseline survey' organized 3 times during the starting year of the project, one in July 2019, one in Aug 2019 and another in Sep 2019 with 50 participants for each session. The training course `value addition and food safety' organized in Apr 2022 with 50 participants. The project management organized exposure visits for the project farmers four times during the project period, one in Nov 2019, one in March 2022, one in May 2022, and other in July 2023 with 50 participants in each of the visits. . and other in chain agro-processing' had longer duration (5 days) followed by orientation and maintenance of equipment' with 4 days duration and on `business management, with 3 days duration. It has been observed that two training courses were organized in 2021 (Apr and Aug) and other two courses in 2022 (Jun and Jul). None of the training courses organized in 2023 and 2024. Details are shown in Table 3.62.

Table 3.62: Capacity building of farmers

Training subject	Number of participant			Training (day)	Time organized (M & Y)
	Male	Female	Total		
1. Group formation and baseline survey	99	51	150	3	July 2019 (3 Days), August 2019 (3 Days), September 2019 (3 Days)
2. Value addition and food safety	33	17	50	2	April 2022 (2 days)
3. Exposure visit	132	104	236	4	November 2019 (3 days), March 2020 (1 day), May 2022 (1 day), July 2023 (1 Day)
4. Bakery products	33	17	50	2	April 2022 (2 days)
5. Book/record keeping	33	17	50	2	September 2019 (2 Days)

Total/Mean	330	206	536	2.6	

M = Month and Y = Year

b) Production of value added products

The collection or assembled of primary moringa products and subsequently production of finished marketable products by the processing center is shown in the following Table 3.63 by operational years. The data observed that during the establishing year, the center could not collect any moringa, so, not produced any marketable products. The actual operations of the center started in the following year 2023 when it collected 1500 moringa leafs and in the next year in 2024 collected 800 leafs. The amount of moringa leaf collected in the center in 2024 is found much lower than the amount collected in 2023, it is because the data gathered from processing in April 2024, which reflected only 4 months activity of the year 2024.

Figure 14: Value added products from moringa at Madhurai processing center

The processing center produced varieties kinds of value added products of moringa by using the collected raw leafs, the major marketable products produced in 2023 are: leaf powder 110 kg, capsule 01 Kg, tablet 01 Kg, soup powder 10 Kg, rice mix 10 Kg and dosa/idli mix 5 Kg altogether 137 Kg. Similarly in 2024 it produced leaf poder 55 Kg, capsule 0.5 Kg, tablet 0.5 Kg, soup powder 08 Kg, rice mix and dosa/idil mix 08 Kg and chapati/atta mix 05 Kg, altogether 77 Kg of value added moringa products and marketed in the local markets. Considering the time of operation in 2024, performance of the center is improved in the year 2024 than 2023. Till now the center marketed 214 Kg of marketable products of moringa that contributed to the health benefit of the community people. Details are shown in Table 3.63.

Table 3.63: Operation of processing center under SDF supported project at Madhurai in May 2024

Establishment year and start of operation	Fresh Moringa leaf (Kg/year) assembled	Total	Secondary/Finished moringa products marketed (kg/year)	Total
Establishment in 2022				
Year 1: 2022	None	0	None	0
Year 2: 2023	Leaf 1500	1500	Leaf powder: 110 Capsule: 01 Tablet: 01 Soup powder: 10 Rice mix: 10 and Dosa/idli mix: 5	137
Year 3: 2024	Leaf 800	800	Leaf powder: 55 Capsule: 0.5 Tablet: 0.5 Soup powder: 08 Rice mix and Dosa/idli mix: 08 Chappati/Atta mix: 05	77
Total	2300	2300		214

c) Financial Transection of processing centers

The financial transection of the center showed in the following Table 3.64 included only the sale value of the moringa products i.e. the gross margin of the center during the operation years. The amount of Indian Rupee plotted in the table indicates that the salable value added products produced by the centers are much cheaper sold by only INR 256 per Kg (averaged across different kinds of products) in 2023 and INR 225/- in 2024 with an average value of INR 240/- per Kg irrespective of year of sale. If we compare the price of finished moringa products in the market against its traditional marketable raw products i.e. fruits, huge gap could be identified. As reported the fruits of moringa during 2023 or 2024 generally sold in the market by INR 50 to INR 100/- per Kg. It is important to be mentioned that the value added products illustrated in the table are produced from leafs of moringa plant not from the traditional marketable fruits so farmers can continue the sale of fruits even when they are selling leafs to the centers. Virtually the leafs of moringa are not used as edible parts, so does not compete with its traditional marketable products.

Table 3.64: Financial transection of processing center

Operational year	Finished moringa products (powder etc.) marketed (INR/Year)*	Total
Year 1: 2022	0	0
Year 2: 2023	32500	32500
Year 3: 2024	17300	17300
Total	49800	49800

*1 USD = INR 84.56

d) Employment generation under processing centers

It has been observed that the processing center has produced numbers of value added products from moringa using skilled manpower for operation of machineries, collection, production and marketing of varieties kinds of processed marketable goods. Following Table 3.65 showed the numbers manpower employed in the center by operational years. Irrespective of operational years and gender segregation, the processing center employed 6 persons. Out of total skilled workers employed, 4 are female and 2 male, and considering year of operation 3 people engaged in 2023 and it continued with the same numbers without variation and male female ratio. Analysis of employment data, indicated that the centers did not consumed large numbers of laborers meaning it is yet to be developed as labor friendly organization. Considering the operational volumes of the centers, it is observed that at present the centers are operating in a limited scale, so it may be assumed that with the increase of operational volumes, the manpower consumption would be increase significantly.

Table 3.65: Number of people employed in the processing center

Operational year	Number of person engaged in operation of processing center (Moringa leaf, powder, tea etc.)		Total
	Male	Female	
Establishment			
Year 1: 2022	0	0	0
Year 2: 2023	1	2	3

Year 3: 2024	1	2	3
Total	2	4	6

e) Employment generation by the farmers

The Table 3.66 worked out the increase of laborer use by the farmers due to project activities considering before and after project situation. The data were collected through recall method. Both male and female laborers were used in the farms but as observed more numbers of female laborers were used than the male laborers regardless of their sources of use. In general laborers used increased with time i.e. higher numbers of laborers used after project situation than the before project activities. Interestingly no increase of laborers was found for females except moringa cultivation but they have increased male persons in other activities like small business other than moringa farming. However the increased use of laborers after project situation is not also remarkable, but can be assumed that with the increase of activities of processing center the capacity of labor consumption in farming will also increase in near future.

Table 3.66: Employment generation by farmers

Sources of employment	Number of person engaged in farming/crop/household							
	Before project		After project		Difference		% Change	
	Male	Female	Male	Female	Male	Female	Male	Female
Moringa	1	3	2	5	1	3	100	67
Livestock	1	2	1	2	0	0	0	0
Small business	1	2	2	2	1	0	100	0
Services	1	2	2	2	1	0	100	0
Total	4	8	7	9	3	1	75	13

f) Product marketing by processing centers

The following table enumerated the data on marketing of finished products through different types of market outlets by the processing centers. It is mentioned that marketing of finished products by the processing centers only done during the project period not before or after project situation. It has been observed that averaged across crops (without considering variation between crops) the highest sale of finished products was made through wholesale (35%), followed by retailers 30%, local markets 20% and by farm gate sale only 153%. If we consider the variation of product marketing of processing centers by market outlets, it is found that centers has marketed considerable amount of products (35%) through wholesaler, it indicated the skill development training and other technical activities of the projects helped the marketing staff of centers for making good communication with the wholesale market actors. They have also developed good accessibility to the retail and local market actors too (Table 3.67).

Table 3.67: Marketing of products by processing center

SDF supported crops	Percent crop product sold by market outlets			
	Farm gate	Retailer	Wholesaler	Local market
Moringa leaf, powder, tea etc.	15	30	35	20

All	15	30	35	20

g) Marketing of crop products by farmers

The market accessibility of the farmers to the moringa crop has been compared by considering before and after project situation. In general the data shown in the Table 3.68, the farmers have accessibility to different types of market outlets for moringa marketing. Under before project situation moringa was mainly marketed through local markets (45%) and by using the whole marketing (30%) but after project implementation the scenario has been found positively shifted to wholesale marketing 35% (increased by 5% than earlier) followed by local markets/hats 25% (decreased by 20% than earlier). Marketing of moringa products through farm gate and retailers also increased by 10% and 5% respectively than the before project environment. Overall no great variation is observed in the process of moringa marketing after having skill developed training and establishing the processing centers. It is because the farmers were practicing good marketing facilities even before starting the project activities. Madhurai is one of the popular agricultural hub with good communication facilities in the country that reflected in the plotted marketing data in the Table 3.68.

Figure 15: FGD session at Kochin, India

Table 3.68: Marketing of products by farmers

SDF supported crops	Percent crop product sold by market outlets							
	Before project				After project			
	Farm gate	Retailer	Wholesaler	Local market	Farm gate	Retailer	Wholesaler	Local market
Moringa	10	15	30	45	20	20	35	25
All	10	15	30	45	20	20	35	25

h) Production packages adopted

The endline survey investigated the adoption levels of different production practices promoted by the SDF assisted project into the project farmers. The project activities like formation of producer group, skill development training, establishment processing plant, arrangement of exposure visits for the farmers to the upgraded farms and offices of Government and private extension agencies etc. motivated the farmers

to adopt crop production packages in certain levels. The following Table 3.69 enlisted the production practices being adopted by the farmers in both of the research sites.

Table 3.69: New production packages adopted by the project farmers

Moringa value chain (Madhurai	Coconut value chain (Kochin
Integrated pest management	Plant protection measures adopted
Timely and staggered harvesting	New health varieties from ICAR-Kayamkulum distributed
Timely pruning	Timely irrigation
Grading and packaging	Adopted appropriate training/pruning
Improved intercultural operation including irrigation	Proper fertilization twice a year
Intercropping of vegetables	Harvesting of green coconut and coconut following proper timing and market
Pollination increased 25% – 30% yield	

i) Post-Harvest Loss Management

Post-harvest loss reduction of interventional crops was one of the important objective of the livelihood enhancement project, and considering the project concept the status of post- harvest loss of moringa and coconut crops were investigated under the study. As reported by the project farmers the post-harvest loss of coconut was higher than moringa under both before and after project situations. In case of moringa the post-harvest lost reduced from 23.6% to 10.0% (by 13.6%) due to project activities (training and value addition) and in coconut it reduced from 25.6% to 20.8% (by 4.8%). Regardless of crops the post-harvest loss of crops reduced by 9.2% by the activities of project. The edible parts are fruits in both the crops, so the improved intercultural management due to project intervention possible plays important role in reducing the damage of fruits at or after harvest. Details are shown in Table 3.70.

Table 3.70: Post-harvest loss reduction occurred due to SDF project activity

Name of crop	Before project	After project	Difference (% Reduction)
	Post-harvest loss (%)	Post-harvest loss (%)	
Moringa	23.6	10.0	13.6
Coconut	25.6	20.8	4.8
All	24.6	15.4	9.2

j) Employment enhancement

The following table plotted the data on monthly engagement of labors in the concerned crops by the farmers under before and after project situation. After project intervention, the labor use per household in their crop production increased by 42% for moringa and 41% for coconut. Regardless of before or after project situation, among the two crops moringa consumed more laborers than the coconut cultivation (Table 3.71). The farmers used higher numbers of laborers, possibly due to adopting new technologies like irrigation or pesticide use, marketing etc., attending agro-business training in the processing plant and exposure visit of households to processing units.

Table: 3.71: Employment enhancement (#) by farmers/producers due to SDF project activity

Name of enterprise	Before project	After project	Difference (%)
	Number labor engaged/month	Number labor engaged/month	
Moringa value chain	5.2	7.4	2.2 (42)
Coconut value chain	3.4	4.8	1.4 (41)
All	4.3	6.1	1.8 (42)

k) Incremental price of crop products

The project activities like exposure visits, agro-business training, use of timely harvesting and sorting/grading assisted the households to have incremental prices/sales for their marketable crop products. The incremental prices/sales, the farmers received after project interventions is shown in the following Table 3.72. After project situation, the farmers received higher incremental price for moringa than the coconut. Regardless of variation between crops, the changes in prices of marketable products due to time and project intervention ranged from 21% to 23% with average of 23%.

Table 3.72: Value of incremental sales received by SDF supported farmers

Name of crop	Before project	After project	Difference (%)
	Market price/Kg/fruit	Market price/Kg/fruit	
Moringa	36.6	45.0	8.4 (23)
Coconut	10.4	12.6	2.2 (21)
All	23.5	28.8	5.3 (23)

l) Accessibility to value added technology

The SDF assisted project created/opened the accessibility of the producer group members to the different new technologies and systems of crop production and marketing for ensuring higher income. Out of many production technologies mentioned by the project staff and farmers, some are enlisted in the following matrix. The table also compared the existing technologies available to the farmers during before starting the project with the availability of technologies to the farmers after project intervention. As reported farmers were happy to know the diversified use of different parts of moringa plant especially leaf products as human food and as fodder too. Another interesting issue for the farmers was grading and packaging of marketable products. They also mentioned about apiculture and enhancement of yield especially for moringa due to increase of natural pollination. Details of the technologies the farmers learned after engaging with the project activities are listed in the following Table 3.73.

Table 3.73: Accessibility of farmers to technology (post-harvest handling and value addition)

Name of crop	Before project	After project
	Name of post-harvest handling techniques	Name of value addition techniques
Moringa value chain	i Marketable moringa fruit	i. Dried moringa leaf, packaging and marketing
		ii. Moringa leaf powder, packaging and marketing
		iii. Moringa soup powder making and marketing
		iv. Use of moringa leaf as cattle feed
		v. Introduced apiculture in the moringa gardens
		vi. Good quality packaging for marketing of products
Coconut value chain	ii Mature coconut iii Green coconut	i. New variety of coconut from ICAR-Kayamkulum
		ii. Preparation and marketing of extra-virgin coconut oil
		iii. Packaging and marketing of green coconut water
		iv. Prepare and use of leaf-stick craft
		v. Preparation of coconut fiber coir rope for household and industrial use

m) Awareness development to the producers

The SDF supported livelihood enhancement project assisted to build up awareness among the producer groups of interventional crops through skill development training and exposure visits. Awareness were created to the production and value addition technology especially to the post-harvest handling and marketing of the value added products to ensure higher prices. After project interventions, the producers of moringa and coconut in both the research sites (Madhurai and Kochin) have developed their awareness to the following production issues:

i. Practicing apiculture into the moringa and coconut plantations to ensure better pollination and higher income from per unit area of land
ii. Harvesting of tender fruits in case of moringa to have higher market price
iii. Grading and packaging of moringa fruits and value added products (dried leaf, leaf powder, soup powder, leaf-pest etc.) to enhance market demand and ensure higher price.
iv. Practicing integrated pest management (IPM) techniques to manage insect/pest damage instead of traditional chemical spray to the ready to eat (raw) products like moringa fruit/leaf and green coconut
v. The project arranged exposure visits for the producers to different Government and non-Government agencies and business firms that enhanced their interest to the diversified agricultural production and businesses
vi. Achieved awareness to the new varieties of coconut especially to the dwarf varieties to mitigate the challenges of skilled labor shortage for harvesting coconut from traditional tall trees

n) Opportunities

The processing centers are constructed in Madhurai one of the famous agricultural production hub of the country and another established in Kochin, which is one of the prominent coconut growing regions of India. Considering the locations and other available facilities the opportunities of the centers are:

i. Moringa is grown as field crop in Madhurai areas and harvested thrice a year, so ample supply is available for value addition products of moringa
ii. The producer groups are found interested to operate the processing centers and marketing different kinds of value added products from Moringa
iii. The market value of moringa and its value added products is good to support higher production of the crop
iv. Moringa is being considered as super food for human and livestock too, so the fortune of its cultivation is encouraging
v. Intercropping of vegetables and oilseeds under Moringa plantation add extra incomes for the producers, so prosperity of its cultivation is positive
vi. Still it's a rainfed crop and so can be produced with minimum costs of production, good opportunity for the poor sections of farmers
vii. Coconut has the opportunity of value addition by producing different kinds of processed food from its kernel, canned green coconut water is also demandable natural drinks
viii. Availability of short structured variety in recent years may relief the producers from the burden of expensive harvesting and it would also help to popularize the cultivation of coconut

o) Limitations

The processing centers established with an average cost of Tk ----- per center (including machineries) one at Madhurai and another at Kochin. Based on each of the centers 1-3 women producer groups with an average 40 members per group has been organized. The project officials trained the members of the producer groups on preparation of different value added products from selected crops like banana, groundnut and cassava, sorting/grading and leveling of an ago-products etc. Some of the limitations observed during the field visit are:

i. Extension of surface irrigation facilities in the moringa growing regions of Madhurai through Government project may change the existing production systems of moringa.
ii. Maize or other high value short seasoned crops might replace the cultivation of moring crops in near future
iii. Shortage of farm laborers for staggered harvesting of moringa (drum stick) at tender stage to capture higher market price
iv. High rainfall during the flowering stage of moringa causes reduction of yield even after good cultural management
v. Shortage of seeds/seedlings of good (HYV) variety of moringa at farm level

vi. The coconut growing farmers facing difficulty due to shortage of skilled laborers for harvesting of green/mature coconut from tall plants
vii. Shortage of seeds/seedlings of good (HYV) variety of coconut at farm level
viii. Reduction of coconut production under existing plantation due to heavy infestation of rugose spiraling white fly

p) Challenges for production and post-harvest processing of interventional crops

The impact study identified some challenges of the producer groups. During physical interview the project farmers mentioned some of the problems they faced after engaging with the project activities. Some problems are natural and some are the teething troubles of development projects and human activities. The identified challenges mentioned by the respondent farmers are summarized below:

i. Rainfall during flowering stage of moringa: it reduced the expected yield/production
ii. Fruit fly damage of flower and tender fruit (pest management): reduced yield and increase post-harvest losses of crops products
iii. Labor shortage resulted higher daily wage during pick season of harvesting
iv. Price fluctuation in the market: reduction prices of crop products during the pick harvesting season
v. Climate change: uncertain tidal surge and extreme rainfall
vi. Transportation: shortage transport increase the cost that resulted low profit margin for the producer groups
vii. Introduction of surface irrigation enhancing promotion of maize and other field crops: Moringa crop facing competition with the maize/rice those are new crops in the area being started to cultivate by the farmers after implementing the water management project of the Government
viii. Harvesting of fruits from tall coconut trees: Laborers are becoming unwilling more and more to do this difficult tasks with the availability of other opportunities like rikshaw/van pulling, construction laborers and works in different Government development projects

q) Recommendation

ix. Development of dwarf (short structured) coconut variety, multiplication of seedlings and proper extension at the field level to be done as early as possible
x. Good/high yielding variety of moringa with year round production capacity is to be developed, multiplied and to be distributed to the farm level
xi. Improved production systems of moringa intercropped with high value crops (vegetable, spices oilseeds etc.) is to be developed, so that moringa cultivation can be commercially viable against cultivation of seasonal field crops like rice or maize after introducing surface irrigation systems

xii. Proper control measures of rugose spiraling white fly is to be developed and adopted by the coconut producers to have higher financial margin from coconut plantation

xiii. To assist producer group, the key staff of the processing centers is to take lead role in developing business linkage with the large food and beverage companies to upgrade the centers as rural business hub

xiv. The linkage system is to be made in such a way that the women member will produce the value added products in the center for some of the large food/beverage companies, from where the company representatives will collect it in regular weekly basis

xv. The project staff at the center will do necessary role so that the producer group members can get credit from the local NGO or banking systems to enhance their production of crops under consideration

xvi. Linkage between producer groups with extension agencies to be made stronger through motivation and by arranging exchange visit

3.3.4 Sri Lanka

The planned activities of SDF project implemented two sites of Sri Lanka one at Anuraradhapura and another at Monaragala through forming beneficiary groups mostly with small farm households under direct supervision of Extension and Training Centre (ETC), Department of Agriculture, Sri Lanka.

Demography of the sample households

The endline study investigated the demographic characteristics of the project farmers to evaluate the representativeness of the sampled households used in the study for data generation. The social status of the sampled households are discussed in the following section.

a) Distribution of households by sex

During beneficiary selection for data generation, the study put equal importance to maintaining proper gender balance. Averaged across the two sites, 30% sampled households were male and 70% female. For individual sites, Anuraradhapura represented by 60% female samples and Monaragala with 80% female population. It indicates that in Anuraradhapura 40% sampled households were male against20% male samples in Monaragala. Details are shown in Table 3.74.

Figure 16: Data collection session at Anuraradhapura, Sri Lanka

Table 3.74: Distribution of sampled Households by sex at SDF project sites in Sri Lanka

Sample Household	Location/Site (%)		All
	Anuraradhapura	Monaragala	
Male	40.0	20.0	30.0
Female	60.0	80.0	70.0
Total	100.0	100.0	100.0

b) Distribution of households by age

The following Table 3.75 showed the distribution of sampled households by their age (year). It has been observed that in general none of the sampled farmers were below 30 years of age and over 70 years (Table 3.75). The distribution of sample households averaged across sites are found very unique i.e. 40% within 30 to 40 years of age group while the rest 60% are within 40 – 70 years of age group. For individual site, in Anuraradhapura 20% selected households were from 30 to 40 years of age group, 20% from 50 to 60 years and rest 60% were above 60 years of age. While the circumstance is almost reverse for Monaragala site, 60% sampled households are from 30 to 40 years of age and the rest 60% from 40 to 50 years of age group, none from 50 to 60 years or above 60 years. The age distribution of samples indicate that the selected farmers for study are comparatively older in Anuraradhapura than the Monaragala site. Details are showed in the Table 3.75.

Table 3.75: Distribution of sampled households by age in Sri Lanka sites

Age (year)	Location/Site (%)		
	Anuraradhapura	Monaragala	All
30 to 40	20	60	40
40 to 50	0	40	20
50 to 60	20	0	10
Above 60	60	0	30
Total	100	100	100

c) Family size of households

The family size of the households is an important indicator to be carefully examined for improving their livelihoods. Considering the fact, the family size of the interviewed households were collected from both Anuraradhapura and Monaragala sites and observed that the average family members per household are comparatively higher among the respondents of Monaragala than Anuraradhapura (Table 3.76). As informed by the farmers, the average family size of Anuraradhapura site is 2.8 members/family against 4.0 members/family in Monaragala. Across locations, the family size is found 3.4 members/family which is found alike with the national average household size 3.7/family[4]. Averaged across locations, within the

[4] Nationally, the average household size in Sri Lanka is **3.7 people per household**. It is calculated by dividing the household population by total households. Ref: ttps://www.arcgis.com/home/item.html?id=a028cd3842e442c39b24efebfbd46090

family the male members are 1.8 against 1.6 female members. In Anuraradhapura the male members/family is 1.4 against 1.4 female members while in Monaragala the male members are 1.8 against 1.6 female members per family.

Table3.76: Family size of the sample households in Sri Lanka sites

Family size by sex	Location/Site (#)		
	Anuraradhapura	Monaragala	All
Male	1.4	2.2	1.8
Female	1.4	1.8	1.6
Total	2.8	4.0	3.4

d) Distribution of households by family size

After examining the family size of the project farmers it has been observed that averaged across locations, maximum families i. e. 30% have 3 persons per family, 10% have 4 persons per family and 20 have 5 persons per family. Interestingly, none of the families found with >5 members per family in Anuraradhapura but 20% of the respondent families in Monaragala reported they have their family size is more than 5 members/family. By segregating locations, it has been observed that in Anuraradhapura 20% respondents have their family size is only 01 members/family, 40% only 02 members/family, 20% have 4 persons/family and another 20% have 5 mmb4rs per family. On the other hand in Monaragala 60% households reported their family size is 3, 20% said they have 5 members per family and rest 20% informed their family members as more than 5. Details are shown in the following Table 3.77.

Table 3.77: Distribution of respondents by family size

Family size (#)	Location/Site (%)		
	Anuraradhapura	Monaragala	Mean
1	20	0	10
2	40	0	20
3	0	60	30
4	20	0	10
5	20	20	20
>5	0	20	
Total	100	100	100

e) Size of landholdings of project farmers

The following Table 3.78 showed the size of landholdings (considering lands under current cultivation) per family in the SDF supported livelihood enhancement project area by locations and gender. Across locations the average size of landholdings of project farmers is found 341.7 decimal per family without considering gender segregation. On the other hand the size of average landholdings per family of non-project farmers is found 224.0 decimal i.e. 34.5% less than the project farmers. Regardless of locations the size of landholdings in female led households of project farmers (208.3 decimal) is less than the male

led households (341.7 decimal). In case of non-project farmers, the scenario is found reverse i.e. male households have less land size (197.9 decimal) than female ones (250 decimal). Considering project farmers, the land size per households in Anuraradhapura is 58.6% higher than the Monaragala site; in contrary the land size for non-farmers in Anuraradhapura is 17.2% less than the Monaragala site. It indicated that the non-beneficiary farmers are comparatively poorer (possetion of cultivable land under the family is considered as the key indicator for family income for rural folk) than the project farmers.

Table3.78: Size of land holdings of project and non-project households in Sri lanka sites

Location/site	Project household (decimal)			Non-project household (decimal)		
	Male	Female	Mean	Male	Female	Mean
Anuraradhapura	750	216.7	483.3	162.5	250.0	206.3
Monaragala	200.0	200.0	200.0	233.3	250.0	241.7
Mean	475	208.3	341.7	197.9	250.0	224.0

f) Distribution of households by landholdings

The distribution of project and non-project farmers against their size of landholdings is shown in the following Table 3.79. For convenience of discussion, the land size of farmers are grouped into less than 200 decimal/family category, 200 – 300, 300 – 400, 400 – 500 and more than 500 decimal holdings/family to show the distribution among the sampled households. It has been observed that in Monaragala 20% farm households of project farmers fall under the category of less than 200 decimal land holdings per family, 60% under 200-300 decimal and 10% each in 300-400, 400-500, and more than 500 decimal land holdings/family. In Anuraradhapura, 60% respondent households of project farmers fall under 200-300 decimal land holdings category, 20% under 400-500 decimal range, and 20% under more than 500 decimal land size/family category. In non-project farmers, 40% farm households of Anuraradhapura fall under the category of <200 decimal land holdings, 40% under 200-300 decimal and 20% under 400-500 decimal land holdings/family. In Monaragala 60% farm households of non-project farmers fall under the category of 200-300 land holdings, and 40% under 300-400 decimal/family category. The data indicated that regardless of research sites maximum households owned 200-300 decimal cultivated land per family.

Table 3.79: Distribution of households by their size of landholdings

Size of land holdings (decimal)	Project household (%)			Non-Project household (%)		
	Site/Location		Mean	Site/Location		Mean
	Anuraradhapura	Monaragala		Anuraradhapura	Monaragala	
<200	0	20	10	40	0	20
200-300	60	60	60	40	60	50
300-400	0	20	10	20	40	30
400-500	20	0	10	0	0	0
>500	20	0	10	0	0	0
Total	100	100	100	100	100	100

g) Annual family income of project farmers

The impact study attempted to identify the changes in family income of project and non-project farmers of both Anuraradhapura and Monaragala sites by generating data through recall methods against before and after project situation. To make it more convenient the data collection methods against family income was split into two main sources like i) crop enterprises that included project interventional crops (banana, groundnut and jackfruit) and other presently growing crops like rice, maize, oilseeds, pulses etc. and ii) non-crop enterprises that included livestock, fisheries, service/daily wage, small businesses and others. The following table summarized the family income of households from crop and non-crop enterprises and compared them under before and after project situation.

As reported by the respondents, irrespective of the research sites, the annual family income of project farmers ranged from LKR 676000 to 816300 with a mean of LKR 746150/annum under before project situation against LKR 902000 to 1014640 with a mean of LKR 958320/annum after project situation. The data presented in the Table 3.80 revealed that in Anuraradhapura the income of project farmers from crop enterprises was 4% higher than the non-crop enterprises under before project condition while it is found 21% higher under after project situation. In Monaragala the consequence is reverse i.e. income of project farmers from crop enterprises was 6% lower than the non-crop enterprises under before project situation and 2% higher under after project circumstances. Averaged by locations the family income of project farmers was 0.33% lower from crop than non-crop enterprise while it is found 13% higher under after project conditions. Details are shown in the Table 3.80.

Table 3.80: Annual family income of project farmer

Location/site	Before project (LKR)*			After project (LKR)*		
	Crop enterprise	Non-crop enterprise	Total	Crop enterprise	Non-crop enterprise	Total
Anuraradhapura	416900	399400	816300	567640	447000	1014640
Monaragala	328000	348000	676000	456000	446000	902000
Mean	372450	373700	746150	511820	446500	958320

LKR = Sri Lankan Rupee. *1 USD = LRK 290.80

h) Changes in family income of project farmers

The following Table 3.81 analyzed the changes occurred in family income of project farmers after implementing the SDF supported livelihood enhancement project by comparing their present incomes with the earlier incomes (before starting the project). Irrespective of location/sites, the income of the project farmers has invariably been increased by 20%-38%. The income has mostly increased by crop enterprise (38%) than non-crop enterprises (20%). Considering the locations, the increase of income from crop enterprises (36%) superseded the increase of income from non-crop enterprises (12%) in Anuraradhapura. In case of Monaragala site, the income-increase from crop enterprises (39%) also exceeded the income increase from non-crop enterprises (28%). It is noted that this income increase does

not necessarily mean due to only SDF project activities, other factors like technology diffusion due to intervention of other agricultural development projects in the locality, the time gap of 03 years etc. might also be contributed to the enhancement of family income.

Table 3.81: Change in family income of project beneficiary under crop and non-crop enterprises

Location/site	Crop enterprise (LKR)*			Non-crop enterprise (LKR)*		
	Before	After	Change %	Before	After	Change %
Anuraradhapura	416900	567640	36	399400	447000	12
Monaragala	328000	456000	39	348000	446000	28
Mean	372450	511820	38	373700	446500	20

*1 USD = LRK 290.80

i) Annual family income of non-project farmers

As of family income of project farmers, the endline survey of the SDF livelihood enhancement project also measured the family income of non-project farmers by comparing their present and earlier (before project start) incomes.

The family income of non-project farmers ranged from LKR 378600 to 672000 with a mean LKR 525300/annum under before project situation against LKR 424600 to 890000 with a mean of LKR 657300/annum under after project situation. The total annual family income either before or after project situation of project farmers was comparatively higher than the non-project farmers. The annual income of project farmers was 30% and 31% higher than non-project farmers under before and after project situation respectively. For non-project farmers, the income from crop enterprise was 25% less than the non-crop enterprise without considering the research sites of Anuraradhapura and Monaragala. Not much variation was observed in the annual family income either before or after project situation in Anuraradhapura and Monaragala sites. Details are shown in Table 3.82.

Figure 17: FGD session at Sri Lanka

Table 3.82: Annual family income of non-project farmer in Sri Lanka

Location/site	Before project (LKR)*			After project (LKR)*		
	Crop enterprise	Non-crop enterprise	Total	Crop enterprise	Non-crop enterprise	Total
Anuraradhapura	265800	112800	378600	289400	135200	424600
Monaragala	336000	336000	672000	440000	450000	890000
Mean	300900	224400	525300	364700	292600	657300

LKR = Sri Lankan Rupee. *1 USD = LRK 290.80

j) Changes in family income of non-project farmers

The following Table 3.83 enumerated the changes occurred in family income of non-project farmers by crop and non-crop enterprises due to SDF supported project activities. Averaged across locations, changes in annual income of the families observed higher in non-project enterprises (27%) than the crop enterprises (20%). In Anuraradhapura site changes in family income of farmers was lower under crop enterprises (9%) than the non-crop enterprises (20%). On the other hand in Monaragala site the changes in family income of non-project farmers was higher in non-crop enterprises (34%) than the crop enterprises (31%). Details are shown in Table 3.83.

Table 3.83: Change in family income of non-project beneficiary under crop and non-crop enterprises

Location/site	Crop enterprise (LKR)*			Non-crop enterprise (LKR)*		
	Before	After	Change %	Before	After	Change %
Anuraradhapura	265800	289400	9	112800	135200	20
Monaragala	336000	440000	31	336000	450000	34
Mean	300900	364700	20	224400	292600	27

*1 USD = LRK 290.80

k) Comparison of change in family income of project and non-project beneficiary

The changes in annual family income of project and non-project farmers at before and after project situation is compared in the following table 3.84. The study/survey measured the enhancement of family income of project farmers due to project activities by subtracting the percentage of increased achieved by the non-project farmers within the same period of time (i.e. before and after project implementation). As identified the changes of family income of project farmers considering before and after project circumstances attained 24% in Anuraradhapura against 33% in Monaragala with mean of 28% irrespective of locations. While the changes of family income of non-project farmers considering before and after project conditions accomplished as 12% in Anuraradhapura against 32% in Monaragala with mean of 25% irrespective of locations.

The analysis of data indicated that the changes in income of project farmers during the project period increased by 12% than the non-project farmers in Anuraradhapura site and 1% in Monaragala site and the changes averaged across the sites is found 3% only. Actually the changes in family income between project and non-project farmers are found mostly insignificant except 12% in Anuraradhapura, possibly because the processing centers established by the SDF project for value addition of crop products are yet to be operated in full swings. In almost all sites the operation of processing centers passed only one cropping season or two, so enhancement of income of project farmers do not have enough time to reflect it. May be with time and by continuation of the operation of processing centers with value addition and proper marketing linkage, the income of project farmers will supersede the income of non-project farmers soon.

Table 3.84: Change in family income of project and non-project beneficiary

Location/site	Annual income of beneficiary (LKR)*				Change (%)	
	Project		Non-project			
	Before	after	Before	after	Project	Non-project
Anuraradhapura	816300	1014640	378600	424600	24	12
Monaragala	676000	902000	672000	890000	33	32
Mean	746150	958320	525300	657300	28	25

*1 USD = LRK 290.80

3.3.4.1 Establishment and Operation of Processing Center

Similar to other countries the SDF supported livelihood improvement project established two processing centers in Sri Lanka, one at Anuraradhapura and another at Monaragala. The processing center at Anuraradhapura is dealing/working on the banana and cassava production with value addition through producing chips and processed chips while the other site at Monaragala is producing value added products from cassava (cassava chips). The current progress of the processing center dealing banana and cassava products is discussed in the following section.

Figure 18: Processing center at Anuraradhapura, Sri Lanka

a) Skill development of farmers

The SDF supported livelihood enhancement project funded for skill development training for the targeted farmers on different production enterprises in value addition and improved marketing systems of their crop products. During the project period 161 participants attended the training programs on various subjects organized by the project management in Sri Lanka. Out of the total (161) participants, 115 (71.4%) were female and 64 (28.6%) male. The duration of the training courses organized in different times ranged from 01 – 02 days. Among the training courses organized, the duration of the training course on `basic awareness about SDF program' was only one day while the duration of other courses on i) marketing survey ii) survey data evaluation iii) business planning and on iv) food technology were two days. It has been observed that two training courses were organized in 2022 (Feb and Aug) and other three courses

in 2023 (Jan, May and Nov). None of the training courses organized during 2021 and 2024. Details are shown in the table 3.85.

Table 3.85: Capacity building of farmers

Training subject	Number of participant			Duration of training (day)	Time organized
	Male	Female	Total		
Basic awareness training About SDF program	23	31	54	01	Feb 2022
Marketing survey	01	11	12	02	Aug 2022
Survey data evaluation training	08	27	35	02	Jan 2023
Business planning training	07	23	30	02	May 2023
Food technology training	07	23	30	02	Nov 2023
Total	46	115	161		

b) Production of Value added Products

The establishment of processing centers at the two sites of Sri Lanka were completed in the later part of 2022. The following Table 3.86 illustrated the production status of the processing centers established at Anuraradhapura and Monaragala by considering assembling of harvested crop products (raw materials) and production of finished products. The data presented in the table indicated that the processing centers in both the centers started functioning in the year 2024. As observed from the data banana is the number one popular crop among the interventional crops under the SDF project. It has been observed that in 2024, the processing center at Anuraradhapura collected 470 Kg banana, of which 110 kg processed products (banana chips) were produced and marketed by the center. The center at Anuraradhapura also collected (or assembled by the farmers at the center) 30 Kg peanut, of which it produced 20 Kg processed fried nuts and marketed. The processing center at Monaragala collected 125 kg marketable raw cassava, of which the center produced 25 kg cassava chips and marketed in the local/wholesale markets. In the operational year the processing centers produced 155 kg (25% of the total supply) processed products from 625 kg marketable raw crop products.

Figure 19: Machineries at the processing center

Table 3.86: Establishment and operation of processing center in Sri Lanka

Establishment year and start of operation	Agricultural product assembled in the center (kg/year)			Total	Finished products marketed (kg/year)			Total
	Banana	Peanut	Cassava		Banana	Peanut	Cassava	
Establishment in 2022								
Year 1: 2022								

Rear 2: 2023								
Year 3: 2024	470	30	125	625	110	20	25	155
Total	470	30	125	625	110	20	25	155

c) Financial transection of the center

The amount of financial transection made in the processing center followed the trends of value addition of crop products made during the concerned years (duration) in the center. In 2024 the amount of financial transaction observed was highest (LKR 121000) as of highest production of banana chips during the year 2024. The financial transaction for peanut and cassava was similar with an amount of SKR 40000/crop/year. Details are showed in the Table 3.87

Table 3.87: Financial transection of processing center in Sri Lanka

Operational year	Finished products marketed (LKR/Year)*			Total
	Banana chips	Peanut processed pack	Cassava	
Year 1: 2022				
Year 2: 2023				
Year 3: 2024	121000	40000	40000	201000
Total	121000	40000	40000	201000

*1 USD = LRK 290.80

d) Employment generation by processing center

The processing centers employed their main working force during the year 2024 instead of when it established. The processing center employed two male staff during the establishment year and continued till to date possibly as watcher and for maintenance purposes. In the year 2024 the center engaged additional 1 male and 2 female workers for processing and preparing the valued added products of banana at Anuraradhapura. The processing center at Monaragala also employed two male staff during the establishment year and continued till to date. In addition the center recruited 3 male and 3 female workers in the year 2024 for the collection, processing and preparation of cassava chips. Up to 2024 both of the processing centers employed altogether 21 staff or which, Anuraradhapura recruited 11 manpower and Monaragala employed the rest 10 workers. The production of banana chips in processing center (Anuraradhapura) per worker per year was 217.5 kg and processed peanut per worker per year was 6.66 kg. 61 Kg. While in

Figure 20: FGD session at Anuraradhapura, Sri Lanka

Monaragala center the output per worker per year was 4.17 kg chips of cassava. Details are shown in the Table 3.88.

Table 3.88: Number of people employed in the processing center in Sri Lanka

Operational year	Number of person engaged in operation of processing center						
	Banana chips		Peanut processed pack		Cassava		
	Male	Female	Male	Female	Male	Female	Total
Year 1: 2022	2				2		4
Year 2: 2023	2				2		4
Year 3: 2024	2	2	2	1	3	3	13
Total	6	2	2	1	7	3	21

e) Employment generation by farmers

The technical team assessed the numbers of workers engaged for banana, peanut and cassava production and processing by the farmers during the project period and earlier. The data presented in the following table observed that the project farmers used more numbers of laborers during the project period after receiving skilled training and other interventional works of the SDF project than the earlier years. In producing the crops the farmers used more female workers than the male workers during project period. However, the rate of change (increase) of laborers used in the crop production was found similar for male and female workers. Engagement of both male and female laborer in farming by the project farmers increased by 27%. Details are shown in the following table 3.89.

Table 3.89: Employment generation by farmers under SDF supported project in Sri Lanka

Sources of employment	Number of person engaged in farming/crop/household							
	Before project		After project		Difference		% Change	
	Male	Female	Male	Female	Male	Female	Male	Female
Banana	11	15	14	19	3	4	27	27
Groundnut	7	11	9	15	2	4	29	36
Cassava	5	9	8	14	3	5	60	56
Total	23	35	31	48	2.67	4.33	39	40

f) Marketing of products by farmers

During the endline survey an investigation was made to assess the marketing of the crop products by the individual farmers at different levels/segments of product marketing. It has been observed that after initiation of the SDF livelihood enhancement project, the farmers increased their banana selling to 25% to the wholesaler from 20% earlier and reduced farm gate sale to 15% at present from 25% before project condition. While no change in product selling is observed between before and after situation in selling banana products to the retailers (40% before and after). In case of peanut, the marketing of products through wholesalers is increased to 30% from 10%, retail marketing is reduced to 45% from 60% and farm gate marketing reduced 20% from 30% considering before and after project situation. But no change in cassava marketing is observed between before and after project time for the farmers. In indicates that the processing center facilitated to improve product sale of farmers through wholesale and local market outlets but no the retailers outlets. Details of the product marketing by the farmers between before and after project situation is shown in the Table 3.90.

Figure 21: Visit of processing center, Anuraradhapura, Sri Lanka

Table 3.90: Marketing of products by farmers in Sri Lanka

SDF supported crops	Percent crop product sold by market outlets							
	Before project				After project			
	Farm gate	Retailer	Wholesaler	Local market	Farm gate	Retailer	Wholesaler	Local market
Banana	25	40	20	15	15	40	25	20
Peanut	20	60	10	10	10	45	30	15
Cassava	15	40	35	10	15	40	35	10
All	20	47	22	12	13	42	30	15

g) Product marketing by processing center

The study made an in-depth analysis on how do the processing center marketed the finished products (banana & cassava chips and salted spicy nut-packs) to the market operators. Marketing of processed products by the processing center started in 2024, though the center established in later part of 2022. It has been observed that the processing center marketed their majority finished products (38%) to the retailers only irrespective of crops or products. Only 12% of the products marketed through wholesaler, 27% directly from the center to the customers and 23% to the local traders. Considering the individual crop products, for banana 30% sold to the customers directly from the center, 45% to the retailers, 10% to the wholesaler and 15% to the local markets. For groundnut processed packs, 40% sold to the customers directly from the center, 30% to the retailers, 10% to the wholesaler and 20% to the local markets. For cassava, 10% sold directly to the customers from the center, 40% to the retailers, 15% to the wholesalers and 35% to the local markets. Details are shown in Table 3.91.

Table 3.91: Marketing of products by processing center in Sri Lanka

SDF supported crops	Percent crop product sold by market outlets			
	Store outlet	Retailer	wholesaler	Local market
Banana chips	30	45	10	15
Groundnut processed pack	40	30	10	20
Cassava chips	10	40	15	35
Others				
All	27	38	12	23

h) Production packages adopted

The impact survey of the livelihood enhancement project explored the adoption levels of different production practices promoted by the SDF assisted project into the project farmers. As observed during the field visit and data collection, the project farmers adopted crop production technologies including value addition and marketing strategies of their products in certain levels. The major technology packages adopted are: new high yielding variety, planting geometry to maintain desired plant population, staggered planting and harvesting of crops, production and marketing of chips from banana and cassava etc. The following table enlisted the production practices being adopted by the farmers under the targeted value chain in both of the research sites. Details are shown in Table 3.92.

Table 3.92: New production packages adopted by the project farmers

Banana value chain	Groundnut value chain	Cassava value chain
Planting geometry to maintain desired plant population	New high yielding variety	Planting geometry to maintain desired plant population
Application of irrigation technology	Marketing of roasted nuts	Application of irrigation
Staggered harvesting	Practicing screening, sorting and grading before marketing	Use of high yielding variety
Sucker selection and bamboo support	Staggered harvesting	Followed sorting and grading before marketing
Polythene cover over banana bunch	Use of good quality packaging for value addition of products	Production and marketing of cassava chips

i) Post-Harvest Loss Management

Post-harvest loss reduction of interventional crops was set as one of the important objective of the livelihood enhancement project, and considering the fact the impact study assessed the changes of post-harvest losses of banana, groundnut and cassava crops in both of the research sites of Sri Lanka. As reported by the project farmers the post-harvest loss of banana was higher than groundnut and cassava under both before and after project intervention. In case of banana the post-harvest lost reduced from 39% to 28.4% (by 10.6%) due to project activities (training and value addition), in groundnut it reduced from 11% to 3.4% (by 7.6%) and in cassava it reduced from 21% to 16% (by 5%). Irrespective of interventional crops the post-harvest loss reduced by 7.7% due to project intervention. The edible parts are matured fruits and tubers/roots for the crops under consideration, so the improved intercultural

management introduced by the project possibly plays an important role in reducing the damage of marketable products at or after harvest. Details are shown in Table 3.93.

Table 3.93: Post-harvest loss reduction occurred due to SDF project activity

Name of crop	Before project	After project	Difference (% Reduction)
	Post-harvest loss (%)	Post-harvest loss (%)	
Banana	39.0	28.4	-10.6
Groundnut	11.0	3.4	-7.6
Cassava	21.0	16.0	-5.0
All	23.7	15.9	-7.7

j) Employment enhancement

The following table presented the data on monthly engagement of laborers in the interventional crops (banana, groundnut and cassava) by the farmers under before and after project situation. After project intervention, the labor use per household in their crop production increased by 8.7% for banana, 66% for groundnut and 15% for cassava. Across over before or after project situation, among the crops banana consumed more laborers, followed by groundnut and cassava cultivation (Table 3.94). The farmers were encouraged to use higher numbers of laborers, possibly due to adopting new technologies promoted by the projects like chips making, sorting/grading, staggered harvesting, and leveling & packaging etc. Attending at agro-business training in the processing plant and exposure visit of households-heads to processing units also played vital role in employing higher numbers of laborers in their crop cultivation. Details are shown in the Table 3.94.

Table 3.94: Employment enhancement (#) by farmers/producers due to SDF project activity

Name of enterprise	Before project	After project	% Increase (after project)
	Number labor engaged/month/hh	Number labor engaged/month/hh	
Banana value chain	4.6	5.0	8.7
Groundnut value chain	3.0	5.0	66.7
Cassava value chain	3.3	3.8	15.0
All	3.6	4.6	30.1

hh = Household

k) Incremental price of crop products

The project activities like exposure visits, training on agro-businesses, use of sorting/grading of edible parts and practicing staggered harvesting of the crops to get higher market prices might be assisted the households to have higher incremental prices/sales for their marketable crop/finished products. The incremental prices/sales that the farmers received after project interventions is shown in the following Table 3.95. After project intervention, the farmers received higher incremental price for banana than the cassava or groundnut. Regardless of variation between crops, the changes in prices of marketable products due to project intervention and time factor ranged from 12% to 75% with an average of 46.8%. Details are shown in the following Table 3.95.

Table3.95: Value of incremental sales received by SDF supported farmers

Name of crop	Before project	After project	% Increase (After project)
	Market price/Kg (LKR)	Market price/Kg (LKR)	
Banana	96	380	74.7
Groundnut	350	400	12.5
Cassava	168	358	53.1
All	204.7	379.3	46.8

l) Accessibility to value added technology

The execution of SDF assisted livelihood enhancement project opened wider accessibility of the producer group members to different new value added products/technologies, modified systems of crop production and marketing for ensuring higher income. Out of many production technologies mentioned by the project staff and farmers, some are enlisted in the following Table 3.95. The table also compared the existing technologies available to the farmers during before starting the project with the availability of technologies to the farmers after project intervention. As reported farmers were happy to know the diversified use of banana and cassava especially producing of vacuum fried chips as alternative of popularly consumable potato chips. Another interesting issue for the farmers was sorting/grading and packaging of marketable value added products. They also mentioned about use of staggered harvesting banana to capture higher market price. Similar responses also received from the farmers of other research site for selling roasted spicy nuts of groundnut instead of selling dried pods in the market with comparatively low prices. Details of the technologies the farmers learned after engaging with the project activities are listed in the following Table 3.96.

Table 3.96: Accessibility of farmers to technology (post-harvest handling and value addition)

Name of crop	Before project	After project
	Name of post-harvest handling techniques	Name of value addition techniques
Banana value chain	i Harvesting and marketing of banana	i Production of vacuum fried banana chips ii Practicing sorting and grading before marketing iii Covering of banana bunch by perforated polythene bag
Groundnut value chain	ii Harvesting, drying and marketing	iv Marketing of fried spicy nuts aging and leveling of nuts for marketing
Cassava value chain	iii Harvesting and sale to the local markets	vi Production of cassava chips vii Sorting, grading and Packaging of value added products (chips)

m) Awareness development to the producers

To build up awareness among the producer groups of interventional crops through skill development training and exposure visits was set as an important objective of the SDF supported livelihood enhancement project assisted. Awareness were developed to the production and value addition

technology especially to the post-harvest handling and marketing of the value added products of interventional crops to ensure higher market prices. After project interventions, the producers of banana, groundnut and cassava in both the research sites (Anuraradhapura and Monaragala) have been developed their awareness to the following production issues:

i. Planting of appropriate banana sucker following proper planting geometry to accommodate more numbers of seedling in a particular land to ensure good vegetative growth, higher yields and income from per unit area of land
ii. Staggered planting by dividing the same plot in different pieces ensured staggered harvesting and good market prices
iii. Staggered harvesting banana, groundnut and cassava to capture higher market prices of the interventional crops
iv. To practice sorting and grading of marketable products of cultivated crops to ensure higher market price and income
v. Production of value added vacuum fried chips from banana and cassava and marketing to the super markets using contractual vendors
vi. Before marketing of value added products it should be wrapped under good quality attractive packaging to enhance market demand and ensure higher price.
vii. Use of polythene cover over the banana bunch improved the quality of fruits (color and size) and reduced insect damage. Very simple good technology to ensure higher market price
viii. Practicing integrated pest management (IPM) techniques to manage insect/pest damage instead of using traditional inorganic chemical to the fresh fruit (ready to eat) products like banana and tomato
ix. Use of support to the fruit bearing plants reduce post-harvest loss of banana, groundnut and cassava and ensure higher market price
x. Production and sale dried-spicy nuts instead of pods for groundnut to have higher price and income of the family
xi. The project arranged exposure visits for the producer group members to different Government and non-Government agencies and business firms that enhanced their interest to the diversified agricultural production and businesses

n) Opportunity

In Sri Lanka, the processing centers established under the direct supervision of the SDF project officials one at Anuraradhapura and another at Monaragala. The processing center at Anuraradhapura is being dealt with the value added products of banana and peanut value chain while the processing center at Monaragala shouldered responsibility of producing value added products (chips) of cassava. The centers have ample opportunities for producing bulk quantities of value added products from the interventional crops, which would ultimately enhance employment and improve livelihoods of the local people. Among

others some of the major opportunities of the SDF supported processing centers are stated in the following section.

i. The selected locations of both the processing centers at Anuraradhapura and Monaragala are in far remote places from the city centers where inhabitants are really poor farm households
ii. Though the sites are far but well accessible for the visitors or officials of the agricultural departments of the country
iii. The interventional crops banana and groundnut are popularly cultivated in the Anuraradhapura, where the center is producing banana chips and roasted spicy peanut. Cassava is also a popular crop in the site of Monaragala
iv. Ample supply of targeted crop products is available in the selected sites of the processing centers for value addition and marketing
v. Intensity of farm families in the locations are found enough to supply the raw crop products for further value addition and marketing
vi. The centers are found well equipped with necessary machineries to produce bulk quantity of targeted value added products (chips and processed nuts) of the interventional crops
vii. The centers are being operated in close collaboration with the Government agricultural extension agencies that made extra opportunities in developing good marketing linkage with super shops and local markets

o) Limitation

The impact study identifies some of the weaknesses of the processing centers during field visit and by making interaction with the producer group members and staff of the centers. The limitations of the center as observed during primary data collection are:

i. Due to natural disasters like heavy rainfall in some of the years, crop damage caused by wild life (elephant), and to desiring quality livelihoods, some of the potential farm households are being shifted to nearby townships
ii. As a result of population shifting the officials of agriculture departments needed to rearrange the producer groups
iii. Shortage of farm laborers during planting and harvesting seasons of the interventional crops increased production costs and as a result reduced gross margin
iv. Shortage of seeds/seedlings of good (HYV) variety of banana and groundnut at farm level
v. Low price of crop products in the local market during harvesting season the targeted crops
vi. Shortage of seeds/seedlings of good (HYV) variety of cassava at farm level
vii. Infestation of insect pest in banana reducing the yield of fuits/unit area

p) Major challenges for production and post-harvest processing of interventional crops

The endline survey emphasized on identifying some of the challenges faced by the producer groups of interventional crops. During physical interview the project farmers mentioned the troubles they faced during crop production and post-harvest handling. Some problems are natural and some are the technical hitches of development projects and human activities. The identified challenges mentioned by the respondent farmers are summarized below:

i) Cost of production of interventional costs are very high due to higher input costs (labor LKR 3000/day, Urea LKR 200, TSP LKR 180 and MP LKR 300)
ii) Excessive fluctuation of market prices of groundnut, banana and cassava. During production season fall of market price
iii) Transport costs are also very high, recent recession made difficulty to stand under only farming of agricultural crops
vi) Marketing of crop products in local and wholesale market add more costs due to hiring laborers for the purposes
vii) The research sites are comparatively far from the responsible agricultural offices that made difficulty in proper monitoring of field works
viii) No market demand of small sized banana and cassava that reduced the farm income
ix) Lacking of storage facilities for the crops products like banana that compelled the producers to sale their products in lower price during market glut
x) Marketing of value added products like banana and cassava chips and dried spicy nuts as well are the major problems mentioned by the members of the producer groups. The continuation of production of value added products of the interventional crops by the members of the producer group would largely be depended upon developing the market linkage to the large national companies. A system is to be designed and developed, so that these established processing centers with its producer groups would act as a production hubs, where representatives of large companies will place their production order and collect the finished products as per weekly schedule. Only then the project interventions regarding value addition of agricultural products would have positive chances to success otherwise it will be under dark like other development projects

q) Recommendation

Considering scope, opportunities and limitations of the processing centers and production of interventional crops, some of the recommendations are stated below:

i. Development of high yielding variety of banana, multiplication of seedlings and proper extension at the field level is to be promoted with utmost efforts
ii. Good/high yielding variety of groundnut with shorter duration is to be developed, multiplied and to be distributed to the farm level
iii. Improved production systems of banana intercropped with high value crops (vegetable, spices oilseeds etc.) is to be developed, so that banana cultivation can be commercially viable against cultivation of other seasonal field crops
iv. Proper control measures of insect pests are to be developed and adopted by the producers of interventional crops to ensure higher financial margin from the farming business
v. To assist producer group, the key staff of the processing centers is to take lead role in developing business linkage with the large food and beverage companies to upgrade the centers as rural business hub

vi. The linkage system is to be made in such a way that the women member will produce the value added products in the center for some of the large food/beverage companies, from where the company representatives will collect it in regular weekly basis

vii. The project staff at the center will do necessary role so that the producer group members can get credit from the local NGO or banking systems to enhance their production of crops under consideration

4. Overall Recommendation

Based on the primary as well as secondary information and the results obtained directly by interviewing the members of the producer groups in the project implemented countries, it may be concluded that the SDF supported project by and large achieved the major development objectives sets in the design. It attained to enhance the family income of the targeted farmers/households by 25% against 15% targeted and reduced post-harvest loss of crops especially fruits and vegetables by 15% against 10% targeted in the project design. Considering the successful completion of the project in 4 countries, some of the common recommendations may be accommodated:

- The SAC should take initiative to design a follow up project on the extension of moringa value chain in the SAARC countries considering the success in India. The project design should importance on developing good/high yielding variety of moringa with year round production capacity, multiplied and to be distributed to the farm level. Improved production systems of moringa by introducing intercropping with high value crops (vegetable, spices oilseeds etc.) is to be developed to make the moringa production systems more commercially viable against other seasonal field crops
- The linkage system in the processing centers is to be developed to accommodate more female member who will produce the value added products in the center for some of the large food/beverage companies, from where the company representatives will collect it in regular weekly basis
- The project staff at the center will provide necessary role so that the producer group members can get credit from the local NGO or banking systems to enhance their production of crops under consideration
- Linkage between producer groups with extension agencies to be made stronger through motivation and by arranging exchange visit
- Marketing of value added products of the interventional crops (like radish paste & pickles and moringa leaf powder and moringa tea etc.) by the members of the producer group largely depend upon the market linkage to the large national companies. A system is to be designed and developed, so that these established processing centers with its producer groups would act as a production hubs, where representatives of large companies will place their production order and collect the finished products as per weekly schedule. Only then the project interventions

regarding value addition of agricultural products would have positive chances to success otherwise it will be under dark like other development projects

Annex I

Questionnaire

Endline Impact Survey

Livelihood enhancement of the small farmers in SAARC region through small scale agro-business focusing on value chain development

1. Name of Respondent _____
2. Location: District _____
3. Age (yr) _____ Sex _____
4. Education level (school year) _____
5. Family size (No.) _____ Male _____ Female _____
6. Size of land holdings

   a) Total cultivated land (ac) _____
7. List of crops grown

Name of Crop	Before project		After project	
	Area (ac)	Earnings/year (R)	Area (ac)	Earnings/year (R)
Moringa				
Coconut				
Rice				
Banana				
Casaba				
Others (berry, vegetables etc.)				
Total				

8. Annual family income (Rupee) by sources

Source/item	Before project (Rupee)	After project (Rupee)
Livestock/poultry		
Fisheries		
Service		
Small business		
Daily wage		
Others (specify)		
Total		

9. Enhancement of capacity building (training) of producers/farmers by SDF project

Name of enterprise	Training subject	Duration	Time received
Moringa value chain	a.		
	b.		
	c.		
Coconut value chain	a.		
	b.		
	c.		

10. New production practices adopted by the SDF project farmers due to project activity

Name of enterprise	Production practices (planting geometry, irrigation, plant protection measures, staggered harvesting etc.)
Moringa value chain	a.
	b.
	c.
Coconut value chain	a.
	b.
	c.

11. Post-harvest loss reduction occurred due to SDF project activity

Name of crop	Before project	After project	Difference (reduction)
	Post-harvest loss (%)	Post-harvest loss (%)	
Moringa			
Coconut			
Banana			
Other fruits			
Vegetables			
Other crops			

12. Employment enhancement (#) by farmers/producers due to SDF project activity

Name of enterprise	Before project	After project	Difference
	Number labor engaged/month	Number labor engaged/month	
Moringa value chain			
Coconut value chain			
Total			

Note: i) Increased labor used by farmers by adopting new technologies (irrigation or pesticide use, marketing etc.)
ii) Employment due to agro-business training and in processing plant iii) Exposure visit to processing units

13. Value of incremental sales received by SDF supported farmers

Name of crop	Before project	After project	Difference
	Market price/Kg/fruit	Market price/Kg/fruit	
Moringa			
Coconut			
Banana			
Other fruits			
Vegetables			
Other crops			

14. Accessibility of SDF supported farmers to technology (post-harvest handling and value addition)

Name of crop	Before project	After project
	Name of post-harvest handling techniques	Name of value addition techniques
Moringa value chain	a.	
	b.	
	c.	
Coconut value chain	a.	
	b.	
	c.	

15. Value addition processing unit established in the locality due to project activity (#) _____
    a) Moringa value chain _____

b) Coconut value chain _____

16. Development of awareness to farmers for production/value addition technology

Name of crop	Before project		After project	
	Name of technology leaflets, booklets, other publications and attended training/workshop/seminar	Name of visiting processing plant, NGO offices, Business people, Govt. offices etc.	Collection of technology leaflets, booklets, other publications and attended training/workshop/seminar	Visit to the processing plant, NGO offices, Business people, Govt. offices etc.
Moringa value chain	a.			
	b.			
	c.			
Coconut value chain	a.			
	b.			
	c.			

17. Major challenges faced during production of interventional crops

Activity	Challenges faced for interventional crop products		
	Moringa	Coconut	Other crops
Seedling collection			
Plantation			
Irrigation			
Intercultural operations			
Marketing			
Market price			

18. Challenges faced during harvest and post-harvest processing of interventional crops

Activity	Challenges faced for interventional crop products		
	Moringa	Coconut	Other crops
Harvesting			
Post-harvest handling			
Primary processing			
Secondary processing			
Processed products (list)			
Post-harvest losses (Kg/number/others)			

19. Reason (s) for engaged in value addition
    a) Increased shelf life
    b) Increased income/kg/quantity of sales
    c) Improved capacity to participate at higher end of the value chain
    d) Improved knowledge and skill sets on processing and value addition
    e) Increased working days or opportunity for additional employment days
    f) others – please specify

20. Are you a member of group/NGO/Cooperatives/CVDP/others? If yes, identify the reasons:
    a) To improve bargaining capacity
    b) To get access to resource: inputs (seed, fertilizer, water, machines etc.)
    c) To get institutional linkage (credit, market etc.)
    d) To get help in aggregation of produce for marketing
    e) To get access to services of line departments and other entitlements (extension, schemes)
    f) Others- please elaborate

21. Suggestions for improvement of the value chain
    a) Moringa

    _____
    _____
    _____

    b) Coconut

    _____
    _____
    _____

Name of interviewer _____
Mobile # _____

Checklist for Qualitative Study

Focus Group Discussion (FGD)

Producer group (5-7 members)

1. Introduction and rapport building
2. Is your area famous for Moringa and Coconut production? Is it fruit growing area?
3. Is growing of Moringa and Coconut profitable? How you grade – highly/medium/low profitable
4. Do you have surplus production of Moringa/Coconut in your locality?
5. What is the average price of Moringa/kg and medium sized coconut/piece in local market
6. How you sell Moringa and coconut? doorstep trader/local market/wholesale market
7. What are the present use of Moringa and coconut other than eaten as raw fruit? Or as fruit for moringa
8. Is there any loss of fruits after harvest (pos-harvest loss) due to lack of customer or variable/different use in the locality?
9. Do you know anyone in the locality who produce processed food (powder/pest etc.) from fruits/crops like moring and coconut
10. Do you feel there will be market for moring and coconut value added products in your locality
11. Whether local entrepreneurs (small holder business people) can compete with large companies for marketing of value added products from moringa or coconut?
12. Do you know any small handy machine for producing value added products of moringa and coconut?
13. If anyone can have a van with small moringa powder producing machine, whether he/she can survive the small business by selling the products?

Key Informant Interviews (KII)

Social representative (School teacher, Imam etc.)

1. Introduction and rapport building
2. Do you have enough or excess production of Moringa or Coconut in your locality
3. Are you satisfied on the market price of above crops during production season?
4. How can we make higher benefit from our agricultural produces like moringa and coconut
5. Have you seen moring powder or virgin coconut oil seller in the market or in the premises of school, or church/temple/mosque?
6. Do you know anyone in your area who is selling moringa leaf powder or coconut virging oil in the market or in the school or church or temple premises?
7. Do you have enough supply of moringa or coconut for preparing value added products?
8. Do you feel you have enough post-harvest loss of moringa or coconut due to ample/excess supply during the production season in the area? Estimate the post-harvest loss of Moring _____, coconut _____ and other crop products _____.
9. Have seen any value added products making machine/device for moringa and coconut in the locality?
10. If anyone sell moringa or coconut value added products in the locality using a powered or manual van, it would promote small scale business or it would help to make value addition to the crop products

Annex II

Power point presentation on the Endline Survey Report

Date: 23 December 2024, SAARC, BARC Campus, Farm Gate, Dhaka

Endline study Report

Livelihood enhancement of the small farmers in SAARC region through small scale agro-business focusing on value chain development

Goal of SDF livelihood Enhancement project

- To develop socio-economic status of the poor and extreme poor in view of poverty reduction and livelihood development through systemic management of resources with the emphasis of women empowerment

Objective

- To identify and replicate successful food processing technologies and models for fruits and vegetables in South and South-East Asia Region
- To increase skill and capacity of smallholder farm families on value addition to the locally produces fruits and vegetables
- To increase income and improve livelihoods of the small holders

Implementing partners

- Rural Development Academy (RDA), Bangladesh
- Department of Agricultural Marketing and Cooperatives, Bhutan
- M.S. Swaminathan Research Foundation (MSSRF), Chennai, India
- Ministry of Agriculture and Animal Welfare, Maldives
- Department of Agriculture, Sri Lanka

Project Information

- Project starting date: 08 October 2018 (As per PFA singed)
- Project cost: 2.15 Million USD including IAs contribution (1.71 million USD from SDF and 0 .43 million in kind contribution from IAs)
- Project duration: 02 Years
- Participating Member Countries : 06 (Except Afghanistan and Nepal)

Agro-processing

- Generally transforms raw agricultural products into processed and value-added goods, like
  - food
  - beverages
  - textiles
  - Pharmaceuticals etc.
- It encompasses a range of activities like
  - Sorting
  - Grading
  - Packaging
  - preserving, and
  - transforming raw materials into finished products

The survey (impact Study)

- Approach and Methodology
  - Primary data collection
    - through questionnaire survey
    - FGD and KII
  - Secondary data collection
    - Document review
    - Personal consultation
- Reporting
  - Result and Resource Framework (R
  - Integrated (country)
  - Country wise

Sample Distribution by Locations

Sl #	Name of country	Name of site	# Project sample	# Non-project sample	Total number of sample
1	Bangladesh	Bogura	5	5	10
2		Gazipur	5	5	10
Sub-total			10	10	20
3	India	Kochin	5	5	10
4		Madhurai	5	5	10
Sub-total			10	10	20
5	Sri Lanka	Anuraradhapura	5	5	10
6		Monaragala	5	5	10
Sub-total			10	10	20
7	Bhutan	Chukha	5	5	10
8		Samtse	5	5	10
Sub-total			10	10	20
Total			**40**	**40**	**80**

Household Survey in Pictures

Household Survey in Pictures

Findings of the Study

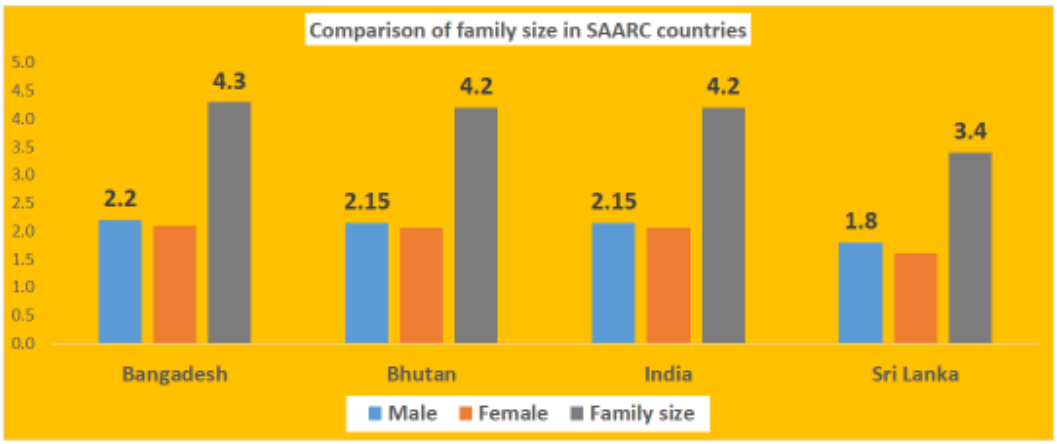
Establishment of Processing Center for Production of Value Added Products

Result and Resource Framework (RRF)

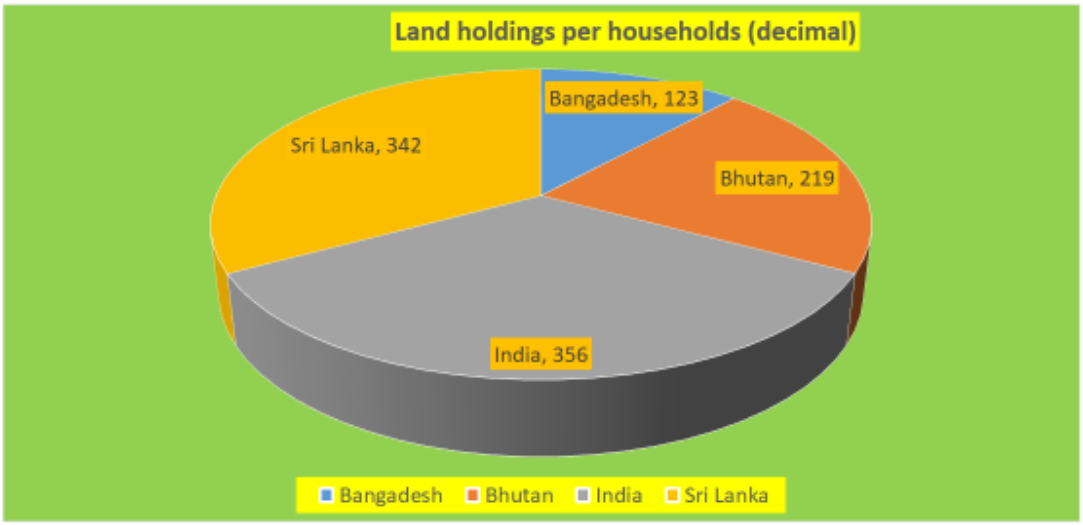
Outcome indicator	Target	Baseline/ control	Endline survey/ Impact study	Increase over control (%)
Enhancement of annual family income (USD)	15%	3215	4009	25
Post-harvest loss reduction (%)	10%	28	15	48
Employment generation/family/season (#)		6	10	54
Incremental sale by farmers (USD)		0.4715	0.6911	47
Access to improved technology (%)		3	10	215
Capacity building of farmers (%)			290	100

Comparison of project countries against key indicators

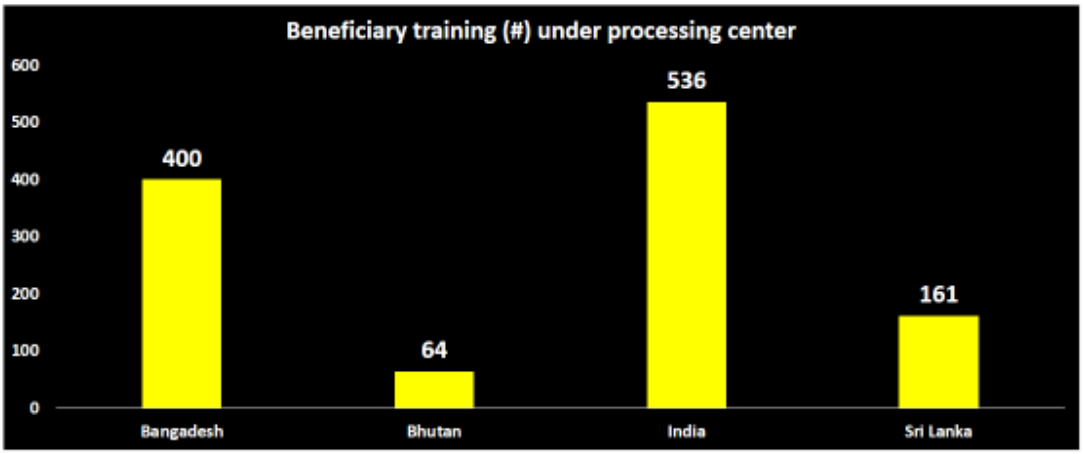
- **Family size of households**



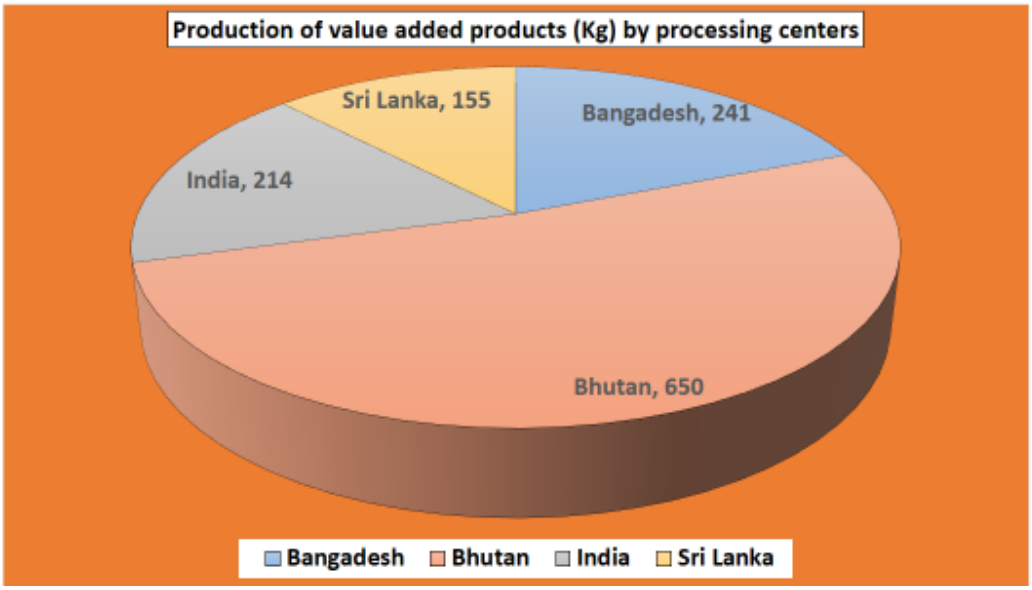
Land holdings per households



Skill development training of beneficiary

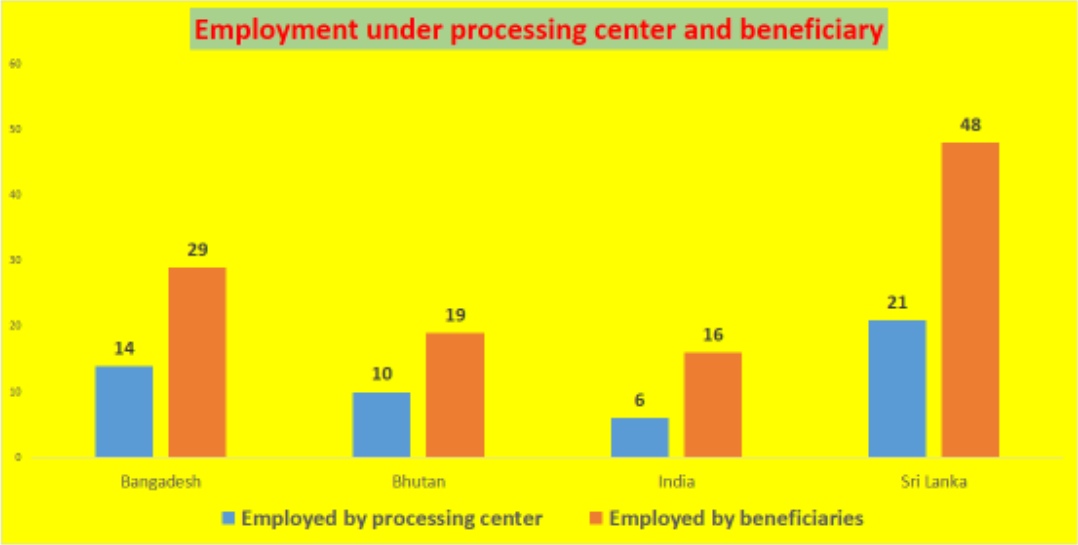


Production of value added products

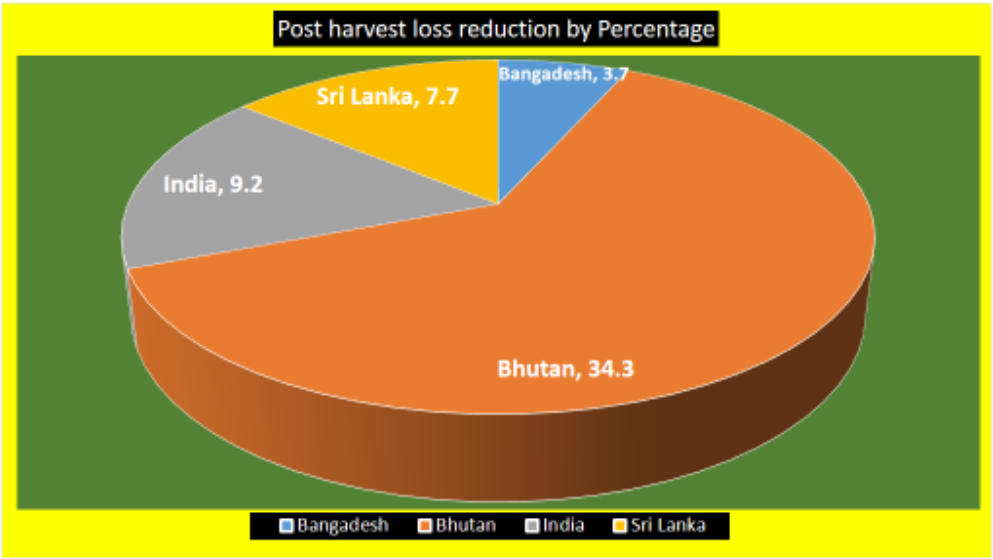


Value added products

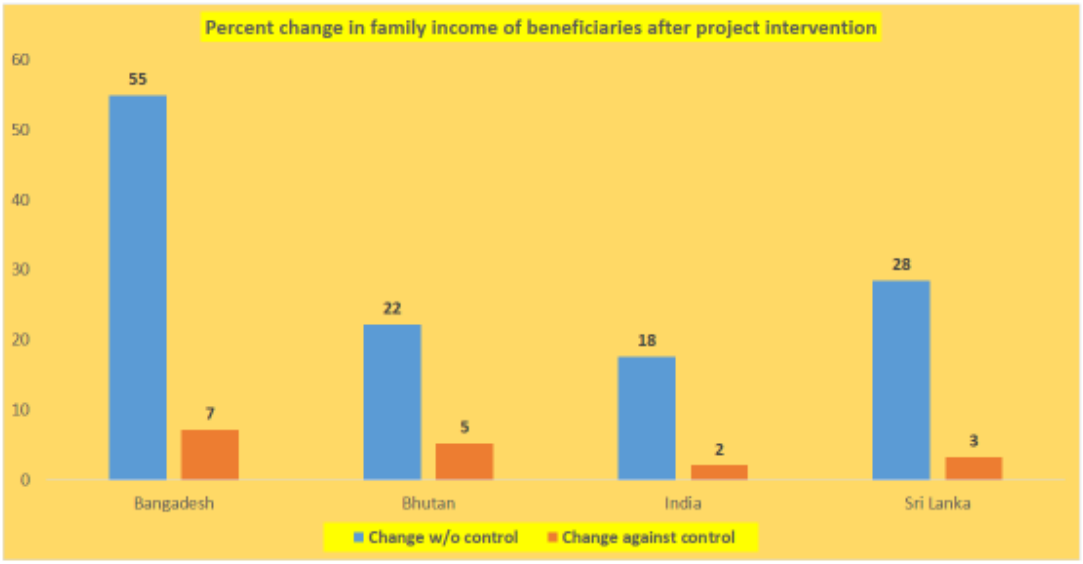
Employment generation



Post harvest Loss Reduction (%)



Change in family income



Bangladesh

Operation of processing center

Establishment year and start of operation	Fresh crop product assembled (kg/year)			Total	Value added finished products marketed (kg/year)			Total
	Banana	Jackfruit	Tomato		Banana chips	Jackfruit chips	Tomato sauce	
Year 1: 2021	100	160	40	300	25	30	40	95
Year 2: 2022	150	200	70	320	36	40	70	146
Total	250	360	110	620	61	70	110	241

New production packages adopted by Farmers

Banana value chain (Bogura)	Tomato value chain (Gazipur)
Planting of young sword sucker	Staggered planting of tomato
Use of support (bamboo) to the fruit bearing plant	Use support to the fruit bearing plant that ensured good harvest
IPM and cleaning of plantation area	Adopted appropriate grading and packaging to ensure higher market price
Covering of banana bunch by polythene to protect insect damage and to develop good color	Adopted recommended harvesting of fruit by keeping petiole
Practicing grading and packaging to ensure higher market price	Practiced staggered harvesting of crop to ensure good market price

Bhutan

Marketing of products by processing centers

SDF supported crops	Percent crop product sold by market outlets			
	Farm gate	Retailer	wholesaler	Local market
Moringa tea	10	20	20	50
Radish pickle	0	0	0	0
All	10	20	20	50

New business model adopted by Farmer

Radish pickle value chain	Moringa tea value chain
Collection, sorting, washing, grading and drying of primary products	Sorting, grading and washing of moringa leaves after harvest
Packaging and marketing of processed (value added) products	Drying of moringa leaves
Group marketing to ensure higher price	Moringa powder processing
Quality pickle production from fresh radish	Moringa tea bag processing
Quality production of radish paste for sale	Use of good quality packaging for value addition of products

Business turnover by interventional crops

Value chain (Location/site)	Business turnover/household/year					
	Product (Kg)		% Change	Earnings (Btn)		% Change
	Before	After		Before	After	
Radish value chain (Chhukha)	35.4	60.2	41	11328	24080	53
Moringa value chain (Samtse)	0	20.2	100	0	21890	100
Mean	35.4	40.2	70.6	11328	22985	76

India

Operation of processing center at Madhurai, India

Establishment year and start of operation	Fresh moringa leaf (Kg/year) assembled	Total	Value added Finished moringa products marketed (kg/year)	Total
Year 2: 2023	Leaf 1500	1500	Leaf powder: 110 Capsule: 01 Tablet: 01 Soup powder: 10 Rice mix: 10 and Dosa/idli mix: 5	137
Year 3: 2024	Leaf 800	800	Leaf powder: 55 Capsule: 0.5 Tablet: 0.5 Soup powder: 08 Rice mix and Dosa/idli mix: 08 Chappati/Atta mix: 05	77
Total	2300	2300		214

New production packages adopted by Farmer

Moringa value chain (Madhurai	Coconut value chain (Kochin)
Integrated pest management	Plant protection measures adopted
Timely and staggered harvesting	New high yielding varieties from ICAR-Kayamkulum distributed
Timely pruning	Timely irrigation
Grading and packaging	Adopted appropriate training/pruning
Improved intercultural operation including irrigation	Proper fertilization (twice a year)
Intercropping of vegetables	Harvesting of green coconut and coconut following proper timing and market
Pollination increased 25% – 30% yield	

Sri Lanka

Marketing of products by processing centers

SDF supported crops	Percent crop product sold by market outlets			
	Store outlet	Retailer	wholesaler	Local market
Banana chips	30	45	10	15
Peanut processed pack	40	30	10	20
Cassava chips	10	40	15	35
Others				
All	27	38	12	23

New production packages adopted by beneficiaries (Sri Lanka)

Banana value chain	Groundnut value chain	Cassava value chain
Planting geometry to maintain desired plant population	New high yielding variety	Planting geometry to maintain desired plant population
Application of irrigation technology	Marketing of roasted nuts	Application of irrigation
Staggered harvesting	Practicing screening, sorting and grading before marketing	Use of high yielding variety
Sucker selection and bamboo support	Staggered harvesting	Followed sorting and grading before marketing
Polythene cover over banana bunch	Use of good quality packaging for value addition of products	Production and marketing of cassava chips

SDF Project Area (Common to SAARC Countries

Opportunity of processing center

- RDA has good market outlets for marketing of chips and other value added products (one entrepreneur started marketing of chips)
- Sites (Anuraradhapura and Monaragala) are in far remote places
- Remote but well accessible
- The interventional crops: banana and groundnut are popularly cultivated in the Anuraradhapura and cassava Monaragala
- Supply of fresh crop products are ample
- Intensity of farm families are enough to supply the raw crop products
- The centers are well equipped with necessary machineries to produce bulk quantity of value added products (chips and processed nuts)

Limitations identified

- The center at Kapasia (BD) producing only tomato sauce without jackfruit or banana chips due to lack of vacuum fryer, though jackfruit is commercial fruit crop in the locality
- Shifting of potential farm households to nearby townships
- Re-arrangement of producer groups
- Shortage of farm laborers during planting and harvesting seasons
- Shortage of seeds/seedlings of good (HYV) variety
- Low price of crop products in the local market during harvesting season
- Moringa cultivation in Samtse is yet to be expanded to have a commercial crop
- Women producer group faced acute competition with large commercial companies for marketing of value added products

Present Challenges

- High cost of production (labor LKR 3000/day, Urea LKR 200, TSP LKR 180 and MP LKR 300)
- Excessive fluctuation of market prices of groundnut, banana and cassava
- Bogura farmers faced cracking of banana plants after fruit set that reduced yield
- The project sites are comparatively far from the responsible agricultural offices that made difficulty in proper monitoring of field works
- Harvesting (climbing) of coconut, and moringa is difficult
- No market demand of small sized banana and cassava
- Lacking of storage facilities for the crops products
- Lacking of market (super/wholesale market) linkage
- Climate change: uncertain tidal surge and extreme rainfall
- Fund shortage is a common challenge for women producers for enhancing business
- Cultivation of moringa may replace by maize or other high value seasonal crops due to introduce surface irrigation
- Market size of moringa tea in Bhutan is still limited; packaging materials for moringa tea is expensive

Recommendation based on observation

- Development and extension of HYV with desirable characters (dwarf coconut, year round moringa etc.)
- Introduction of proper inter or mixed cropping
- Practicing IPM (rugose spiraling white fly etc.)
- The key staff of the processing centers is to take lead role in developing business linkage with the large food and beverage companies
- Centers are to be developed as production hub for the large food/beverage companies, from where the company representatives will collect it in regular/weekly basis
- RDA may take lead role in developing business linkage with the large food and beverage companies to upgrade the centers as rural business hub
- The center at Kapasia, Gazipur could be equipped with vacuum fryers to produce jackfruit and banana chips instead of only tomato sauce; Bogura-center may also produce tomato sauce
- Linkage with research institutes to be established

Annex III

Project Results and Resources Framework (RRF) by countries (locations)

Table: Project Results and Resources Framework (RRF)

Outcome indicator	Baseline/control				
	Bangladesh	Bhutan	India	Sri Lanka	Mean
Enhancement of Family income (USD)	3157	1929	5583	2191	3215
Post-harvest loss reduction (%)	14.1	51.2	24.6	23.7	28
Employment generation/family/season (#)	9.3	7.4	4.3	3.6	6
Incremental sale/Kg of crop product (USD)	0.49915	0.42143	0.28313	0.68233	0.4715
Access to improved technology (#)	3	4	3	3	3
Capacity building of farmers (#)					

Table: Project Results and Resources Framework (RRF)

Outcome indicator	Endline survey/Impact study				
	Bangladesh	Bhutan	India	Sri Lanka	Mean
Enhancement of Family income (USD)	4431	2983	5427	3194.4	4009
Post-harvest loss reduction (%)	10.4	16.9	15.4	15.9	15
Employment generation/family/season (#)	12.9	14.4	6.1	4.6	10
Incremental sale/Kg of crop product (USD)	0.6744	0.4786	0.3470	1.2643	0.6911
Access to improved technology (#)	12	11	11	7	10
Capacity building of farmers (#)	400	64	536	161	1161

Table: Project Results and Resources Framework (RRF)

Outcome indicator	Increase over control (%)				
	Bangladesh	Bhutan	India	Sri Lanka	Mean
Enhancement of Family income (USD)	40	55	-3	46	25
Post-harvest loss reduction (%)	26	67	37	33	48
Employment generation/family/season (#)	39	95	42	28	54
Incremental sale/Kg of crop product (USD)	35	14	23	85	47
Access to improved technology (#)	300	175	267	133	215
Capacity building of farmers (#)					