# Five Year Plan

## Bangladesh Tea Research Institute

## FY2017-2021

বাংলাদেশ চা বোর্ড

বিটিআরআই

**Bangladesh Tea Research Institute**

**(An organ of Bangladesh Tea Board)**

**Srimangal, Moulvibazar**

**Ministry of Commerce**

**Government of the People's Republic of Bangladesh**

# Five Year Plan

## Bangladesh Tea Research Institute

*Advancing Bangladesh Tea*

# Contents


| | | Page |
|---|---|---|
| Contents | | i |
| List of Tables | | iii |
| List of Appendices | | iii |
| List of Acronyms | | iv |
| Summary | | vi |
| **Chapter 1.** | **INTRODUCTION** | 1 |
| **Chapter 2.** | **BANGLADESH TEA RESEARCH INSTITUTE AT A GLANCE** | 2 |
| 2. 1. | Background: Past and Present Scenario | 2 |
| 2.2. | Mandate | 3 |
| 2. 3. | Vision | 4 |
| 2. 4. | Missions | 4 |
| 2.5. | Objectives | 4 |
| 2.6. | Major Activities | 5 |
| 2.7. | Achievements | 6 |
| 2.8. | Strengths | 8 |
| **Chapter 3.** | **BTRI AND BANGLADESH TEA BOARD** | 9 |
| 3.1. | BTB: Background and Functions | 9 |
| **Chapter 4.** | **A BRIEF NOTE ON BANGLADESH TEA INDUSTRY** | 11 |
| 4.1. | History | 11 |
| 4.2. | Review of Past Strategic Plan for Tea Industry | 11 |
| 4.3. | BTRI: Past Policies and Contribution to Tea Industry | 12 |
| 4.4. | Tea Production and Contribution to National Economy | 14 |
| 4.5. | Vision-2021 and Road Map: Bangladesh Tea Industry | 14 |
| **Chapter 5.** | **BTRI: PROSPECTS, CURRENT AND FUTURE CHALLENGES** | 16 |
| 5.1. | Prospects | 16 |
| 5.2. | Current and Future Challenges | 16 |
| 5.2.1. | Addressing Climate Change Impacts | 17 |
| **Chapter 6.** | **RESEARCH & DEVELOPMENT GOAL & TARGETS OF BTRI IN THE FYP** | 18 |
| 6.1. | Strategic Goal | 18 |
| 6.2 | Objectives | 18 |
| 6.3. | Targets | 18 |
| 6.3.1. | Research | 18 |
| 6.3.2. | Development | 19 |
| 6.4. | SWOT Analysis | 19 |

| | | |
|---|---|---|
| **Chapter 7.** | **STRATEGIC PLAN FOR RESEARCH TO IMPLEMENT FYP** | 21 |
| 7.1. | Identification of the Problems | 21 |
| 7.2. | Research Targets | 21 |
| 7.2.1. | Division of Soil Science | 21 |
| 7.2.2. | Division of Botany | 25 |
| 7.2.3. | Division of Agronomy | 28 |
| 7.2.4. | Division of Plant Pathology | 29 |
| 7.2.5. | Division of Entomology | 33 |
| 7.2.6. | Division of Biochemistry | 38 |
| 7.2.7. | Division of Statistics & Economics | 41 |
| 7.2.8. | Technology Division | 44 |
| **Chapter 8.** | **STRATEGIC PLAN FOR DEVELOPMENT TO IMPLEMENT FYP** | 45 |
| 8.1. | Identification of the Problems | 45 |
| 8.2. | Development Targets | 45 |
| 8.2.1. | Human Resources Development | 45 |
| 8.2.2. | Strengthening of BTRI Main Station | 46 |
| 8.2.2.1. | Establishment of New Laboratories | 46 |
| 8.2.2.2. | Modernization of the BTRI Factory | 47 |
| 8.2.2.3. | Improvement of BTRI Library | 48 |
| 8.2.2.4. | Improvement of BTRI Infrastructures | 48 |
| 8.2.3. | Strengthening of the Experimental Farms | 49 |
| 8.2.3.1. | Development of BTRI Farm | 49 |
| 8.2.3.2. | Development of Bilashcherra Experimental Farm | 49 |
| 8.2.4. | Strengthening of BTRI Sub-stations | 50 |
| 8.2.4.1. | Development of Fatickcherri Sub-station | 51 |
| 8.2.4.2. | Development of Kaliti Sub-station | 51 |
| 8.2.4.3. | Development of Panchagarh Sub-station | 52 |
| 8.2.4.4. | Development of Bandarban Sub-station | 52 |
| 8.2.5. | Service Development | 53 |
| 8.2.6. | Access to ICT | 53 |
| 8.2.7. | Linkage Development | 54 |
| **Chapter 9.** | **RECOMMENDATIONS** | 55 |
| **Chapter 10.** | **CONCLUDING REMARKS** | 58 |
| | **Appendix I.** | 59 |
| | **Appendix II.** | 60 |

# List of Tables


| Table | Title | Page |
|---|---|---|
| 1 | Resources for Research and Development | 8 |
| 2 | Research Targets of BTRI in the FYP | 18 |
| 3 | Development Targets of BTRI in the FYP | 19 |
| 4 | Priority Targets for Human Resource Development (HRD) | 46 |
| 5 | Priority Development Targets for the Establishment of New Laboratories | 46 |
| 6 | Priority Development Targets for BTRI Factory | 47 |
| 7 | Priority Development Targets for BTRI Library | 48 |
| 8 | Priority Development Targets for BTRI Infrastructures | 48 |
| 9 | Priority Development Targets for BTRI Farm | 49 |
| 10 | Priority Development Targets for Bilashcherra Expt. Farm (BEF) | 49 |
| 11 | Priority Development Targets for Fatickcherri Sub-station | 51 |
| 12 | Priority Development Targets for Kaliti Sub-station | 51 |
| 13 | Priority Development Targets for Panchagarh Sub-station | 52 |
| 14 | Priority Development Targets for Bandarban Sub-station | 52 |
| 15 | Priority Targets for Service Development | 53 |
| 16 | Priority Development Targets for ICT | 53 |
| 17 | Priority Targets for Linkage Development | 54 |


# List of Appendices


| Appendix | Title | Page |
|---|---|---|
| I | Target of Expenditure for Research in the FYP | 59 |
| II | Target of Expenditure for Development in the FYP | 60 |

# List of Acronyms

| | |
|---|---|
| ADB | Asian Development Bank |
| Approx. | Approximate |
| B | Boron |
| BARC | Bangladesh Agricultural Research Council |
| BARI | Bangladesh Agricultural Research Institute |
| BEF | Bilashcherra Experimental Farm |
| BINA | Bangladesh Institute of Nuclear Agriculture |
| BJRI | Bangladesh Jute Research Institute |
| BRRI | Bangladesh Rice Research Institute |
| BTB | Bangladesh Tea Board |
| BTRI | Bangladesh Tea Research Institute |
| BTRP | Bangladesh Tea Rehabilitation Project |
| Cd | Cadmium |
| CEC | Cation Exchange Capacity |
| CFC | Common Fund for Commodities |
| COG | Cost of Grocery |
| Cr | Chromium |
| CTC | Crushing Tearing Curling |
| Cu | Copper |
| DFID | Department for International Development |
| DNA | Deoxyribonucleic Acid |
| EEC | European Economic Community |
| EPA | Environmental Protection Agency |
| EGCG | Epi-gallo Catechin Gallate |
| EU | European Union |
| FAO | Food and Agriculture Organization |
| Fe | Ferrum (Iron) |
| FYP | Five Year Plan |
| GABA | Gamma Amino Butyric Acid |
| GC-MS | Gas Chromatography-Mass Spectrophotometer |
| GDP | Gross Domestic Product |
| GIS | Geographic Information Systems |
| GL | Green Leaf |
| GMP | Good Manufacturing Practice |
| GOB | Government of Bangladesh |
| ha | Hectare |
| Hg | Mercury |
| HPLC | High Performance Liquid Chromatography |

| | |
|---|---|
| HRD | Human Resources Development |
| ICT | Information and Communication Technology |
| IPM | Integrated Pest Management |
| ISO | International Organization for Standardization |
| ISR | Induce Systemic Resistance |
| JICA | Japanese International Cooperation Agency |
| Kg | Kilogram |
| m | Meter |
| MIS | Management Information System |
| Mo | Molybdenum |
| MOU | Memorandum of Understanding |
| Mn | Manganese |
| MTC | Management Training Centre |
| MRL | Maximum Residue Limit |
| MSL | Mean Sea Level |
| NARS | National Agricultural Research System |
| NCP | Nucleus Clone Plot |
| NIB | National Institute of Biotechnology |
| No. | Number |
| ODA | Overseas Development Authority |
| Pb | Led |
| PCR | Polymerase Chain Reaction |
| PDU | Project Development Unit |
| PGPM | Plant Growth Promoting Microorganisms |
| PhD | Doctor of Philosophy |
| $P^H$ | Power Exponent of Hydrogen Ion |
| PPO | Polyphenol Oxidase |
| PTRS | Pakistan Tea Research Station |
| PVC | Polyvinyl Chloride |
| R&D | Research and Development |
| SCFE | Super Critical Fluid Extraction |
| SOA | Sulphate of Ammonium |
| SWOT | Strength, Weakness, Opportunities and Threats |
| UNDP | United Nations Development Program |
| VFBD | Vibro Fluid Bed Dryer |
| VP | Vegetative Propagation |
| WB | World Bank |
| WHO | World Health Organization |
| Wi-fi | Wireless Fidelity |
| Zn | Zinc |

# Summary

The history of Bangladesh tea industry is about 162 years of old with the baseline of 1854, when the commercial cultivation of tea was started at Malnicherra, Sylhet. Since then tea has developed itself as an agro-based and labor intensive industry in the country. Tea sector plays a significant role in the national economy through employment generation of the ethnic minorities' in greater Sylhet and Chittagong hill districts, poverty alleviation in rural areas especially in North Bengal, export earnings as well as import substitution. At present there are 166 tea estates and more than 746 small growers have devoted an area of 116,186.88 ha out of which 59,609 ha of land has been brought under tea cultivation till 2015. It provides direct employment to about 133,000 poor people, 50% of whom are women. Tea industry struggling with various adversities has increased per hectare yield from 639 kg/ha in 1970 to 1,270 kg/ha in 2015. At present, the internal consumers of the country are consuming about 98% of its produce resulting shrinkage of export market in abroad.

BTRI is engaged in conducting comprehensive, scientific, technological, economic researches and providing development services to the tea industry since her establishment in 1957. For advancing researches and development strategies, the Institute has formulated the "1$^{st}$ Five Year Plan" in accordance with the goal and objectives of 'Vision-2021' and 'Road Map: Bangladesh Tea Industry' declared by the Government of Bangladesh.

The FYP is composed of ten chapters focusing introductory and general discussions in brief on BTRI, BTB and the Bangladesh tea industry in Chapter 1-4, respectively. The prospects, current and future challenges of the Institute along with climate change impact on tea industry are illustrated in the Chapter 5. The Chapter 6 configured with strategic goal, research and development targets including SWOT analysis to achieve the targets listed in the FYP. The proposed research projects which will be expected to finish during the period submitted by the respective research divisions of the Institute are furnished in the Chapter 7. The development targets on HRD, laboratories, farm machineries, CTC factory, farms and Sub-stations, other services, ICT and linkage development, etc. are described in Chapter 8. A general recommendation on top priority targets, fund and resources flows and the possible impacts of the strategic plan drawing in the conclusion are summarized in the Chapter 9 and 10, respectively. The total approximate budget of expenditure for research and development to implement the FYP is estimated as 50 crores allotted in Appendix I & II.

# Chapter 1

# INTRODUCTION

The economic and social development of Bangladesh is highly dependent on the growth and development of the agricultural sector. Tea, being a leading cash crop of the country contributing significantly to the national economy. Currently, the tea industry is meeting the total domestic demand resulting shrinkage of export market in abroad.

The tea industry of Bangladesh stands on 166 tea estates and more than 746 small growers intensified mostly in greater Sylhet, Chittagong hill districts and North Bengal. About 59,609 hectares of land are brought under tea cultivation which produced 67.38 million Kg of made tea with the average production of 1,270 Kg in 2015.

The Government of Bangladesh has declared Vision-2021 highlighting a target for tea industry to produce 100 million Kg of tea by 2021 to meet internal demand, and restore and retain the global market. Linking with the Vision, the government has also formulated a 'Road Map: Bangladesh Tea Industry' with special emphasis on strengthening and capacity building of Bangladesh Tea Research Institute (BTRI).

BTRI is responsible for basic, strategic, applied and adaptive research on tea, as well as technology packaging and transfer. Research on tea has contributed significantly to increased productivity and quality. On the other hand, for upscaling the Institute, updating research, improving skills, advancing services, livelihood, infrastructure, etc. with changed environment development is mandatory. In view of these points, the Institute has felt the need to align her activities with a 'Strategic Goal', 'Objectives' and 'Targets' prioritizing Research and Development in the Five Year Plan (FYP). The FYP has been made on the basis of SWOT (Strength, Weakness, Opportunities and Threats) analysis. This Strategic Plan outlines the current budget and resource flows as well as capacity development which influences the performance of the Institute.

BTRI might able to implement the "1$^{st}$ Five Year Plan" through collaborative linkage especially with Bangladesh Tea Board, and other national and international research organizations, planters, tea laborers and consumers. The implementation of 'Five Year Plan' will strengthen the Institute and ultimately the tea industry to uphold the national interest.

# Chapter 2

# BANGLADESH TEA RESEARCH INSTITUTE AT A GLANCE

## 2.1. Background: Past and Present Scenario

Our tea is an extension of North East Indian tea. Before the partition of British India, scientific support on tea culture for this region use to come from Tocklai Experimental Station, Assam, and India. The availability of proven technology for the tea industry immediately after partition of India in 1947 was very limited. To solve the various problems of growing and manufacturing of tea and to continue the inherited industry on sound scientific footing, the then Pakistan felt the necessity of a separate research station of its own. Thus, the then Pakistan central Government (under the Ministry of Commerce in its 5$^{th}$ meeting) in 1952 adopted a resolution to create a separate tea research station for its own industry. Later, in 1957 Pakistan Tea Research Station (PTRS) was established at Srimangal. It started functioning in the same year from 28$^{th}$ February. During 1957-1958, the construction of the main laboratory building, Director's Bungalow and few staff quarters were completed. Functioning of the Institute started with the appointment of three Senior Scientific Officers-Chemist, Agronomist and plant pathologist with some skeletal staffs during the latter part of 1958. After the liberation, the research station was raised to the status of an institute naming as Bangladesh Tea Research Institute (BTRI) in 1973. Now BTRI is one of the 12 National Agricultural Research System (NARS) Institutes of Bangladesh.

The Institute is situated about 3.2 Km away from Srimangal town centre and about 24.3 m above the Mean Sea Level (MSL). The institute has four sub-stations viz. Fatickcherri (Chittagong), Kaliti (Moulvibazar), Panchagarh and Bandarban.

There are three major research Departments, which encompass six research disciplines, named as Divisions. These Departments are: Department of Chemistry comprising Soil Science and Biochemistry Divisions; Department of Crop Production with Botany and Agronomy Divisions and Department of Pest Management with Entomology and Plant Pathology Divisions. There are two more research divisions' namely-Tea Technology and Statistics-Economics Divisions. Thus there are all in all eight research divisions. Discipline-wise various research programmes are run by these divisions with a meagre number of scientists. Besides, the institute has collaborative research projects with other research

institutes and Universities. Suitable collaborative research initiative by Universities on tea is always welcome and encouraged by the Institute.

Director is the technical and administrative head of the Institute. Chief or Principal Scientific Officers who are the heads of Research Departments or Divisions respectively help the Director in formulating and executing the research programmes of the Institute and in running the advisory service to the tea estates.

The technical know-hows and innovations are regularly disseminated through institute's publications like-Tea Journal of Bangladesh, Annual Report, Circulars, Memoranda, Pamphlets etc. relating to different aspects of tea culture. Annual Course for the managerial staffs, deployment of resource subject-experts in Post Graduate Diploma Course at MTC, BTB, Workshops, Seminars and 'Group Tea Tasting Sessions' are regularly held at different times of the year.

BTRI is a scientific organization of the Bangladesh Tea Board under the Ministry of Commerce. The research programmes of the Institute are mostly adaptive and field oriented in order to meet the current need of the industry.

Although BTRI has research responsibility, its mandate requires that it provides advisory service to planters also. It accomplishes this through direct scientists-to-planter contact, often through participatory manner. A large portion of BTRI resources is devoted to this important linkage.

**2.2. Mandate**

The institute does not have any defined official mandate mentioned anywhere so far. However, the theme spelled out in a meeting of the then Pakistan Tea Board has been the guiding principle for the functioning of the institute which is often quoted as "Mandate" as spelled out in a 1952 meeting mentioned earlier. With the progress of time and demand of the current millennium setting up, a philosophical or contextual framework in order to have guidelines on broad statement of policies governing the diversity of research activities and keeping conformity with other similar national and international Institutions has been revised to as- Mandate :

- Conducting research-strategic and fundamental in all aspects and conditions of tea or generating basic knowledge and evolving environmentally sound technologies, tea clones or varieties for raising sustained productivity, production and processing.
- Collecting, evaluating, conserving and exchanging gene resources of tea.
- Manpower development by assisting, guiding and supporting institutions devoted to academic pursuits of teaching, research and of extension of tea and allied disciplines.
- Promoting extension service including adaptive trials, on-farm research, extension research, training, demonstrations and communication of latest technologies.
- Building strong scientific relations and linkage with national and international agencies for strengthening research and development efforts.
- Developing information and communication mechanisms including library and documentation, publications, internet network, MIS and GIS for national and international interactions national planning and policy making.

**2.3. Vision**

- To make Bangladesh Tea a reputed and preferred world standard.

**2.4. Mission**

- Assist the tea industry by appropriate research and technology to produce and supply high quality and safe tea for all the domestic consumers and also restore the traditional tea markets in aboard.

**2.5. Objectives**

- To increase yield and improve quality of Bangladesh tea through research.
- To transfer proven and adaptive newly innovated technologies to the tea industry.
- To render advisory service to the tea industry.

**2.6. Major Activities**

- Evolving high yielding and quality clones of tea.
- Development of bi-and poly-clonal seed stocks for seed orchards (Seedbaries).
- Conservation of gene resources of tea.
- Rising and supply of fresh and rooted cuttings of improved varieties to tea estates.
- Identification of quality deteriorating factors of made tea during processing and market networking systems.
- Quality Evaluation on chemical compositions of processed/unprocessed tea.
- Quality Standardization and specification of Bangladesh tea in the global market.
- Formulation of fertilizer, pesticide and irrigation policy for tea and ancillary crops.
- Rehabilitation of soil, soil-fertilizer relationship analysis and understanding.
- Adoption of appropriate methodology in improving the soil condition in existing proposed and rehabilitated tea areas.
- Standardization of cultural practices like: planting, spacing, pruning, plucking, mulching, planting shade trees and green crops, grafting, etc.
- Management and control of various insects, mites and nematode; diseases, disorders and weeds of tea and ancillary crops.
- Pest surveillance and monitoring.
- Improvement and Investigation into the tea processing unit for quality tea.
- Possibility of multiplication of tea through micro-propagation.
- Introduction of suitable economic plants under crop diversification programme.
- Regular advisory services to the tea estates.
- Economic study of tea cultivation
- Environmental factors and their influences on tea industry.

Sub-Stations Activities:

- Demonstration of zonal field experiments.
- Multiplication of improved planting materials and distribution.
- Collection of Zonal information and arrangement of trainings/Workshops, etc.
- Provide services to the surrounding tea estates and small growers.

## 2.7. Achievements

Achievements of high productivity and quality-excellence of Bangladesh tea are the moto of this institute. Since its establishment, BTRI has, to its credit many outstanding contributions to the industry. However, some achievements of this institute are listed below:

**Varietal Improvement (Tea Breeding)**

- Twenty clones of high yield and quality evolved and released.
- Five hybrid tea seed of biclonal and polyclonal stocks developed.
- General seed stocks re-evaluated and ten good seed orchards registered.
- A rich Gene bank being established for germplasm conservation.

**V.P. Nursery Techniques**

- Standardized vegetative propagation (VP) techniques for tea.
- Nucleus clone plot establishment and management determined.

**Tea Soil Management**

- Fertilizer policy for mature and young tea updated on yield basis
- Management of soil properties viz. texture, structure, pH, nutrients, etc. established.
- Critical values of nutrients in tea soil determined.
- Replacement of S.O.A. by urea as a cheap nitrogenous fertilizer.
- Rock phosphate as economy fertilizer substitute for other phosphatic fertilizers.
- Soil rehabilitation methods recommended.
- Proper soil mapping initiated.
- Possible new areas surveyed.

**Agronomic Practices**

- Pruning cycle for optimum crop production determined.
- Crop harvesting methods to optimise yield and quality determined.
- Ideal plant population, planting methods, pre and post-planting practice determined.
- Grafting method for rapid mother bush establishment determined.

**Pest Management**

- Tea diseases, disorders, different weed species, insects-mites-nematodes in the tea growing regions surveyed and identified, their management strategies ascertained.
- Bio-ecology of major pests studied.
- Biotic potential for three major pests determined.
- Crop loss assessment for four major pests assessed.
- Integrated pest management method optimized and decision analysis made.
- Resistant/Susceptible agro types of tea to termite & *Helopeltis* pest identified.
- Few bio-control agents identified and predatory efficiency determined.
- Few plant origin Bio-pesticides evaluated.
- Standardized pesticides used in tea.
- Compatibility of pesticides and fertilizers determined
- Appropriate spraying technique and schedule determined.
- Awareness on MRL of pesticides created.
- Safe harvest interval determined.

**Biochemistry**

- Correlation between theaflavin level and temperature during processing established.
- A soft drink "Cha-Cola" from tea developed and patented.

**Tea Processing**

- Performance of different preconditioning methods for CTC processing determined.

**Statistics & Economics**

- Annual crop forecasting method determined.
- Production cost of tea analysed.
- Economic size of a tea estate determined.
- Development of the tea industry during pre and post liberation period addressed.
- Break-even yield of Bangladesh tea estimated.

### 2.8. Strengths

For successful completion of the divisional researches and delivering developmental services to the tea industry, the following resources those listed in the table are considered as strengths of the Institute.

Table 1. Resources for Research and Development

| Serial No. | Resources | Description | | Remarks |
|---|---|---|---|---|
| 1 | Manpower | Scientific Personnel | Total=36 | Distributed in BTRI main station, BEF, regional Sub-stations, etc. |
| | | | Vacant=11 | |
| | | Other officers & staffs | Total=146 | |
| | | | Vacant=69 | |
| | | Tea laborers | Registered=380 | |
| | | | Non-registered= 62 | |
| 2 | Laboratories | The laboratories are accompanied by the respective research division | | Needs to strengthen |
| 3 | Germplasm | Located at BTRI main farm, BEF and regional Sub-stations | | Conserve for varietal dev. |
| 4 | Nursery & Seed Baries | Located at BTRI main station, BEF and regional Sub-stations | | Needs to strengthen |
| 5 | Experimental Farms | Bilashcherra Experimental Farm (BEF) and BTRI main farm are used by the research division for trial of a new experiment | | Development is urgent necessary |
| 6 | Sub-stations | Fatickcherri, Kaliti, Panchagarh and Bandarban Sub-stations | | Needs to strengthen |
| 7 | Sprinkler irrigation set | Small-scale sprinkler sets are using at BTRI main farm and BEF no set is there at Fatickcherri and Kaliti | | Needs to improve and increase |
| 8 | Mini Factory | Located at BTRI main campus | | Experimental purposes only |
| 9 | CTC Factory | A model factory located at BTRI campus | | Process GL of BEF & BTRI farm |
| 10 | Vehicles (Running) | Tractor with trolley | 2 Nos. | Using to render different services at BTRI, BEF and Sub-stations |
| | | Track | 1 No. | |
| | | Microbus & Jeep | 4 Nos. | |
| | | Car (New) | 1 No. | |
| | | Pick-up | 5 Nos. | |
| | | Motor Bike | 7 Nos. | |

# Chapter 3

# BTRI AND BANGLADESH TEA BOARD

### 3.1. BTB: Background and Functions

Tea board was established as per provision of Tea act. 1951. At present it is being governed as per provisions of the Tea Ordinance, 2016 (amendment of the Tea Ordinance, 1977 and Tea Ordinance, 1986).

It is "a body corporate" of the Government of the People's Republic of Bangladesh, which formed by the name of the Bangladesh Tea Board just after the War of Liberation in 1971. The board is responsible for overall development of tea industry, authority over marketing of tea, improvement of quality, research on tea quality and other related fields.

Bangladesh tea Board is a statutory body under the Ministry of Commerce. It has two directorates, namely Bangladesh Tea Research Institute (BTRI) and Project Development Unit (PDU) to carrying out researches and to supervise development works, respectively for the advancement of Bangladesh tea.

The functions of the Board as defined in the Tea Ordinance, 2016 are directed towards the development of the tea industry which includes the following:

- To take initiatives for overall development of Bangladesh tea industry.
- To take steps to increase tea production.
- To monitor import, regulate and control export and sell.
- To take measures to improve the quality of tea.
- To provide training on tea tasting.
- To undertake, assist or encourage scientific, technological and economic research and maintain and assist in the maintenance of demonstration farms and manufacturing stations for promotion of tea and other economic crops.
- To collects statistics from growers, manufacturers or dealers of tea or other persons on any matter relating to tea and tea industry.
- To undertake welfare measures for tea garden laborers and employees.
- To establish new tea gardens.
- To take measures for proper utilization of the land available in the tea gardens in excess of the area under tea cultivation.

- To promote cooperatives activities among the smallholding tea growers.
- To arrange training for the personnel working under the board.
- Others.

Bangladesh Tea Research Institute (BTRI) is working in cooperation with Bangladesh Tea Board by conducting researches, providing training for the tea personnel (Manager, Assistant Managers and small growers), supplying qualitative planting materials to the tea estates, assisting advisory services, publishing journals, circulars, leaflets; arranging seminars and workshops, playing role in implementing development projects, etc. for up scaling the tea industry.

# Chapter 4

# A BRIEF NOTE ON BANGLADESH TEA INDUSTRY

## 4.1. History

Historically, Bengal was the terminus of the Tea Horse Road connecting the subcontinent with China's early tea-growing regions in Yunnan. Atisa is regarded as one of the earliest Bengali drinkers of tea. Black tea cultivation was introduced in Bengal during the British Empire. European traders established the first subcontinental tea gardens in the port city of Chittagong in 1840, when plantations were set up beside the Chittagong Club using Chinese tea plants from the Calcutta Botanical Garden. The first home-grown tea was made and tasted near the Karnaphuli River in Chittagong in 1843. Commercial cultivation of tea began in the Mulnicherra Estate in Sylhet in 1854. The Surma River Valley in the Sylhet region emerged as the centre of tea cultivation in Eastern Bengal. Plantations also flourished in Lower Tippera (modern Comilla) and North Bengal of Karatoya Valley.

Tea was a major export of British Bengal. The Assam Bengal Railway served as a lifeline for the industry, transporting tea from growers in the Surma and Brahmaputra Valleys to exporters in the Port of Chittagong. The Chittagong Tea Auction was established in 1949 by British and Australian traders. British companies such as James Finlay and Duncan Brothers once dominated the industry. The Ispahani family also became a highly prominent player in the industry.

## 4.2. Review of Past strategic Plan for Tea Industry

During the war of liberation in 1971, Bangladesh tea industry was severely damaged since most of the tea estates are on the international boundary between Bangladesh and India. As the industry suffered a serious set-back after the liberation war, from 1972-1974, the then the government headed by Bangabandhu Sheikh Mujibur Rahman had collected 30 lakh Indian Rupees from Industrial Bank of India at low interest rate to renovate the factories, and also had provided subsidies on fertilizers to recover the tea industry. After that, a number of studies were carried out to find out the ways and means to rehabilitate and rejuvenate the war torn tea industry by various national and international committees and missions. According to the recommendation, the then the Govt. of Bangladesh took a massive development program in the name of Bangladesh Tea Rehabilitation Project (BTRP)

with the financial and technical assistance from British ODA, EEC & GOB. British Govt. provided 27 million Pound Sterling while EEC provided 6.6 million Pounds to rehabilitate the industry. The overseas fund was made available as grant to Bangladesh Govt. but loan to the end users in most cases except water supply and medical equipment to tea estates. The BTRP was a 12 year rehabilitation project from 1980 to 1992. The objectives of BTRP were to increase per hectare yield of tea by intensive cultivation practices, replanting of old tea area, replacement planting of uneconomic tea, and also extension of some tea areas, reduce the cost of production, improve the quality of made tea, intensive land use by afforestation, crop diversification, manpower development through imparting training, their efficiency and output, self and hygienic sanitation and Medicare, etc. Besides overseas assistance from ODA and EEC under BTRP Bangladesh tea sector received an amount of Tk. 320.00 million including interest out of 6.145 million Pounds as grant from EU's COMPLEX (Compensation for export loss) fund with the objectives of upgrading road and bridges, expansion of irrigation facilities, preventive health care for estate's labors, sales promotion and marketing of tea, integrated education facilities, implementing monitoring cell, audit and implementation, etc.

However, the government has begun to promote small-scale tea growers in the Chittagong Hill Tracts and Northern Bangladesh under the projects titled as "Small Holding Tea Cultivation in Chittagong Hill Tracts" and "Small Holding Tea Cultivation in Northern Bangladesh" to create more employment opportunity for the ethnic minorities and marginal tea growers as well as to meet the challenges of rising domestic demands for quality tea. A project under Common Fund for Commodities (CFC) was taken by BTB in 2013 to promote small tea growers particularly in Bandarban district and Panchagarh has already been over in June, 2015.

### 4.3. BTRI: Past Policies and Contributions to Tea Industry

Research and Development is a continuous process. So, for continuous development of an industry research is mandatory to way out the process of how to develop. In view of this point, BTRI has been trying to help the tea industry since its establishment in 1957. BTRI had taken a number of researches and development projects inflowing national and international funds to solve the problems faced by the industry. That is why, the Institute has been able to release eighteen outstanding clones, establishment of seed baries and gene bank for further improvement of planting materials, establishment of mini factories

and CTC tea processing unit, plant protection techniques and pesticides standardization for tea, fertilizers recommendation, development of 'cha cola', improvement of pruning schedule, nursery and field management techniques, etc.

During the period of 1964-1985, the Institute had supplied 1,077,029 rooted and 11,727,566 fresh cuttings of improved plant materials to different tea estates which ensured the modest drive for replacement and rejuvenation of morbid tea population in Bangladesh. In 1965, the Institute established an experimental farm at Bilashcherra with a grant area of 228.36 ha to conduct field trials on tea and ancillary crops. Besides this, two Sub-stations- one at Fatickcherri for Chittagong Circle and another at Kaliti for Lungla and Juri Circles were established in 1969 and 1972, respectively with the object of taking up advisory work, conduct experiments under different agro-climatic condition, implementing research findings of BTRI and propagation of planting materials for the tea estates. Further the BTRI had been managing two commercial tea estates namely Dauracherra tea estate since 1977 and New Samanbagh tea estate since July, 1984 to develop them as model gardens. The institute possesses an Experimental Tea Factory which is in operation since 1978 to innovate modern manufacturing process. In 1981, the Institute started organizing valley-group tea tasting sessions and factory visits in collaboration with ODA Marketing Advisor to survive in the competitive world market for quality tea. To intensify this activity, a new tea tasting room was established at the Institute and since last August, 1986 monthly open day sessions on tea tasting is being organized.

As for technology transfer, the Institute has been able to develop an effective communication linkage among planters and researchers through advisory and extension services. Since 1963, 'Annual Short Course' on tea husbandry for the planters and management personnel is in practice. Moreover, a regular field-oriented course for field-staffs of different valley circles of Sylhet and Chittagong is being arranged since 1973.

A collaborative program of 'Study Tour' to different tea growing countries of the world is being continued for the researchers since 1979 to gain experience and exchange views on tea husbandry. Seminar and workshops are being convened periodically to disseminate the expertise views and experience among the planters and personnel of the tea estates.

In 1982, a co-ordinated project jointly initiated with BARC, Dhaka on the management of problem tea soils of Bangladesh. In 2003, A Pesticide Residue Analytical Laboratory was

inaugurated at BTRI under the financial support of EU's COMPLEX fund to determine the MRL values of different pesticides present in made tea.

### 4.4. Tea Production Scenario and Contribution to National Economy

During the partition in 1947, Bangladesh owned 103 tea estates, covering 28,734 ha of tea plantation with annual production of 18.36 million Kg of made tea. With the advancement of time, the industry had to struggle through manifold constraints to meet up the internal demand from the then West Pakistan that lead to mandatory extension of 3% per year in 1961. For which the area of tea plantation in 1970 had increased to the extent of 42,637 ha by 150 tea estates with an increase of production of 31.38 million Kg yielding about 639 Kg per hectare. Now, Bangladesh tea is comprised of 166 tea estates and more than 746 small growers covering 12 districts viz. Maulvibazar, Habiganj, Sylhet, Chittagong, Rangamati, Bandarban, Brahmanbaria, Panchagarh, Lalmonirhat, Thakurgaon, Nilfamari and Dinajpur. Total land area for tea is 116,186.88 ha in which 66,052.35 ha is cultivable. About 59,609 ha of land has been brought under tea cultivation till 2015. Total tea production in 2015 was 67.38 million Kg with the annual production of 1,270 Kg. Tea sector contributes about 1% of the total GDP in Bangladesh. This sector occupies approximately 0.2 million people directly and indirectly which is about 4.4% of the country's total employment.

### 4.5. Vision-2021 and Road Map: Bangladesh Tea Industry

Few decades ago, Bangladesh tea was a consistent export earner and a big player in the global markets because of its low rate of internal consumption and high demand in the international markets. At present, the internal consumers of the country are consuming about 98% of its produce. Consequently, this abrupt increase in internal consumption (@ 3.23%) causes to decrease exportable surplus with a slow rate of production (@ 2%), which in turn causes to decline in export (@ 2.98%) of tea. According to the current growth rate (1.6% per year) of the population, by the end of 2021 the country's total population will reach to 180 million which will require 76 million Kg of made tea to meet the internal demand. But if the current trend of tea production continued, by the end of 2021 it will only be 70 million Kg. So, in the coming year the country will be treated as big importer of tea.

Recently, government has declared the "Vision-2021" and "Road Map: Bangladesh Tea Industry" to meet the domestic demand, restore and extend the export market by increasing the production of quality tea. The 'Vision-2021' has highlighted a target to

produce 100 million Kg of made tea by 2021 to meet internal demand and restore the global market of tea. Linking with the Vision, the govt. has also declared a Road Map mentioning short-term, mid-term and long-term action plan for overall development of Bangladesh tea industry with special emphasis on strengthening and capacity building of Bangladesh Tea Board, Bangladesh Tea Research Institute (BTRI) and Project Development Unit. The following action plans have been mentioned in the Road Map to strengthen the Institute:

- Strengthening of BTRI Sub-stations
- Transfer BTRI-developed clones, seeds and other technologies to the tea industry
- Increase the use of organic matters to improve soil health
- Development of clones and improved seeds by hybridization
- Application of IPM for controlling pests (insect, mite, nematode, diseases and weeds)
- Establishment of biotechnology laboratory (for tissue culture and genome analysis).
- Overall development for improving livelihood of the personnel and tea laborers of the institute.
- Others.

# Chapter 5

# BTRI: PROSPECTS, CURRENT AND FUTURE CHALLENGES

## 5.1. Prospects:

Productivity of tea in Bangladesh is low due to various reasons arising out of technical, financial and management problems. Effective research needs to be conducted with a view to raising productivity of our tea and improving its quality. A strategic research plan has to be formulated with comprehensive programs for all round development of the tea industry. Such a plan must cover the following research thrust areas:

- Utilization of biotechnology for the development of high yielding quality clones of special feature like drought tolerance, insect and disease resistance, etc.
- Bio-fertilizer to improve soil health
- Raising organic matter status of tea soils
- Irrigation & drought management to cope with climate change threats
- IPM components with particular emphasis on bio-control agents and bio-pesticides and pesticide residue in tea
- Toxigenic effects of pesticides on the components of tea ecosystem
- Modernization of tea manufacturing process
- Development of packaging material for safe-storage of made tea
- Mechanization in tea culture with special emphasis on plucking
- Product diversification and value addition in tea
- Factory Hygiene & Good Manufacturing Practices (GMP) in the tea processing unit.
- Application of ICT in tea management system
- Technique for efficient Energy source utilization
- Socio-economic study on tea industry
- R & D management
- GIS & environment study with special emphasis on climate change impacts

## 5.2. Current and Future Challenges

- Lack of modern scientific equipment and growing of lab Facilities
- Soil degradation, new emerging pests and diseases as a result of climate change
- Poor infra-structural and manpower facilities at sub-stations for extension services

- Lack of facilities towards mechanization to face the challenges of labor shortage
- Lack of scope of higher academic and professional training
- Limiting career building scope/promotion opportunities for potential scientists
- Lack of updated reference library facilities
- Updating of BTRI publications, its standard and dissemination to the users
- Exchange of scientific knowledge by personal visits, arrangement of seminar/workshop among tea growing countries
- Transport facilities for mobility of scientists/ experts to collect research data as well as provide essential advisory services to the industry
- Building linkage with national and international research organizations
- Lack of facilities to initiate researches on climate change impacts on Bangladesh tea

### 5.2.1. Addressing Climate Change Impacts

Occurrence of global warming that leads to climate change is now the much talked issue in the world. This is not only an issue of rising greenhouse gases in the atmosphere but also an issue of 'side effects' of warming. As a deltaic country, Bangladesh is facing the most devastating side effects of global warming in agriculture, fisheries, livestock, marine ecology and biodiversity, infrastructures, livelihood and food security as a whole. Tea, being an agro-biotic component is adversely influenced by extreme variation in temperature, erratic rainfall, high humidity and extreme solar radiation during summer results in severe pests' outbreak, heavy fogs during winter, drought, flash floods, landslide in hilly zones, unpredicted cyclones and tropical storms, frequent lighting, etc. All of which are likely to increase as a result of climate change-the ultimate consequence of global warming.

Studies in the short term relationship between weather parameters and tea yields in Bangladesh have been done in the past, but long-term effects of climate change on tea production has not been evaluated. So, research on sustainable productivity of tea by overcoming the side effects of warming and setting mitigation strategies with the support of financial institutions and from policy makers is urgent necessary to cope with the current and future threats to tea industry.

# Chapter 6

# RESEARCH & DEVELOPMENT GOAL AND TARGETS OF BTRI IN THE FYP

## 6.1. Strategic Goal

In relating with the "Vision-2021", "Road Map: Bangladesh Tea Industry", Vision-Missions-Objectives and Functions of Bangladesh Tea Board a correlated research and development goal is decided by the Institute in the Five Year Plan (FYP). The 'Goal' is-

- Making Vision-2021 a reality by accelerating researches and rendering development services to the tea industry.

## 6.2. Objectives

Bangladesh tea industry is facing some incomprehensible challenges since few decades. To overcome the current and future challenges, the Institute has formulated some strategic objectives to upscale the industry. The major objectives of the FYP are to:

- Improve research facilities at BTRI of various dimensions essential by the industry.
- Improve various development facilities relating with research environment.
- Strengthen BTRI farms & regional Sub-stations rendering quality services to industry.
- Make skillful Human Resources accelerating research and managements, and
- Develop research linkage and promote effective use of ICT in tea industry.

## 6.3. Targets

In achieving the 'Goal' and fulfilling the 'Objectives' of FYP, the following Targets are illustrated under the sector of Research and Development-the pillar of success.

### 6.3.1. Research

The researches of BTRI are performed by the respective division. Each division has the scope to conduct collaborative research with other division(s) to achieve the target. However, the target research areas for the advancement of tea industry are described in the table below:

Table 2. Research Targets of BTRI in the FYP

| Target No. | Targets | Division |
|---|---|---|
| 1 | Improvement of soil productivity and soil health | Soil science |
| 2 | Improvement of planting materials (cultivars, seed, etc.) by Conventional and biotechnological approaches | Botany |
| 3 | Improvement of agronomic techniques, and development of technologies to cope with climate change impacts | Agronomy |
| 4 | Improvement of IPM strategies against tea diseases, disorders and weeds; researches on pesticide toxicity & factory hygiene | Plant Pathology |
| 5 | Improvement of IPM strategies to fight against insects, mite and nematodes, detection of MRL of insecticides in tea | Entomology |
| 6 | Diversifying uses and value addition in tea for commercial purposes for the ultimate consumers | Biochemistry |
| 7 | Modernization of statistical database and economic analysis on BTRI technologies, tea industry, small growers and tea laborers | Statistics & Economics |
| 8 | Evaluation and improvement of packaging materials for CTC tea | Technology |

### 6.3.2. Development

The targets mentioned in the Research sector will achieve if the following development targets are taken under consideration for implementation of Five Year Plan.

Table 3. Development Targets of BTRI in the FYP

| Target No. | Targets |
|---|---|
| 1 | Human Resources Development (HRD) to increase knowledge and skills |
| 2 | Establishment & Strengthening of BTRI research laboratories for quality research |
| 3 | Modernization of tea processing factory (CTC) for the retention of quality |
| 4 | Development of the experimental farms (BTRI farm & BEF) to demonstrate trials |
| 5 | Strengthening of BTRI Sub-stations for regional field trials & rendering services |
| 6 | Improvement of all sorts of services for uplifting the Bangladesh tea industry |
| 7 | Improvement of access to ICT for all the employees for updating knowledge |
| 8 | Development of linkage with national and international research organizations |

### 6.4. SWOT Analysis

**Strengths**

- Long established research institute serving to the tea industries since 1957
- Recognized as a lead Tea Research Institution nationally and internationally
- Improved technologies available

- Qualified human resources in research, farms and office managements, etc.
- Capable of generating new ideas for tea industry
- Capable of disseminating technologies to the tea industry
- Capable of formulating and implementing Research and Development projects

**Weaknesses**

- Inadequate and old or obsolete equipment
- Inadequate research laboratories with modern facilities
- Inadequate ICT facilities
- Lack of skilled human resources
- Lack of laboratories and service delivery facilities at the sub-stations
- Very old infrastructure especially at experimental farms (BTRI farm and BEF)
- Commercialization of technologies developed
- Lack of linkage with national and international research organizations

**Opportunities**

- Strengthening research divisions with modern equipment
- Establishment of new research laboratories with modern facilities
- Development of high yielding variety with special feature by biotechnological means
- Research on climate change impacts on tea industry
- Improvement of skills of the employees by trainings
- Strengthening sub-stations with research laboratories
- Modernization of tea processing factories and mechanization opportunity
- Diversification and value addition in tea
- Improving infrastructure of BTRI farm, BEF and Sub-stations
- Engagement of scientists in short term consultancies and contract research
- Establishing partnerships and linkages with national and international organizations
- Access to Information and Communication Technology
- Establish partnerships and linkages for funding through project proposals

**Threats**

- Unavoidable climate change impacts on tea industry
- Soil degradation in tea gardens resulting poor production and re-establishment
- New emerging pests and diseases with changed environment
- Shortage of natural water reservoirs and poor irrigation facilities
- Labor shortage in tea industry

# Chapter 7

# STRATEGIC PLAN FOR RESEARCH TO IMPLEMENT FYP

### 7.1. Identification of the Problems

In relation to the Research Targets addressed in the Chapter 6, Article 6.2.1., the following problems are identified and different experiments in multiple directions are taken by the respective research division to achieve the targets of FYP. The problems are:

- Nutritionally tea soils are gradually exhausting; information on status of micronutrients and heavy metals is unavailable.
- Stress resistance clones are unavailable, and exploitation of Biotechnological approaches for the development of tea cultivar is not started.
- Research on mitigation of drought and mechanization in tea are not initiated.
- Development of disease-resistant tea cultivar, researches on fungicide residue in tea, toxic limit of herbicides in tea soils & pond water and factory hygiene are not done.
- Cost effective, eco-friendly, sustainable technologies for managing insect-mite-nematode and information on dissipation pattern of pesticides are not available.
- Diversifying uses of tea for commercial purposes, detection of heavy metals in tea, and extraction of secondary metabolites from tea are not initiated.
- Statistical databases on the status of BTRI technologies, tea industry as well as socioeconomic profiles of small tea growers and tea laborers are not updated.
- Evaluation of packaging materials for the retention of made tea quality is not done.

### 7.2. Research Targets

The targets which will be achieved in the FYP have already been mentioned in the Article 6.2.1. The total approximate budget of expenditure for research is presented in the Appendix I.

## 7.2.1. Division of Soil Science

This division has proposed seven research projects under three programme areas viz. Nutrient Management, Arsenic and Heavy Metasl, and Soil Fertility Improvement of tea to implement FYP. Detailed information regarding these projects is described below:

## Programme Area: Nutrient Management

| **Title 1:** | **Status of Micronutrients (B, Mo, Zn, Mn, Fe & Cu) in Some Selected Tea Soils and Its Effect on the Growth and Yield of Young Tea** |
|---|---|
| Objectives: | ➢ To estimate the status of micronutrients in tea soils.<br>➢ To determine the effect of micronutrients on the growth and yield of young tea. |
| Justification: | Micronutrients require very minute quantity for plant. Comprehensive study on micronutrients status in tea soils of different agro-ecological zones is not done yet though these elements are essential and play an important role for the growth and development, yield, and quality of tea. This experiment will set to estimate the present status of micronutrients in tea soils and their effect on growth and yield of young tea. |
| Expected Outputs: | Status of micronutrients in tea soils and their role on the growth and yield of young tea will be determined. |
| Budget: | 5 Lakhs (approx.) |

| **Title 2:** | **Determination of Critical Values of Nutrients in Tea Soil and Plant Leaf** |
|---|---|
| Objectives: | ➢ To determine the critical values of essential elements in soil and plant leaf required for optimum tea cultivation and production. |
| Justification: | Critical values of nutrients in tea soil and plant leaf are very important for proper fertilizer management. Shortage of a particular nutrient element in tea soils impacted largely on crop yield. As the fertility status of soil is gradually exhausting day by day, so the critical values of essential elements in tea soil as well as tea plant leaves are urgent necessary to estimate and accordingly recommend a standard fertilizer dose to the tea estates. |
| Expected Outputs: | Critical values of essential nutrients in tea soils and plant leaves will be determined which will play an imperative role in proper fertilizer management in tea. |
| Budget: | 10 Lakhs (approx.) |

## Programme Area: Arsenic and Heavy Metal

| **Title 3:** | **Present Status of Arsenic (As) and other Heavy Metals (Pb, Cd, Hg, Cr) in Tea Soils, Green Leaves and Made Tea in Bangladesh** |
|---|---|
| Objectives: | ➢ To determine the content of arsenic and other heavy metals in tea soils, green leaves and made tea. |

| | |
|---|---|
| Justification: | Tea is rich in many trace inorganic elements. In addition to many essential elements required for human health, some toxic elements may also be present in tea leaves. This could be due to polluted soil, application of pesticides, fertilizers of industrial activities. There is often little information available about the safety of tea leaves and finished products with respect to heavy metal contamination. Due to the significant amount of tea consumed, it is important to know the toxic metal contents in tea. |
| Expected Outputs: | Status of arsenic and other heavy metals in tea soils, green leave and made tea will be determined. |
| Budget: | 15 Lakhs (approx.) |

**Programme Area: Soil Fertility Improvement**

**Title 4: Response of Dolomitic Lime and Its Effect on the Changes of Soil Properties and Yield of Mature Tea**

| | |
|---|---|
| Objectives: | ➢ To determine the optimum dose of dolomite for tea.<br>➢ To analyze the effect of dolomitic lime on soil properties and yield. |
| Justification: | The tea plant is perennial in nature and exists on the same land more than 60 years after planting. During this period, different inorganic pesticides and fertilizers are applied in tea garden which might influence soil physical, chemical and biological properties adversely. As a result, the complex soil body becomes less productive. Dolomitic lime may be a better option to bring back the soil fertility and productivity. |
| Expected Outputs: | Yield of mature tea as well as physico-chemical properties of tea soil will be improved. |
| Budget: | 5 Lakhs (approx.) |

**Title 5: Effect of Vermicompost on Soil Properties, Growth and Yield of Tea**

| | |
|---|---|
| Objectives: | ➢ To determine the optimum dose of vermicompost for tea.<br>➢ To analyze the effect of vermicompost on reducing the use of chemical fertilizer. |
| Justification: | Organic matter status in tea soils is around 1% which is quite unsatisfactory. Population and functions of soil microorganisms are gradually limiting due to overuse of inorganic fertilizers and pesticides. Application of vermicompost in tea garden may help to retain the soil properties in ideal condition. |
| Expected Outputs: | Yield of mature tea as well as physico-chemical properties of tea soil will be improved. |
| Budget: | 10 Lakhs (approx.) |

| **Title 6:** | **Studies on Physical Properties of Selected Tea Soils of Bangladesh** |
|---|---|
| Objectives: | ➢ To determine the physical properties of soil and its effect on the improvement of soil fertility. |
| Justification: | Physical properties mean texture, structure, bulk density, particle density, porosity, hydraulic conductivity, etc. of a soil. Soil physical properties greatly influence chemical properties of soil and nutrient dynamics in soil-plant system. It is very important for optimum nutrient management. For the improvement of fertility status, both chemical and physical properties of tea soils should give emphasis. |
| Expected Outputs: | Status of the physical properties of tea soils and its influence on the chemical properties will be identified which will play an important role on improvement of fertility level. |
| Budget: | 5 Lakhs (approx.) |

| **Title 7:** | **Biochar as a Soil Amendment and Its Effect on Tea Soil Properties** |
|---|---|
| Objectives: | ➢ To observe the effect of biochar on the physico-chemical properties of tea soil. |
| Justification: | Biochar is the porous carbonaceous solid produced by thermochemical conversion of organic materials in an oxygen depleted atmosphere which has physicochemical properties suitable for the safe and long-term storage of carbon in the environment and, potentially, soil improvement. A good portion of the carbon so produced will remain in soils for hundreds and, possibly, thousands of years. Hence, biochar can be an important component of a global response to carbon abatement, though the challenges of achieving such a large-scale utilization of biochar would be considered. Some possible reasons which help to account for the impacts of biochar on soils are: a) increase in pH of acid soils, b) increase in water retention, especially sandy and silty soils, c) provision of nutrients in the ash contained within the biochar, d) enhancement of the cation exchange capacity (CEC) of the soil, so increasing nutrient use efficiency and e) enhancement of microbial communities including bacteria, mycorrhizae and fungal hyphae and f) benefits to soil physical properties. |
| Expected Outputs: | Fertility status of tea soil will be improved by using biochar. |
| Budget: | 10 Lakhs (approx.) |

## 7.2.2. Division of Botany

Botany division has been carrying out a total of 24 ongoing experiments under four different programme areas. A brief description of the five years research plan according to its programme areas are presented below:

### Programme Area: B1

| **Title 1:** | **Preliminary Selection of Vegetative Clones** |
|---|---|
| Objectives: | ➢ To isolate desirable mother bushes from the existing variable seedlings.<br>➢ To identify promising plants constitute yield and quality potential.<br>➢ To isolate plants tolerant to insect, disease and drought.<br>➢ To observe rooting ability of the selected mother bushes. |
| Justification: | The best plants are isolated from a seedling population base that has been derived from a superior Jat or superior breeding lines. A systematic evaluation of millions of seed population across the country is to be accelerated for isolating high yielding quality clones with pest -diseases and drought tolerant characteristics. |
| Expected Outputs: | Isolation of some tea bushes having desirable characteristics through exploiting variability within the seedling population. |
| Budget: | 35 Lakhs (approx.) |

### Programme Area: B2

| **Title 2:** | **Long Term Yield and Quality Trial of Provisionally Selected Clones** |
|---|---|
| Objectives: | ➢ To select promising test clones having desirable characteristics like high yield, cup quality, tolerant to drought and pest attacks, etc.<br>➢ To identify stress tolerant test clones such as drought tolerant.<br>➢ To identify test clones those are less susceptible to pests and diseases. |
| Justification: | Clonal selection is the most important practice in tea for evolving better varieties of plants of either yield or quality or both. In fact, clonal traits determine yield and quality potentials and resistance and tolerances to bitic and abiotic stresses. And once selected as a planting material, an estate is expected to benefit from the decision for 50 or more years. |
| Expected Outputs: | Selection of suitable clones having desirable characteristics e.g. high yield, better quality, tolerant to pests, water stress, etc. for commercial cultivation. |
| Budget: | 35 Lakhs (approx.) |

**Programme Area: B3**

| **Title 3:** | **Breeding of Tea** |
|---|---|
| Objectives: | ➢ To study compatibility between different clones and agrotypes.<br>➢ To observe seed setting ability of different cross combinations.<br>➢ To observe hybrid vigour of seed progeny.<br>➢ To identify suitable generative agrotypes for hybrid seed production.<br>➢ To select vegetative clones from hybrid progeny of desirable characters.<br>➢ To study yield and quality of different bi & poly clonal seedlings.<br>➢ To evaluate performance of indigenous and exotic biclonal seeds.<br>➢ To collect and *ex-situ* conservation of genetic resources of tea (tea germplasm) from home and abroad in order to use in future for varietal improvement programme. |
| Justification: | Selection of compatible cultivar for hybrid seed production and selection from hybrid progeny. |
| Expected Outputs: | Selection of suitable seedling jat/jats having desirable characteristics e.g. high yield, better quality, tolerant to pest & diseases as well as water stress etc. for commercial cultivation. |
| Budget: | 50 Lakhs (approx.) |

**Programme Area: B4**

| **Title 4:** | **Micro-propagation and Biotechnology in Tea Breeding** |
|---|---|
| Objectives: | ➢ Establishing tissue culture protocol for rapid multiplication of elite clones/cultivars.<br>➢ Plants of clonal attributes having strong tap root could be developed through somatic embryogenesis.<br>➢ Biochemical marker could be developed for characterization of tea genotypes in order to select high quality tea producing genotypes.<br>➢ Establishing specific DNA markers associated with important agronomic character aiming to use them in marker aided breeding programme.<br>➢ DNA based molecular marker could be used to characterize tea germplasm and thus facilitate conservation of plant genetic resources. |
| Justification: | Methodology of vegetative propagation is standardized. But it has limitations because of slow multiplication rate, poor survivability of some clones, need for copious initial planting material, unavailability of suitable shoots during winter dormancy and in drought period as well as seasonal dependence of rooting etc. These problems could be overcome through micro propagation of desirable clones through tissue culture. Recently, |

development of molecular biology has resulted in alternative DNA based markers for crop improvement of tea. These markers can assist the process of traditional breeding with several efficacies. The greatest advantages of molecular markers are: 1. free from environmental influence and 2. Detection of polymorphism at an early stage. Therefore, application of biotechnology (e.g. molecular breeding and tissue culture) appears to be an ideal choice of the problems related to tea crop improvement.

| | |
|---|---|
| Expected Outputs: | A protocol for rapid multiplication and molecular marker database will be developed for the characterization of existing tea genotypes. |
| Budget: | 75 Lakhs (approx.) |
| Comment: | This experiment is subjected to establish a Biotechnology Laboratory |

**Programme Area: B5**

| **Title 5:** | **Dissemination of BTRI Clones, Improved Seeds and other Technologies** |
|---|---|
| Objectives: | ➢ Establishment of zonal nurseries under BTRI and tea estate's collaboration.<br>➢ To support tea estates with an emphasis on less developed tea estates.<br>➢ To increase national production of tea.<br>➢ To improve the quality of Bangladesh tea. |
| Justification: | The important reason of low production is assumed to be due to the inferior stock of genetic materials. BTRI so far released 18 outstanding clones and four biclonal seed stocks. But till to date, hardly 6-9% clonal plantations is covered in tea gardens of Bangladesh. As a result, the overall production has not risen to a desired level. Moreover, there is a tendency of tea planters to plant Indian clones in their gardens. It must be kept in mind that clones selected from the indigenous plant population and tested under prevailing climatic and soil condition are more suitable and adaptive to respond for better crop production, pest and diseases resistant in the long run. |
| Expected Outputs: | Production and quality will be increased. |
| Budget: | 25 Lakhs (approx.) |

## 7.2.3. Division of Agronomy

This division has proposed three research projects under two programme areas viz. Drought Management and Mechanization in Tea to overcome the global climate change impacts and labor crisis in tea industry. Detailed information regarding these projects is described below:

**Programme Area: Drought Management**

| **Title 1:** | **Mitigation of Drought on Tea Plantation for Sustainable Production and Establishment of Sources of Irrigation Water** |
|---|---|
| Objectives: | ➢ To construct water reservoir in a places closer to the plantation area<br>➢ To construct dam in suitable places on the perennial *cherras* (water canal) running inside the garden particularly in *tillah* area<br>➢ To develop rain water harvesting system<br>➢ To establish effective permanent irrigation system |
| Justification: | Drought and nutritionally poor soil are the great challenges for tea consistent production in Bangladesh. Almost every year Bangladesh tea is experiencing drought and thus causes heavy crop loss. |
| Expected Outputs: | Yield and production will be increased by reducing drought effect of mature tea and mortality rate of young tea plants will be reduced. |
| Budget: | 1.23 Crore (approx.) |

| **Title 2:** | **Upgradation of Cultural Practices in Relation to Mitigation of Drought and Soil Nutritional Aspects** |
|---|---|
| Objectives: | ➢ To develop technologies for conservation of soil moisture<br>➢ To develop suitable conversion techniques of seed plants to high yielding clone through grafting<br>➢ To establish *mulch-bari*<br>➢ To introduce three-stages shade management |
| Justification: | Higher evaporation during dry period makes soil dry and the tea bushes suffer from water stress which ultimately causes death of the bushes. For combating the situation, different cultural practices and new concepts can be introduced for effective management of drought and soil organic matter. |
| Expected Outputs: | Condition of tea soil will be improved by incorporating crushed and decomposed pruning litter. Appropriate mulching will minimize the impact of drought in tea field and soil will be enriched. Grafting technique will provide expected tea plants having the characteristics of high yield and comparatively more tolerant to drought. |
| Budget: | 26 Lakh (approx.) |

**Programme Area: Mechanization in Tea**

| **Title 3:** | **Upgradation of Plucking and Pruning Practices through Partial Mechanization** |
|---|---|
| Objectives: | ➢ To introduce mechanical harvesting system in tea<br>➢ To change effective pruning cycle |
| Justification: | The tea industry is currently facing serious labor crisis especially during plucking and light pruning. Thus the mechanization in plucking and pruning will helps to reduce labor and time. |
| Expected Outputs: | Cost effective mechanized technology will be developed. |
| Budget: | 15 Lakh (approx.) |

## 7.2.4. Division of Plant Pathology

In continuation with the routine works, this division has proposed six research projects under three research areas viz. Tea Disease Management, Pesticide Toxicity, and Microbial Contamination & Factory Hygiene. The implementation of the proposed projects will help the tea industry by introducing cost effective, eco-friendly management strategies for tea diseases, promoting judicious and safe use of pesticides for quality tea, and encouraging growers in manufacturing teas under more hygienic environment for the sake of the ultimate consumers.

**Programme Area: Tea Diseases Management**

| **Title 1:** | **Initiation of Biotechnological Approaches for the Development of Disease Resistant Tea Cultivar** |
|---|---|
| Objectives: | ➢ To develop disease resistant tea cultivar |
| Justification: | Tea diseases are caused by a variety of plant pathogens including fungi, and their management requires the use of techniques like transgenic technology, molecular biology, and genetics. Various genes have been introduced into other plants, and the enhanced resistance against fungi. The genetically modified tea cultivars if developed successfully will show the resistant mechanism against a particular disease causing fungus and thus lessen the pressure on overuse of fungicide in tea gardens. |
| Expected Outputs: | A cost-effective, sustainable disease resistant cultivar will be developed for the tea industry. |
| Budget: | 10 Lakhs (approx.) |
| Comment: | It is a collaborative research project and the implementation will depend on the establishment of Biotechnology laboratory at BTRI. |

| | |
|---|---|
| **Title 2:** | **Characterization and Pathogenicity of Fungal Pathogens Associated with Tea Diseases in Bangladesh** |
| Objectives: | ➢ To characterize fungal pathogens associated with tea diseases and to examine their pathogenicity.<br>➢ To investigate the diversity of the genus of the fungal pathogens associated with tea diseases.<br>➢ To characterize the potential of sources of fungal pathogens of tea. |
| Justification: | This is a modern work related to molecular biology of the diseases causing fungi. The Knowledge and information in this area will help to establish molecular approaches for the management of tea diseases occurring in different region with similar climatic conditions. |
| Expected Outputs: | The genetic information of the disease causing fungi will be addressed and a protocol will be established for further study. |
| Budget: | 25 Lakhs (approx.) |
| Comments: | The implementation of the project will depend on availability of fund for equipment as well as establishment of Biotechnology laboratory at BTRI. |
| **Title 3:** | **Exploitation of Plant Growth Promoting Microorganisms (PGPM) in Controlling Tea Diseases** |
| Objectives: | ➢ To assess the population of rhizospheric beneficial microorganisms.<br>➢ To evaluate the ability of the microorganisms for growth & development of tea plants.<br>➢ To assess the competence of the microorganisms against defense response to tea plant. |
| Justification: | PGPM are naturally occurring soil bacteria/fungi that aggressively colonize plant roots and benefit plants by providing growth promotion, plant productivity and immunity. Some PGPM also elicit physical or chemical changes related to plant defense, a process referred to as 'induced systemic resistance (ISR). Inoculation of crop plants with certain strains of PGPM at an early stage of development might improves biomass production through direct effects on root and shoots growth. PGPR might also increase nutrient uptake from soils, thus reducing the need for fertilizers and preventing the accumulation of nitrates and phosphates in agricultural soils and ultimately confers the plant defense. |
| Expected Outputs: | Inoculation of tea plants with certain strains of PGPM might provide defense response to the tea plants that will ultimately reduce the loads on fungicide application in the gardens. |
| Budget: | 5 Lakhs (approx.) |

**Programme Area: Pesticide Toxicity**

| **Title 4:** | **Detection of Fungicide Residue in Made Tea** |
|---|---|
| Objectives: | ➢ To assess the Maximum Residue Limit (MRL) of fungicides present in made tea.<br>➢ To decide the MRL of different fungicides used in Bangladesh tea.<br>➢ To create an awareness on fungicide application in tea. |
| Justification: | Application of fungicides in the tea gardens is a common practice for controlling fungal diseases. Different kinds of chemicals like Oxychloride/Hydroxides/Oxides of Copper, Carbendazim (Benzimidazole), Hexaconazole/Propiconazole/Difeconazole (Triazole), Mancozeb/Propineb (Dithiocarbamate), iprodine (Dicarboximide) Azoxytrobin (Strobilurin), Thiram (Dimethyl Dithiocarbamate), Bismarthazole (Thiadiazole), Chlorothalonil, Glycine Derivatives, Aryloxyalkanoic acid, etc. are extensively used in tea. Their residue limit in fresh plucked leaves as well as in made tea is quite unknown in Bangladesh. A detailed research on MRL of fungicides used in tea has been undertaken in the Five Year Plan with the above objectives to save the consumer's health. |
| Expected Outputs: | The safe dose of the fungicides will be determined and the more toxic chemical will be screened out by MRL test, ultimately the consumer will be protected. |
| Budget: | 10 Lakhs (approx.) |
| Comment: | Expenditure will dependent on the required equipment needed for a particular fungicide to be analyzed. |

| **Title 5:** | **Detection of Toxicity Level of Herbicides in Tea Soils and Surrounding Pond's Water for Growing Mycoflora and Mycofauna** |
|---|---|
| Objectives: | ➢ To assess the toxic level of herbicides in tea soils and pond water.<br>➢ To study the effects of herbicide on mycoflora and mycofauna.<br>➢ To create an awareness on herbicides application in tea. |
| Justification: | Non-judicial and overuse of herbicides to kill weeds is a common phenomenon in the tea gardens. Various hazardous herbicides like paraquat (Bipyridylin), Glyphosate (Glycine Derivatives), 2, 4-D Amine Salt (Aryloxyalkanoic Acids), Metribuzin (Triazinone), Simazine (Triazine), Butachlor (Chloroacetamide), etc. are used extensively that might enter the food-chain in the tea ecosystem. Herbicide or its active ingredients when applied on the weed population or incorporate with soil may persist in the edaphic system and can pollute nearby water sources by surface run-off, seepage, through washing of equipment, clothes, etc. The research has been undertaken in the Five Year Plan with the above |

objectives along with their potential risk to soil health/productivity, mycoflora and mycofauna subsisting in tea soils and surrounding environment.

Expected outputs: The findings of the experiment will help to screen out more hazardous herbicides or their active ingredient which are responsible for unbalancing the tea ecosystem, as well as to create awareness against safe use of herbicides.

Budget: 10 Lakhs (approx.)

## Programme Area: Microbial Contamination and Factory Hygiene

**Title 6: Studies of Microbial Effects on Made Tea Quality**

Objectives:

- To examine the microbial loads on made tea
- To observe the changes of liquor parameters upon microbial contamination.
- To evaluate the existing tea processing practices in the factories.
- To generate awareness on Good Manufacturing practices (GMP) among the tea estates.

Justification: Black tea is processed through a series of operations viz. plucking of green leaves, withering, CTC rolling, oxidation, drying, grading, packing and dispatch. After processing in the factory, the finished teas are mostly come to the consumers through auctioning, blending, repackaging, selling and buying in the markets. Harmful foodborne microbes (e.g. *Aspergillus*, *Penicillium*, *Salmonella*, *E. coli*, etc.) may enter the manufacturing process and market networking system through several routes such as raw materials, machinery, air, and surfaces in the manufacturing area, factory personnel or frequent movement of the visitors in the production unit. The research work has been undertaken in the Five Year Plan with the above objectives so as to provide wholesome and safe drink to the consumer.

Expected Outputs: The management personnel, factory owners, tea blending and marketing companies will be encouraged to process their tea in more hygienic environment under Good Manufacturing Practices (GMP).

Budget: 5 Lakhs (approx.)

## 7.2.5. Division of Entomology

This division has proposed ten research projects under five programme areas viz. Integrated Pest Management, Studies on Indigenous Plant Extracts, Bio-control of Pests, Screening of Pesticides and Pesticide Residue in Tea to implement the FYP. Detailed information regarding these projects is described below:

**Programme Area: Integrated Pest Management**

| **Title 1:** | **Evaluation of Sex Pheromone Trap and Sticky Traps against *Helopletis* and Thrips** |
|---|---|
| Objectives: | ➢ To evaluate the efficacy of sex pheromone trap against *Helopeltis*<br>➢ To evaluate the efficacy of blue sticky trap against Thrips |
| Justification: | Insect pest management in tea mainly relies on synthetic insecticides because they are readily available, highly promoted, inexpensive, easy to apply and quick acting. But the indiscriminate and unscientific use of pesticides has led to many problems, such as pests developing resistance, resurgence of once minor pest into a major problem besides environmental and food safety hazards. Governments are also becoming aware of the negative environmental and health aspects associated with the use of these compounds. So now there is an urgent need for the development of alternative control technologies. Sex pheromone trap and stick traps can be effective alternate options for controlling *Helopeltis* and Thrips in tea. The primary uses of insect pheromones are for detection and monitoring of populations and for mating disruption whereas sticky traps are used for mass trapping of insects. |
| Expected Outputs: | Efficacy of pheromone & sticky trap, trap height and no. of traps per unit area will be determined as a tool of IPM. |
| Budget: | 10 Lakhs (approx.) |

| **Title 2:** | **Effect of Some Organic Amendments For the Control of Plant Parasitic Nematodes in Tea** |
|---|---|
| Objectives: | ➢ To study the effect of some organic amendments for controlling plant parasitic nematodes in tea soil |
| Justification: | Plant parasitic nematodes are soil pest and major pest of tea nursery. In our country the control of parasitic nematodes mainly depends on chemical nematicides. High cost, environment safety and global restriction on the importation of chemical nematicides have impelled scientists to search for alternative control measures against nematode of economic food crops. Soil amendments with organic manures have been shown to improve plant growth and reduce nematode infection. |

| | |
|---|---|
| Expected Outputs: | Comparative efficacy and effective organic materials will be determined as components of IPM in tea. |
| Budget: | 6 Lakhs (approx.) |

**Programme Area: Studies on Indigenous Plant Extracts**

| **Title 3:** | **Evaluation of Indigenous Plant Extracts against Major Pests of Tea** |
|---|---|
| Objectives: | ➢ To determine toxic effect of tested plants against major tea pests |
| Justification: | The large-scale use of synthetic insecticides in tea leads to adverse effects such as development of pesticide resistance, frequent pest outbreaks, emergence of new pests, environmental pollution and health hazards. As tea is a consumable commodity, the effect of residue of pesticides in made tea is harmful to human health. In this context, botanicals are being considered as environmentally safe, selective, biodegradable, economical and renewable alternatives for use in IPM programmes in tea. These botanical materials can be used as an alternative to chemical pesticides. This will be very helpful in minimizing the undesirable side effects of synthetic pesticides. |
| Expected Outputs: | Crude extracts of *tested plants* will effectively be utilized as safer phytopesticidal products in both organic and inorganic tea estates as one of the potent tools in integrated management of major insect pests infesting tea in Bangladesh. |
| Budget: | 5 Lakhs (approx.) |

**Programme Area: Bio-control of Pests**

| **Title 4:** | **Searching and Identification of Bio-control Agents for the Control of Pests of Tea** |
|---|---|
| Objectives: | ➢ To find out the natural enemies i.e. predator, parasitoid in the tea ecosystem as bio-control agents for the control of pests of tea. |
| Justification: | The importance of insect natural enemies as bio-control agents is largely realized as they play a remarkable role in the management of many crop pests and keep their population low. Conservation and application of naturally occurring bio-control agents are more preferred than introduction of exotic predators and parasitoids for better efficacy and to avoid ecological problems. The knowledge gained from a study of natural enemies may be of immense practical value in insect pest management. Reviews on predators and parasitoids of tea pests are available from India, but not from tea plantations of Bangladesh. Therefore, periodic surveillance of pests and their natural enemies is needed. |

| | |
|---|---|
| Expected Outputs: | Use of natural enemies (parasite, predator and pathogen) of pests is an effective alternate measure - which is environmentally viable. It should be considered as a major component of Integrated Pest Management (IPM). |
| Budget: | 3 Lakhs (approx.) |

**Title 5: Predation Capacity of Potential Predators and Spider Fauna against Insect Pests of Tea**

| | |
|---|---|
| Objectives: | ➢ To determine the predation capacity of potential predators and spider fauna against major insect pests of tea. |
| Justification: | The large-scale use of synthetic insecticides in tea leads to adverse effects such as development of pesticide resistance, frequent pest outbreaks, emergence of new pests, environmental pollution and health hazards. In order to searching alternative to chemicals biological control is important as one of the major component of IPM. The predatory nature of most of the predators economically important. They have the capacity to search and feed ravenously on larval and adult stages of aphids, mites and other soft bodied arthropods. Based on the findings, attempts were made to determine the Predation capacity of spider against major pests of tea. |
| Expected Outputs: | Use of natural enemies (parasite, predator and pathogen) of pests is an effective alternate measure - which is environmentally viable. It should be considered as a major component of IPM. |
| Budget: | 16 Lakhs (approx.) |

**Title 6: Antagonistic Potential of Entomopathogens on *Helopeltis*, Red Spider Mite, Thrips, Looper Caterpillar and Plant Parasitic Nematodes in Tea**

| | |
|---|---|
| Objectives: | ➢ To determine the bioefficacy some potential entomopathogens against plant parasitic nematodes in tea soil. |
| Justification: | Different groups of pesticides like organochlorine, organophosphate, pyrethroids, carbamates, etc. have been used in the tea for controlling insects. Their extensive uses cause destruction of beneficial organism including predators, parasitoids and pollinators. It may further lead to development of resistance in insect, phytotoxicity, residue in tea and last but not the least the environmental pollution. Entomopathogens can be alternative options for controlling insects. Many researchers have been reported on the effectiveness of entopopathogens as biocontrol agent against insects in many crops. They produce and excrete metabolites that are inhibitory to insects. So attempts have been made to evaluate the antagonistic potential of some entomopathogens against major insects in tea. |

| | |
|---|---|
| Expected Outputs: | Comparative efficacy and Potential entomopathogens will be determined as components of IPM in tea. |
| Budget: | 12 Lakhs (approx.) |

**Programme Area: Screening of Pesticides**

| **Title 7:** | **Screening of Pesticides against Major Pests of Tea** |
|---|---|
| Objectives: | ➢ To find out a range of alternate and economical pesticides (Insecticides, Miticides and Nematicides)<br>➢ To avoid pest resistance and unavailability of pesticides<br>➢ To ensure variable choice for effective pesticides by the management |
| Justification: | A number of insecticides are standardized against the insect pest in tea. It is convenient to use insecticide of different groups to lessen the risk of resistance, cost of pesticides, environmental pollution and carcinogenic and mutagenic effects towards living organisms. So the experiments have been undertaken to evaluate the efficacy of new group of pesticides against major insect pest in tea and standardized the effective but less toxic to beneficial insects and environment. |
| Expected Outputs: | Planter/user will have a wider choice in selecting the right pesticide against insects, mites and nematodes in tea. |
| Budget: | 2 Lakhs (approx.) |

| **Title 8:** | **Determination of Judicious Use of Pesticides for a Model Tea Estate** |
|---|---|
| Objectives: | ➢ To determine the judicious use of potential pesticides (Insecticides, miticides and nematicides) to avoid pest resistance, undesirable pesticide residue and develop economically viable pesticide schedule for a model tea estate. |
| Justification: | Insect pest management in tea relies on insecticides as one of the main tools. It would be difficult to produce enormous quantity of food without it. Use of pesticides on food crops can results in residues in their products which cannot always be avoided. But the correct and judicious use of pesticides minimizes such residues. Now-a-days, residue level of pesticides has become a burning question due to adverse effect of non- judicious application of pesticides. Prudent use of insecticide in tea must be taken seriously as resistance problems in tea pests may arise. Usage pattern of pesticides in tea plantation is varying. There is no definite usage pattern of pesticides in tea estates. Therefore, a study should be undertaken to determine the judicious use of potential pesticides to avoid pest resistance, undesirable pesticide residue and develop economically viable pesticide schedule for a model tea estate. |

| | |
|---|---|
| Expected Outputs: | Judicious use of pesticide schedule for a tea estate will be developed. |
| Budget: | 2 Lakhs (approx.) |

**Title 9: Effect of Nematicides on Soil Microorganism in Tea**

| | |
|---|---|
| Objectives: | ➢ To determine the effect of chemical nematicides on soil microorganism |
| Justification: | Soil microorganisms play an important role in the cycling of nutrient such as carbon and nitrogen and their function is essential to maintain soil fertility. The importance of free living nematodes to nutrient cycling and the suppression of plant parasitic nematodes are also well recognized. Therefore, both soil micro-organisms and free living nematodes are essential for sustainable crop production. The chemical nematicides not only kill parasitic nematodes but also kill soil micro-organisms and free living nematodes. Such type of research is not available in Bangladesh tea. So, attempt has been made to determine the effect of different chemical nematicides on soil micro-organism in tea. |
| Expected Outputs: | The toxicity of the nematicides on soil microorganisms will be understood. |
| Budget: | 3 Lakhs (approx.) |

**Programme Area: Pesticide Residue in Tea**

**Title 10: Dissipation Pattern of Some Commonly Used Pesticides in Tea from Bush to Mug**

| | |
|---|---|
| Objectives: | ➢ To determine the pesticide residue in made tea<br>➢ To know the dissipation pattern of new pesticides from bush to mug<br>➢ To pin point its status in the sample so that preventive and precautionary measures could be made in time |
| Justification: | As tea is a consumable commodity, the effect of residue of pesticides in made tea is harmful to human health. In this perspective, EPA/ Codex Alimentarious/ FAO/WHO, German Law etc. have given restrictions on producing and procuring tea having pesticide residue. Different groups of pesticides show different dissipation pattern. The present experiment has been undertaken to generate data on dissipation pattern of different groups of pesticides and its transfer from bush to mug so that preventive and precautionary measures could be made in time. |
| Expected Outputs: | The pesticide residue as well as dissipation pattern of different new pesticides from bush to mug will be determined. |
| Budget: | 16 Lakhs (approx.) |

## 7.2.6. Division of Biochemistry

This division has proposed nine research projects under three programme areas viz. Tea as Healthy and Quality Drinks, Diversify Uses of Tea and Food Grade Secondary Metabolites Extraction from made tea to implement the FYP. Detailed information regarding these projects is described below:

**Programme Area: Tea as Healthy and Quality Drinks**

| **Title 1:** | **Qualitative & Quantitative Biochemical Analysis of Made Tea** |
|---|---|
| Objectives: | ➢ To make a modern Biochemistry Lab based on ISO parameters.<br>➢ To get highly qualitative and quantitative analytical reports. |
| Justification: | Qualitative and Quantitative parameters of made tea collected from different tea processing factories and markets will be evaluated to justify whether they are valued or not for human health. |
| Expected Outputs: | Biochemistry division will be a high grade quality Lab. |
| Budget: | 30 Lakhs (approx.) |
| Comment: | For routine evaluation this division needs different reagents, instruments and man power. |

**Programme Area: Diversify Uses of Tea**

| **Title 2:** | **Production of Tea as Cola/Soft Drinks/Carbonated Beverage Products Using Different Kinds of Flavors, Spices, etc.** |
|---|---|
| Objectives: | ➢ To generate alternative tea product for commercial production.<br>➢ To make biochemistry lab self-dependent in production of cola tea. |
| Justification: | The existing carbonated beverages in the markets are not safe for human consumption. This natural tea beverage will add a new dimension in soft drinks industry. After COG or feasibility test production facility will be developed. |
| Expected Outputs: | Another market of tea will be created if proper formulation, adaptation and managerial supports are performed homogeneously. |
| Budget: | 10 Lakhs (approx.) |

| **Title 3:** | **GABA Tea Production & Upscaling the Methods for Commercial use** |
|---|---|
| Objectives: | ➢ To produce GABA tea whose hypertensive effect has already been confirmed By Stanton, 1963.<br>➢ To set up Nitrogen Plant for the production of GABA tea. |

Justification: This product has tremendous pharmaceutical application to maintain blood pressure and neurotransmission system. Successful implementation of this product will brighten our institute to all.

Expected Outputs: Worldwide GABA tea is being used as medicinal replacement of GABA neurotransmitter. It will create a pharmaceutical application of tea.

Budget: 15 Lakhs (approx.)

**Title 4: Tea Lemonade and Upscaling the Methods for Commercial Purposes**

Objectives:
- To produce tea lemonade as alternative tea product.
- To determine the food value of tea lemonade

Justification: Tea is just not a sole drink. Diversifying use of tea and production of tea products like tea lemonade in commercial purpose will upscale the tea industry. After COG or feasibility test production facility will be developed.

Expected Outputs: Alternative use of tea will be created and tea lemonade will popular Like lemon lemonade.

Budget: 05 Lakhs (approx.)

**Title 5: Instant Tea and Upscaling the Methods for Commercial Purpose**

Objectives:
- To produce instant tea pulverizing fresh/processed tea into powder paste upon enzymatic and chemical conversion.
- To make instant tea as intact packet form.

Justification: As the demand of instant tea is increasing radically, therefore to produce instant tea is the demand of time.

Expected Outputs: Instant tea will make a newer dimension of tea use.

Budget: 10 Lakhs (approx.)

**Title 6: Flavoring Tea Production**

Objectives:
- To produce tea with natural flavor like orange flavor, lemon flavor, etc.
- To determine and see its food value with respect to ISO parameters.

Justification: As the demand of flavoring tea is increasing radically, therefore to produce tea with natural flavors is the demand of time.

Expected Outputs: Flavoring tea as like lemon tea, orange tea, apple tea, strawberry tea, etc. will be available in market.

Budget: 05 Lakhs (approx.)

| **Title 7:** | **Chocolate Tea and Upscaling the Methods for Commercial Purpose** |
|---|---|
| Objectives: | ➢ To generate a diversified use of Tea as chocolate, chewing gums, etc.<br>➢ To make a comparative analysis of food and nutritional value with different chocolates present in local markets. |
| Justification: | Production of chocolate from tea- a natural source of beneficial biochemical components will help to meet health demand to the chocolate lovers. After successful innovative approach, commercial production may be generated. |
| Expected Outputs: | Chocolate is very popular for children. Tea chocolate will make a breakthrough in chocolate world. |
| Budget: | 10 Lakhs (approx.) |

| **Title 8:** | **Determination of Heavy Metals from Soils, Tea Extracts & Tea Leaves** |
|---|---|
| Objectives: | ➢ To develop a newer food supplements for our poultry and fish.<br>➢ To make a comparative analytical data with this new food supplement to existing poultry feeds from view of lipid profile, heavy metal contents, etc. |
| Justification: | If tea can be used as a food supplement in the broiler industry, local demand of tea will be increased exponentially along with consumption as beverage. |
| Expected Outputs: | This proposed research project will provide us a concrete output on harmful heavy metals found in the processed tea, tea leaves and soil location wise which will help the owners of tea estate to ensure carcinogenic heavy metals free tea. This study will also give us crystal clear data to adopt regulation on the concentration of heavy metals in tea management comparing WHO requirement. Expected output on Heavy metal content, lipid profile and vitamin K concentration in the chicken consuming food supplement of tea extracts will provide an excellent figure and we hope it will make a break throw in tea industry making an another local market of tea extracts along with beverage. |
| Budget: | 35 Lakhs (approx.) |

**Programme Area: Food Grade Secondary Metabolites Extraction**

| | |
|---|---|
| **Title 9:** | **Development of Methodologies for the Extraction of Food/Pharma Grade Secondary Metabolites from Tea and Development of Formulation for Commercial Purpose** |
| Objectives: | ➢ To develop methods for the extraction of polyphenol oxidase, antioxidants (EGCG), Anthocyanine, theaflavin from tea<br>➢ To develop methodology for extraction of coloured pigments from black tea to use for food, cosmetic and health care products.<br>➢ To develop technology for making tea tablets, tea capsules, etc.<br>➢ To scale up Super critical extraction technology for the extraction ofvolatile components and flavoring agents of tea, yellow and red pigments from the various sources of tea to produce various cosmetics and functional food products. |
| Justification: | Technology developed by this study will develop a new horizon of tea industry to develop tea tablet/ capsule of different antioxidants, theraflavin, thearubigins etc. New different sector of tea e.g. pharmaceutical, cosmetic, medical, textile will be created. |
| Expected Outputs: | Extracted PPO will be used in cosmetic industry, textile industry, pharmaceuticals and medical. Tea tablet, capsules, shells of antioxidants or polyphenols having different taste and flavor will be developed for commercial use. Product extracted by SCFE technology will be ready to use various cosmetics and health care product. |
| Budget: | 80 Lakhs (approx.) |

## 7.2.7. Division of Statistics & Economics

This division has proposed five research projects under two programme areas viz. Evaluation of Technologies and Economics of Tea to implement the FYP. Detailed information regarding these projects is described below:

**Programme Area: Evaluation of Technologies**

| | |
|---|---|
| **Title 1:** | **Adoption of BTRI Matured Technologies and Its Extension to Tea Estates of Bangladesh** |
| Objectives: | ➢ To identify the present status of BTRI technologies and its efficiency by the tea estates for crop improvement.<br>➢ To prepare a statistical database on adoption of the BTRI technologies by the tea estates.<br>➢ To find out the limitations of the dissemination of BTRI innovated technologies to the tea industries. |

| | |
|---|---|
| Justification: | BTRI has developed a number of technologies from its beginning and made a great impact on tea improvement providing these technologies. But there is no information about the percentage of application of the technologies and its efficiency in implementation. So the current data regarding the disseminated technologies to the estate required to up-to-date which will be helpful for the study of efficiency of these technologies and the dissemination hinders of BTRI. |
| Expected Outputs: | This experiment will help to draw out a complete feature about the adoption of BTRI technologies. An up-to-date statistical database regarding the employed technologies in the tea estates is essential for further extension for crop improvement. |
| Budget: | 5 Lakhs (approx.) |

**Programme Area: Economics of Tea**

**Title 2: A Study to Assess the Technical, Allocative and Cost Efficiency in Some Selected Small Tea Growers at Panchagar**

| | |
|---|---|
| Objectives: | ➢ To assess the technical, allocative and cost efficiency in some selected small tea growers at Panchagar.<br>➢ To assess the socio-economic position of the small tea growers.<br>➢ To find out the benefit cost ratio of the small tea growers.<br>➢ To find out the constrain affecting the production of small growers. |
| Justification: | Technical efficacy reflects the ability of a firm to obtain the maximum possible output from a given set of inputs and production technology. Through this investigation the constrain hampering the production of the small firms will come out. |
| Expected Outputs: | This study will reveal the ability of proper utilization of investments for maximum outturn by the small growers firm. The overall feature of the efficacy and limitations of a small firm will help the firm to be effective in future. |
| Budget: | 5 Lakhs (approx.) |

**Title 3: Study on Economic Profile in Relation to Current Economic Status of Expenditure in Selected Tea Estates of Greater Sylhet and Chittagong**

| | |
|---|---|
| Objectives: | ➢ To determine the cost and return of Bangladesh tea in present economic condition.<br>➢ To determine the estate wise resource use efficiency of tea production.<br>➢ To determine the cost and return of Bangladesh tea.<br>➢ To find out the major constrain which affect the higher productivity of Bangladesh tea. |

Justification: The cost of production is directly dependent upon the every cost items of cultivation and other sectors of tea production. The study was undertaken to find out the cost of production and economic profitability in concern of present economic condition of tea production. Per kilogram and per hectare cost are needed to determine concerning the present increased price value of cost components.

Expected output: The cost of production in tea cultivation will further determine in respect of current increased economic condition of tea cultivation of greater Sylhet and Chittagong.

Budget: 10 Lakhs (approx.)

**Title 4: Economics of Optimum Fertilizer Dose for some Selective Clones at BTRI farm**

Objectives:
- To find out the optimum economic fertilizer dose for some selected clones of BTRI to study the economic efficiency of the clones.
- To determine the benefit cost ratio.
- To assess the marginal rate of return for selective clones.

Justification: This study was conducted to assess the economic efficiency of optimum fertilizer dose for some selected clones of BTRI. The assessment of economic efficiency of optimum fertilizer is mandatory before the establishment of a clone in the plantation filed.

Expected outputs: Useful required optimum fertilizer dose for the specific clones will be determined through this experiment which will show the result of the best effective economic performance of the clones.

Budget: 3 Lakhs (approx.)

**Title 5: Development of a Statistical Database on Different Issues of Tea Cultivation and Production**

Objectives:
- To create a portal database system about the different aspects regarding tea plantation to ensure the availability of necessary information for tea production of Bangladesh.

Justification: Complete information regarding every sectors of tea cultivation like agronomic practices, climatic condition, environmental effects, pests and diseases, productivity, crop forecasting, economic condition market status etc. is needed to up-to-date for progressive development of tea production.

Expected output: A statistical database with current information regarding tea culture will be developed.

Budget: 5 Lakhs (approx.)

## 7.2.7. Technology Division

This division has proposed one research project under the programme area Suitability of Packaging Materials to implement the FYP. Detailed information regarding this project is described below:

**Programme Area: Suitability of Packaging Materials**

| **Title 1:** | **Study on the Suitability of Different Polypropylene as Packaging Material of Tea** |
|---|---|
| Objectives: | ➢ To find out moisture gain per cent of different polypropylene on time<br>➢ To find out the quality of made tea in polypropylenes |
| Justification: | Retention of quality of black tea after manufacturing is a great challenge today. As tea is hygroscopic in nature, it can absorb moisture from the atmosphere at any stages of grading, packing, transporting and marketing channel, and quality become deteriorate resulting decrease in shelf life. |
| Expected Outputs: | Self-life of the finish product will be increased. |
| Budget: | 5 Lakh (approx.) |

# Chapter 8

# STRATEGIC PLAN FOR DEVELOPMENT TO IMPLEMENT FYP

## 8.1. Identification of the Problems

In relation to the Development Targets addressed in the Chapter 6, Article 6.2.2., the following problems are identified and different endeavors in multiple directions will be initiated to achieve the targets of FYP. The problems are:

- The human resources are qualified but need to make skillful to handle laboratory equipment required in the proposed research projects mentioned in the FYP.
- Lack of modern laboratory facilities to conduct researches needed for tea industry.
- Promotion complexities for the eligible employees.
- Tea manufacturing capacity of the BTRI factory (CTC) is not satisfactory.
- Existing facilities in the library are not sufficient enough.
- Very old infrastructure and other service facilities especially at BTRI main station and Bilashcherra Experimental Farm (BEF).
- There are no researches and multi-location trial facilities at the Sub-stations, and other service facilities are not sufficient enough.
- Shortage of manpower for efficient management of research and development at BTRI, Farms and the Sub-stations.
- Access to and application of ICT in tea industry and research and development linkage with national and international organizations and Universities are not satisfactory.

## 8.2. Development Targets

The targets which will be achieved in the FYP have already been mentioned in the Article 6.2.2. Total approx. budget of expenditure for development sector is presented in the Appendix II.

### 8.2.1. Human Resources Development (HRD)

Skilled human resource is the prerequisite for the advancement of an organization or a nation. So, for upscaling the Institutional researches and overall development of BTRI the following priority targets for HRD are included in the FYP to strengthen the Institute.

Table 4. Priority Targets for HRD

| Areas | Development Targets |
|---|---|
| Skill Development Training | ➢ Training for at least 50 eligible employees in home and abroad<br>➢ Ensuring foundation training for all the eligible candidates |
| Higher Education (Masters and PhD) | ➢ Creation of Higher Education Opportunities for at least 15 eligible employees in home and abroad |
| Promotion | ➢ Elimination of promotion complexities for the eligible employees and way out to solve the promotion barrier accordingly |

### 8.2.2. Strengthening of BTRI Main Station

The Institute stands on 34.90 ha of land which is occupied by main office, research divisions, Farm, factories, infrastructures and other resources. Since 1957, the Institute is serving for the tea industry by conducting researches as well as technology packaging and transfer. To face the current millennium challenges, the Institute needs to strengthen with modern research facilities, skilled human resources, improved infrastructures and working environment. The priority development targets for BTRI main station are described below:

#### 8.2.2.1. Establishment of New Laboratories

BTRI has eight research divisions in its main station only. Each division has great opportunity to perform quality research in their respective field of tea cultivation. But there are limited access to modern laboratory facilities and equipment. For conducting proposed research projects effectively and efficiently, the following development targets regarding establishment of new laboratories are presented to implement the FYP.

Table 5. Priority Development Targets for the Establishment of New Laboratories

| Areas | Development Targets |
|---|---|
| BTRI Central Laboratory | ➢ Establishment of a Central Laboratory |
| | **Justification:** The proposed research projects require some common laboratory instruments such as GC-MS, Thermocycler (PCR), Refrigerator (- $80^0$C), HPLC, Gel Documentation System, Electron Microscope, etc., but most of them are not available at BTRI. It is not possible to supply the same instrument to all the respective division for a common purpose. In that sense establishment of a Central Laboratory with common facilities and uncommon instruments is strongly recommended. It will save the expenditure on laboratory instruments. It will also open the door of conducting collaborative researches among the divisions, and with national and international research organizations and Universities. |

| | |
|---|---|
| Biotechnology Laboratory | ➢ Establishment of Biotechnology Laboratory |
| | **Justification:** Biotechnological research will open the avenue for conducting sophisticated genetic research for the improvement of tea. Rapid multiplication of elite clones/varieties will be possible. Plants of clonal attributes having strong tap root could be developed through somatic embryogenesis. Thus, stress tolerant varieties could be developed. DNA based molecular marker could be used for screening the plants. It will help *in vitro* conservation of germplasm and thus facilitate conservation of plant genetic resources which could be used in future breeding programme. |
| Tea Disease Clinic | ➢ Establishment of Tea Disease Clinic |
| | **Justification:** Existing laboratory facilities in respective division are not sufficient enough to conduct the experiments presented in FYP as well as to carrying out routine researches on tea microbiology and damaging effects of the disease causing agents. Tea Disease Clinic will provide precise and authentic information on tea pathogens, and prescription to the tea industry to manage them effectively. |
| Green House | ➢ Establishment of a Green House |
| | **Justification:** Most of the research projects proposed by BTRI need performance evaluation in controlled environment before the field trial. A Green House is strongly recommended to establish at BTRI to conduct small scale pot experiment, Plant response and physiology study against drought, insect, diseases, nutrients, plant breeding study, etc. It will also save the experimental cost efficiently. |

#### 8.2.2.2. Modernization of the BTRI Factory

This CTC factory is considered as model one in Bangladesh. The current processing capacity of the factory is 600-650 Kg Green Leaves (GL) or about 140 Kg of made tea per hour. It needs to modernize and increase in capacity of processing with new equipment as early as possible. The proposed development targets for BTRI factory in the FYP is mentioned below:

Table 6. Priority Development Targets for BTRI Factory

| Areas | Development Targets |
|---|---|
| Factory Machineries | ➢ Supplying 36” X 13” Dia, 5 Cut CTC Machine<br>➢ Supplying Rotorvane (15” full Stainless Steel)<br>➢ An arrangement for a VFBD Dryer ( Capacity 300 Kg per hour)<br>➢ An arrangement for a Milling cum Grooving machine |

#### 8.2.2.3. Improvement of BTRI Library

BTRI has a library in its own campus belonging to 4,615 books and 9,047 scientific papers. It is responsible for periodic publications like Tea Journal of Bangladesh, Circular, annual reports, etc. In addition with regular activities, the library needs to strengthen with modern facilities for the scientific personnel and other management staffs. The proposed development targets for BTRI library in the FYP is mentioned below:

Table 7. Priority Development Targets for BTRI Library

| Areas | Development Targets |
|---|---|
| Books & Journals | ➢ Buying 100 Books and Scientific Journals related to tea |
| Computer & printers | ➢ Buying 1 computers with a printer |
| ICT facilities | ➢ Connected with Wi-Fi or Broad band internet line |
| Accessories | ➢ Buying 12 Nos. of Chairs and 4 Book Shelves |

#### 8.2.2.4. Improvement of BTRI Infrastructures

The institute has full-fledged infrastructures in its own campus which are proposed to improve in the FYP. The priority development targets for Mosque, residence, guest house, workshop, store house, roads, car parking shades, etc. are mentioned in the table below:

Table 8. Priority Development Targets for BTRI Infrastructures

| Areas | Development Targets |
|---|---|
| Mosque | ➢ Renovation of toilet and adjacent urination place<br>➢ Buying 1 set Mike, setting a Minar and Repairing washing place |
| Electricity line | ➢ Changing the very old electricity line by high load enduring one |
| Residence | ➢ Repairing of the house no. D-5 located at hunting residential area<br>➢ Putting tiles in C-type and D-type, changing ceilings of D-type<br>➢ Ensure regular maintenance of E, F, G and H-type residences<br>➢ Establishment of a multistoried buildings for the officers |
| Guest house | ➢ Renovation of the driver's room, Extension of store & kitchen room<br>➢ TV for each room, new set of plates, glass and cooking pots |
| Store houses | ➢ Renovation of the central store house<br>➢ Renovation of the fertilizer & dolomite keeping house |
| Workshop | ➢ Renovation of the workshop with modern equipment<br>➢ Establishment of car washing shade |
| Plumbing | ➢ Changing the Master Water Tank and the old water supply line |
| parking shade | ➢ Establishment of a car parking shade capacity of at least 10 cars |
| Roads | ➢ Repairing of about 250 m frontal farm & Officer's hostel road |

### 8.2.3. Strengthening of the Experimental Farms

The institute has two experimental farms, one is BTRI farm located at BTRI main campus and another is Bilashcherra Experimental Farm (BEF) located at Kalighat Union, Srimangal. Divisional trials and newly developed technologies are demonstrated at these two farms for subsequent dissemination in the country wide tea estates.

#### 8.2.3.1. Development of BTRI Farm

The farm is located at the BTRI main station having 11.22 ha of land under tea. It includes of an office building, plantation area, NCP, nurseries, seed barri, germplasms, water reservoirs, store houses, farm machineries, management staffs, labors and their residences and other natural resources. The priority development targets for BTRI farm in the FYP are listed below:

Table 9. Priority Development Targets for BTRI Farm

| Areas | Development Targets |
|---|---|
| Farm infrastructure | ➢ Renovation of the existing office building and store house |
| Farm machineries | ➢ Providing one sprinkler irrigation set to cover whole plantation |
| Labor welfare | ➢ Extension and renovation of the labor quarters |
| Manpower | ➢ As per recommendation of BTRI and Bangladesh Tea Board |
| Production (approximate) | ➢ 8 lakhs Fresh cuttings for the tea estates<br>➢ 4 lakhs improved seedlings and rooted cuttings |

#### 8.2.3.2. Development of Bilashcherra Experimental Farm (BEF)

The farm was established in 1965 and stands on 228.36 ha of land of which 109.05 ha is occupied by tea. It comprised of an office building, store houses, farm machineries, vehicles, management staffs, labors and their residences, school, hospital, holly places, plantation area, NCP, nursery, seed barri, germplasms, water reservoirs, and other natural resources. The priority development targets for BEF in the FYP are listed below:

Table 10: Priority Development Targets for BEF

| Areas | Development Targets |
|---|---|
| Farm Office & store houses | ➢ Establishment of a new Farm Office as early as possible<br>➢ Establishment of 3 store houses for different uses |
| Computer & Printers | ➢ At least two Computers with Printers for office management |
| Tea plantation | ➢ 4 ha new extension and 7 ha infilling in the old plantation area<br>➢ A new permanent nursery of 50,000 saplings capacity |

| | |
|---|---|
| | ➢ A new seed barri of 2 ha and<br>➢ Plantation of shade trees in 50 ha of tea cultivated areas |
| Farm infrastructure (roads, bridges, etc.) | ➢ 2 new bridges between the sections 5 & 6 and 8 & 9<br>➢ Development of guard wall in the bridge on section-5<br>➢ Development of 500 m new road in the section-11<br>➢ Establishment of shade -house in the section-2, 10 & 11<br>➢ 60 ha of old plantation areas surrounded by protective net |
| Farm machineries (Irrigation set, vehicles, etc.) | ➢ Buying 2 new tractors with trolly<br>➢ Buying a new sprinkler set with PVC pipe<br>➢ Buying a new light-weight pump machine<br>➢ Buying a car for the labors health-care and transportation<br>➢ Buying a microbus for child education of officers and staffs<br>➢ Buying 3 motor cycles for the farm supervisors<br>➢ Shade for irrigation set, spray voucher, tractors, etc. |
| Labor welfare | ➢ Establishment of 60 *Mirtinga-type* labor quarters<br>➢ Establishment of 4 shallow tube wells<br>➢ Extension of 500 m water supply line at Gang Para & Garo Para<br>➢ Renovation of 50 labor quarters in *Pakka Line* at BEF<br>➢ Development of a new road at Garo Para labor quarter area |
| Residential & other facilities for officers & staffs | ➢ Build in a new building for one farm supervisor and 10 staffs<br>➢ Build in a new bungalow for the farm superintendent<br>➢ Gas line in the residential areas<br>➢ Boundary wall around the office, hospital and residence |
| Holly places | ➢ Extension and improvement of the mosque for the Muslims<br>➢ Establishment of a new Church for the Christians |
| Schools and Hospital | ➢ Build in a new hospital for the labors<br>➢ Renovation of the primary school |
| Production (approximate) | ➢ 40 lakhs Kg green leaves<br>➢ 1,500 Kg improved seeds for seedlings<br>➢ 75,000 seedlings and rooted cuttings<br>➢ Nursing 25,000 shades species |

### 8.2.4. Strengthening of BTRI Sub-stations

The Institute has four regional Sub-stations namely Fatickcherri (Chittagong), Kaliti (Moulvibazar), Panchagarh and Bandarban Sub-station. The aims of these Sub-stations are to conduct regional field trials of the developed technologies, setting experiments, render advisory services and arranging trainings, workshops, seminars, meetings and demonstrations on tea cultivation practices for the tea estates' personnel and small growers. All the Sub-stations are proposed to strengthen in the FYP to promote regional trials and deliver services to the tea industry.

### 8.2.4.1. Development of Fatickcherri Sub-station

This Sub-station is operating since 1969, stands on 40.48 ha of land of which 15.82 ha is occupied by tea. It comprised of a well-developed nursery, seed barri, a hot spot for medicinal plant species, few labor quarters, two officer's bungalow, etc. There is a great opportunity to strengthen the Sub-station. The development strategies of this Sub-station in the FYP are mentioned below:

Table 11. Priority Development Targets for Fatickcherri Sub-station

| Areas | Development Targets |
|---|---|
| Laboratory | ➢ A small scale lab. having major facilities of all the divisions |
| Irrigation set | ➢ 1 sprinkler set capacity of covering 15.82 ha planted areas |
| New plantation | ➢ New extension covering 3-4 ha of land<br>➢ Plantation of 500 shade species in the drought-prone area |
| Labor welfare | ➢ Appointment of 15 laborers & establishment of 15 labor houses |
| Manpower | ➢ As per recommendation of BTRI and Bangladesh Tea Board |
| Transport facilities | ➢ A Jeep for the Officer In-charge to render services to tea estates |
| Residence | ➢ Renovation of the existing Bungalows for the Officer-In-Charge |
| Boundary wall | ➢ Two boundary wall around the Office and the Officer's Bungalow |
| Production (approximate) | ➢ 75 lakhs fresh cuttings for the tea estates<br>➢ 1 lakh rooted cuttings for the tea estates<br>➢ 1,500 Kg tea seeds from the existing seed barri<br>➢ 2.5 lakhs Kg green leaves |

### 8.2.4.2. Development of Kaliti Sub-station

This Sub-station is operating since 1972, stands on 20 acres of land of which 12.5 acres are occupied by tea. It comprised of a permanent nursery (1 acre), eight labor quarters, officer's bungalow, etc. The development strategies of this Sub-station in the FYP are mentioned below:

Table 12. Priority Development Targets for Kaliti Sub-station

| Areas | Development Targets |
|---|---|
| Irrigation set | ➢ 1 mini sprinkler set capacity of covering the planted areas |
| Farm machineries | ➢ Repairing of existing irrigation pump |
| Nursery | ➢ Extension of the nursery capacity of nursing 400,000 seedlings<br>➢ Changing the existing agro-net of HYV nursery |

| | |
|---|---|
| New plantation | ➢ New extension covering 2 acres of land |
| Computer | ➢ 1 computer with printers for office management |
| Motor Bike | ➢ 1 Motor bike for the Field Assistant |
| Manpower | ➢ As per recommendation of BTRI and Bangladesh Tea Board |
| Labor welfare | ➢ Appointment of 5 laborers<br>➢ Established of 5 labor houses |
| Office & residence | ➢ Extension and renovation of Office and Bungalow |
| Boundary wall | ➢ A boundary wall around the Office and the Officer's Bungalow |
| Production (approximate) | ➢ 10 lakhs fresh cuttings for the tea estates<br>➢ 4 lakh rooted cuttings for the tea estates<br>➢ 20,000 nos. shade species for the tea industry |

#### 8.2.4.3. Development of Panchagarh Sub-station

This Sub-station is operating since 2000. It stands on 4.7 acres of land. It comprised of a permanent nursery, mother bush areas, officer's Bungalows, guest houses, etc. The development strategies of this Sub-station in the FYP are mentioned below:

Table 13. Priority Development Targets for Panchagarh Sub-station

| Areas | Development Targets |
|---|---|
| Laboratory | ➢ A mini lab. covering major facilities of the research divisions |
| Nursery | ➢ Renovation of the permanent nursery with a new agro-net<br>➢ Establishment of a nursery house for farm operations |
| Farm improvement | ➢ Establishment of a Compost Production Plant |
| Manpower | ➢ As per recommendation of BTRI and Bangladesh Tea Board |
| Office & residence | ➢ Extension of office and residential facilities for the employees |
| Guest House | ➢ Modernization and extension of the existing guest house |
| Production (approx.) | ➢ Nursing and distribution of 4.5 lakhs tea saplings |

#### 8.2.4.4. Development of Bandarban Sub-station

This Sub-station is operating since 2005, stands on 1.1 acre of land of which 0.91 acre is occupied by tea. It comprised of a permanent nursery, mother bush area, office building, etc. The development strategies of this Sub-station in the FYP are mentioned below:

Table 14. Priority Development Targets for Bandarban Sub-station

| Areas | Development Targets |
|---|---|
| Factory | ➢ Establishment of a Bought Leaves Factory as soon as possible |
| Nursery | ➢ Providing a new agro-net and renovation of the nursery |

| | |
|---|---|
| Laboratory | ➢ A mini lab. covering major facilities of the research divisions |
| Farm machineries | ➢ A power pump to irrigate nursery and mother bush area<br>➢ Establishment of a shallow tube well |
| Office Accessories | ➢ Buying of a Photocopier and necessary office furniture |
| Subsidy | ➢ Arrangement for subsidies to the small growers for plantation |
| Vehicle | ➢ A Jeep for the employees to render services to small growers |
| Manpower | ➢ As per recommendation of BTRI and Bangladesh Tea Board |
| Residence | ➢ Extension of residential facilities for the employees |
| Road | ➢ Repairing of the road adjacent to the Office building |
| Production (approx.) | ➢ Nursing 2 lakhs tea saplings for the small growers |

### 8.2.5. Service Development

In addition to different services provided by BTRI to the tea industry, the following targets are taken under consideration with a special emphasis to implement the FYP.

Table 15. Priority Targets for Service Development

| Areas | Development Targets |
|---|---|
| Advisory services | ➢ Services for small growers in North Bengal to maintain tipping standard, plucking table and pruning cycle<br>➢ Improve and increase the number services to the tea industry |
| Seminar/Workshop | ➢ At least 30 at BTRI and all the Sub-stations |
| Technology | ➢ Quick dissemination of the developed technology |
| Training | ➢ Increase the frequency of training programs for the management employee of the estates and small tea growers |
| Labor welfare | ➢ Improvement of existing Sanitation, Health, Education facilities |

### 8.2.6. Access to ICT

Access to and application of ICT is urgent necessary for quick dissemination of technologies and providing related services to the industry. In view of this, the following development targets are taken under consideration to implement the FYP.

Table 16. Priority Development Targets for ICT

| Areas | Development Targets |
|---|---|
| Software | ➢ Development of Institutional software on tea husbandry<br>➢ Development of Offline Mobile Applications on tea culture |
| Wi-Fi zone | ➢ Wi-fi facilities for BTRI main station and the Sub-stations |
| Online services | ➢ E-filing communication system among the related offices |

### 8.2.7. Linkage Development

Institutional or multidisciplinary collaborative linkage is essential for sharing and gaining knowledge, developing skills and experiences, updating research and improving services. In consideration of the point, the following targets are taken to implement the FYP.

Table 17. Priority Targets for Linkage Development

| Areas | Development Targets |
|---|---|
| National | ➢ At least 10 MOU or Research Collaboration Linkage with National Research Organizations and Universities |
| International | ➢ At least 5 MOU or Research Collaboration Linkage with International Research Organizations and Universities |
| Seminar/Workshop | ➢ Increase the frequency of Arranging seminar/Workshops from technological aspects for the development of tea industry |

# Chapter 9

# RECOMMENDATIONS

The Institute has proposed 46 need based research projects for the tea industry and some development targets prioritizing HRD, laboratories, infrastructures, CTC factory, experimental farms, Sub-stations, ICT, etc. which will be expected to complete within the period. The timely implementation of the proposed plan depends on proper inflows of fund and resources into its operations. Whatever the source of fund is it should be utilized on priority basis according to urgent need and demand of the Institute and the industry as a whole. The following top priority targets are recommended to start the FYP into implementation. These are:

1. **Establishment of New Laboratories:** Conventional research approaches may not sustain to overcome the current challenges faced by the tea industry. Need based research in relation to changed environment should need to initiate at BTRI. Neighboring India, China, Srilanka and even Indonesia has introduced multidimensional facilities in their research organizations to keep up the tea. In Bangladesh, various research institutes like BRRI, BARI, BJRI, BINA, NIB, etc. have already been initiated sophisticated research environment to developed high yielding crop varieties with special character such as salinity tolerance, submergence tolerance, disease and drought tolerance, shortening of life cycle, Zn-enriched rice, etc. in their crop improvement programs. So, the BTRI is strongly put an emphasis to establish new laboratories at the main station, and in regarding this, convincing justifications and recommendations are illustrated in the Chapter 8, Article 8.2.2.1.

2. **Human Resources Development:** The key elements of human resource development are learning, education and training. The Institute lays emphasis on training, focusing on the job training, role based training and career training. The current process begins with assessing the needs of individual scientist, management officers and staffs. Once the needs are identified, individuals are trained and capacities developed, and ultimately it will be conducive to implement the plan.

3. **Modernization of CTC factory:** The current processing capacity of the CTC factory is mentioned earlier in the Chapter 8, but it is recommended to modernize with new machineries to retain the quality of finished teas as well as to increase the performance of the factory.

4. **Initiation of Mechanization:** Labor crisis in tea industry is gradually dominating due to rapid urbanization and industrialization. So, to overcome the emerging challenge the Institute recommends to flow of resources either financial or physical into its research and development operations to initiate mechanization.

5. **Development of physical resources at BEF:** The farm needs a massive development program in various dimensions. To enhance the performance and improve the working environment, the institute is strongly recommended to build and modernize physical resources especially office building, store houses, and residences for the management staffs of the Bilashcherra Experimental Farm as early as possible.

6. **Establishment of Brought Leaf Factory at Bandarban Sub-station:** The small growers of Bandarban could not process, and didn't get fair price for their green leaves that they produced in the garden. To inspire them and to extend tea cultivation in the hill district, it is recommended to establish a Bought Leaf Factory with modern equipment in suitable place urgently.

7. **Providing Irrigation set at Fatickcherri Sub-station:** The land area under tea at the sub-station is 15.82 ha, suffer from severe water stress mostly the young saplings and planted hilly slopes during dry seasons which ultimately increase the mortality rate of plants and thus hamper crop yield. New extension without irrigation facility becomes challenging and unfruitful. So, it is recommended to supply a sprinkler irrigation set so as to save the plantation.

8. **Changing Water and Electricity Supply Line of BTRI:** The existing water and electricity supply lines of BTRI main station is more than fifty years of old, which are inconvenient to provide services in its boundary and thus incurred over expenditure to repair every year. There is needed a massive improvement program. Therefore, it is recommended to change these lines with improved materials to ensure proper supply of water and electricity.

9. **Establishment of a Multistoried Dormitory at BTRI:** The Institute felt a challenge to provide accommodation for the new employees; trainees and other delegates who are participated in different programs. To get relief from the hassle, it is recommended to establish a new dormitory in its own premise.

10. **Access to ICT and Linkage development:** For quick dissemination of technologies, providing related services, effective communication and office management, there is no alternative to ICT. On the other hand, institutional or multidisciplinary collaborative linkage is essential for sharing and gaining knowledge, developing skills and experiences, updating research and improving services. In view of these, it is recommended to create ICT facilities including all the sub-stations as well as linkage with national & international research organizations and universities through MOU.

## Recommendation on Fund and Resource Flows:

Research and development sectors of BTRI are funded by the government through BTB. The need based special projects such as establishment of laboratories, laboratory equipment and facilities, initiation of mechanization, modernization of CTC factory, farm machineries (like sprinkler irrigation set), labor welfare projects like development of residence, school, hospital, etc. can be funded through consultative and participatory approaches of BTRI, BTB and the Ministry of Commerce with national and international agencies such as BARC, ADB, WB, EU, UNDP, JICA, DFID, etc. On the other hand, the Institute and the Board can be searched fund and resources jointly from the government of Bangladesh as well as foreign agencies to conduct research, and develop mitigation strategies to overcome the climate change threats on tea industry.

# Chapter 10

# CONCLUDING REMARKS

Progress or failure of an organization is mostly dependent on its operational activities oriented with vision-missions-objectives-functions as well as attitudes on materialization of either short-term or long-term articulated strategic plan towards the goal. In quest of successive progression of BTRI, the Institute has formulated the "1st Five Year Plan" FY2017-2021 in consideration with past policies and strategies to ameliorate its divisional researches, related research facilities, development services, etc. for the advancement of the tea industry.

In relating with the 'Vision-2021', 'Road Map: Bangladesh Tea Industry', Vision-Missions-Objectives and Functions of Bangladesh Tea Board a correlated research and development goal is addressed in the FYP as 'Making Vision-2021 a reality by accelerating researches and rendering development services to the tea industry'. The strategic goal of the plan is assembled with some 'Objectives' and 'Targets' illustrated under the sector of 'Research' and 'Development'-the pillar of success.

The research projects proposed by the respective division have presented in the FYP and furnished accordingly to overcome the current challenges faced by the industry. The development targets are described after identifying the problems, which prioritize human resources development, establishment of new laboratories, improvement of CTC factory, experimental farms, strengthening of Sub-stations, access to ICT, development of linkages, infrastructures, etc. for the advancement of the institute.

The BTRI has some qualified scientists, management officers and staffs. So, the Institute might able to implement the FYP through collaborative linkage with BTB, national and international research and financial organizations, planters, tea laborers and consumers. The proper implementation of the "1st Five Year plan" of BTRI will bring significant changes in research and development sectors, which will ultimately herald a positive transformation in the tea industry.

**Appendix I. Target of Expenditure for Research in the FYP** (Taka in Lakh)

| Serial No. | Sector of Expenditure | Purposes | Approving Authority | Sources of Fund | Expected Yearly Expenditure | | | | | Amount (Lakh Tk.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1st | 2nd | 3rd | 4th | 5th | |
| 1 | Soil Science Division | No of Exp.=7 (field & lab.), equipment, etc. | BTB/BTRI | BTB or Project | 12 | 12 | 12 | 12 | 12 | 60 |
| 2 | Botany Division | No of Exp.=5 (field & lab.), equipment, etc. | BTB/BTRI | BTB or Project | 44 | 44 | 44 | 44 | 44 | 220 |
| 3 | Agronomy Division | No of Exp.=3 (field & lab.), equipment, etc. | BTB/BTRI | BTB or Project | 32 | 32 | 32 | 33 | 35 | 164 |
| 4 | Plant Pathology Division | No of Exp.=6 (field & lab.), equipment, etc. | BTB/BTRI | BTB or Project | 13 | 13 | 13 | 13 | 13 | 65 |
| 5 | Entomology Division | No of Exp.=10 (field & lab.), equipment, etc. | BTB/BTRI | BTB or Project | 15 | 15 | 15 | 15 | 15 | 75 |
| 6 | Biochemistry Division | No of Exp.=9 (field & lab.), equipment, etc. | BTB/BTRI | BTB or Project | 40 | 40 | 40 | 40 | 40 | 200 |
| 7 | Statistics & Economics | No of Exp.=5 (field & lab.), equipment, etc. | BTB/BTRI | BTB or Project | 5 | 6 | 5 | 6 | 6 | 28 |
| 8 | Technology Division | No of Exp.=1 (field & lab.), equipment, etc. | BTB/BTRI | BTB or Project | 1 | 1 | 1 | 1 | 1 | 5 |
| Total target of expenditure (approx.) | | | | | 162 | 163 | 162 | 164 | 166 | 817 |

**Appendix II. Target of Expenditure for Development in the FYP** (Taka in Lakh)

| Serial No. | Sector of Expenditure | Purposes | Approving Authority | Sources of Fund | Expected Yearly Expenditure | | | | | Amount (lakh Tk.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1st | 2nd | 3rd | 4th | 5th | |
| 1 | HRD | Training & higher education for eligible candidates | BTB/BTRI | BTB or Project | 30 | 30 | 30 | 30 | 30 | 150 |
| 2 | BTRI Laboratories | BTRI Central lab., Biotech. Lab., Tea Disease Clinic & Green house | BTB/BTRI | BTB or Project | 262 | 263 | 262 | 263 | 261 | 1,311 |
| 3 | CTC Factory (emergency) | CTC machine, Rotorvane, Dryer, Grooving machine, etc. | BTB/BTRI | BTB or Project | 35 | 35 | 35 | 35 | 32 | 172 |
| 4 | BTRI Library | Computer with Printer, Chair and Book shelves, etc. | BTB/BTRI | BTB or Project | 1 | 1 | 1 | 1 | 1 | 5 |
| 5 | BTRI Infrastructure | Mosque, Residence, Store houses, Workshop, Roads, etc. | BTB/BTRI | BTB or Project | 200 | 200 | 200 | 200 | 200 | 1,000 |
| 6 | BTRI Farm | Renovation of office building, Machineries, etc. | BTB/BTRI | BTB or Project | 30 | 30 | 30 | 30 | 30 | 150 |
| 7 | Bilashcherra Experimental Farm (BEF) | Plantation, New office, store houses, Labor houses, Roads, Bridge Vehicles, School, Hospital, etc. | BTB/BTRI | BTB or Project | 110 | 110 | 110 | 110 | 110 | 550 |
| 8 | Fatickcherri Sub station | Lab., Irrigation set, New plantation, Vehicle, etc. | BTB/BTRI | BTB or Project | 30 | 30 | 30 | 30 | 30 | 150 |
| 9 | Kaliti Sub-station | Mini irrigation set, New plantation, Vehicle, Computer set, etc. | BTB/BTRI | BTB or Project | 6 | 6 | 6 | 6 | 6 | 30 |
| 10 | Panchagarh Sub-station | Lab., Nursery, Manpower, Residence, Guest house, etc. | BTB/BTRI | BTB or Project | 10 | 10 | 10 | 10 | 10 | 50 |
| 11 | Bandarban Sub-station | Factory, Lab., Nursery, Residence, Vehicles, etc. | BTB/BTRI | BTB or Project | 110 | 110 | 110 | 110 | 110 | 550 |
| 12 | Service Development | Technology, Training, Seminar/Workshops, etc. | BTB/BTRI | BTB or Project | 6 | 6 | 6 | 6 | 6 | 30 |
| 13 | ICT | Wi-fi, Software, Online services | BTB/BTRI | BTB or Project | 3 | 3 | 3 | 3 | 3 | 15 |
| 14 | Linkage Development | Seminar/workshops, National & International MOU, etc. | BTB/BTRI | BTB or Project | 4 | 4 | 4 | 4 | 4 | 20 |
| Total target of expenditure (approx.) | | | | | 837 | 838 | 837 | 838 | 833 | 4,183 |