



2019

GROW LIBERIA

CURRICULUM

Natural Rubber Production and Ribbed Smoked Sheets Processing

One Semester Certificate Course for Technical and Vocational Education Training

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Acronyms

BCTC	Bong County Technical College
BWI	Booker Washington Institute
IMTC	Inter-Ministerial Technical Committee on TVETs
GBCC	Grand Bass Community College
GROW	GROW Liberia
GOL	Government of Liberia
LATA	Liberia Agricultural Transformation Agenda
RSS	Ribbed Smoked Sheets
RSS-CDC	Ribbed Smoked Sheets Curriculum Development Committee
MOA	Ministry of Agriculture
MOCI	Ministry of Commerce and Industry
MOE	Ministry of Education
MOL	Ministry of Labor
MYS	Ministry of Youth and Sports
NCCC	Nimba County Community College
TAVTC	Tumutu Agriculture Vocational Training Center
TVET	Technical and Vocational Education Training

Background

As the Liberian rubber sector works to regain its momentum in the world market, the Government of Liberia (GOL) is promoting investment in the rubber sector in part through the introduction of Ribbed Smoked Sheets (RSS) processing. The Government of Liberia aims to leverage the West African market demand for Ribbed Smoked Sheets (RSS) in the short-term and other products derived from rubber in the long-term.

In order to grow RSS processing in Liberia, an alternative processing method new to the country, workforce technical skills development will be needed. To this end, four Technical and Vocational Education Training (TVETs) institutions collaborated with the GROW program to develop and launch an RSS curriculum for students. A draft curriculum was developed by an established Curriculum Development Committee (CDC) that consisted of partner TVETs, the Inter-Ministerial Technical Committee (IMTC), and GROW technical team. The draft curriculum was validated at a workshop on August 31, 2017 and approved for piloting at partner TVET institutions. It was piloted for two semesters at partner TVETs in 2017-2018 and updated to reflect learning in 2019. Twelve instructors have completed qualified training courses to continue to teach the course to future students.

The following curriculum is for a single semester course with emphasis on practical and hands on skills development. TVETs with capacity and resources may opt for modified versions tailored for their institutions.

About GROW Liberia

GROW Liberia collaborates with businesses, investors, associations, and government agencies to accelerate systemic solutions that transform high growth sectors and drive inclusive economic growth. GROW invests in agricultural industries, including rubber, with funding from the Swedish International Development Cooperation Agency (SIDA).

TVET RSS training program, developed with support from GROW, is important to Liberia's future RSS opportunity. With close to a century of experience as one of Africa's leading natural rubber producers, over 100,000 hectares of rubber plantations under cultivation, and technical colleges now offering courses in rubber cultivation and processing to a youthful workforce, Liberia is well positioned to be a new hub for Ribbed Smoked Sheets (RSS) in West Africa. For the rubber sector in Liberia, RSS presents a less capital intensive processing alternative with the potential to involve a wider range of actors in value addition and contribute to the development of the industry.

The curriculum is a product of the culmination of the combined efforts of GROW Liberia, the IMTC and partner TVET institution

MESSAGE Chair from the Inter-Ministerial Task Force on Technical and Vocational Education and Training

The Inter-Ministerial Task Force on Technical and Vocational Education and Training (TVET) was constituted by the President of Liberia to spearhead the Government's efforts to improve the level of technical training for the youth of the country. The Ministry of Youth and Sports (MYS) chairs the IMTC which is co-chaired by the Ministry of Education (MOE) with the Ministries of Labor (MOL), Agriculture (MOA) and Commerce and Industry (MOCI) serving as members.

On August 31, 2017 the draft curriculum developed for a certificate course in PRODUCTION OF NATURAL RUBBER AND MANUFACTURE OF RIBBED SMOKED SHEETS, (RSS) representing the coordinated efforts of the IMTC and the five TVETs; Bong County Technical College (BCTC), Booker Washington Institute (BWI), Grand Bassa Community College (GBCC), Nimba County Community College (NCCC) and the Tumutu Agriculture Vocational Training Center (TAVTC) with funding and technical support from GROW Liberia, was validated and approved for piloting. TAVTC dropped out of the program due to the lack of support and some difficulties in scheduling alignment.

The initially validated curriculum was rolled out for piloting at the five partner TVETS. Now that the pilot phase is completed and consensus has been attained amongst the partners on the way forward, as recommended, the Government of Liberia wishes to extend its thanks and appreciation to the GROW/SIDA family, the administration and support staff from partnering TVETS, the consultants and all those who contributed to and participated in the development of this product.

This curriculum will serve as the standard course for rubber culture and processing at TVETs and other agricultural institutions.

Honorable D. Zogar Wilson
Minister for Youth and Sports

Introduction

In August, 2017, the Inter-Ministerial Technical Committee (IMTC) on Technical and Vocational Education Training (TVET) validated a CURRICULUM FOR CERTIFICATE COURSE IN “PRODUCTION OF NATURAL RUBBER AND MANUFACTURE OF RIBBED SMOKED SHEETS” that had been jointly developed by a committee composed of representatives from the IMTC and five TVETs with technical support from national and international consultants supported by GROW.

A pilot phase was ran by four (4) TVETs during the 2017/2018 academic year based on memoranda of understanding developed between GROW and five (5) TVETs to develop a training curriculum for rubber agronomy and the processing of natural rubber ribbed smoked sheets that will be piloted at the five TVETs starting in the first semester of the 2017/2018 academic year. The partnership between GROW and the TVETS focused on the following areas:

- Convert RSS training manual developed by GROW into a course of study that will be offered in Second semester 2017/ 2018;
- Develop the associated curriculum, including the instructors training guides, instructional resources and training manuals on all activities ranging from farm management to the RSS processing;
- Develop an internship program that will be offered to participating students as part of the course of study and allow them to put the acquired knowledge into practice at rubber farms and RSS processing facilities;
- Work with the private sector and relevant authorities, including the government and other local, regional and international bodies, for approval and adaptation;
- Set up a monitoring and evaluation framework to ensure that students are acquiring skills and training that meet the needs of the industry.

The curriculum was originally designed to be run for two semesters as a skills development and capacity building training in the rubber value chain for TVET & college students, rubber farmers, factory managers and high school leavers with specific emphasis on rubber production and processing of ribbed smoked sheets (RSS).

The curriculum was validated and piloted at four of the five TVETs. During the pilot phase, GROW and partners monitored and evaluated the program and made recommendations to fine-tune the curriculum which is then expected to be adopted as the standard for all agricultural TVETs and institutions of higher learning.

During the course of the curriculum development process, some follow-up support actions were recommended. These include:

- That the TVETs should be encouraged and empowered to establish their own nurseries and rubber farms to enhance their sustainability for teaching practical skills and income generation;
- The TVETs be encouraged to actively participate in extension and advisory services for building capacity in tapping skills and efficiencies to address the low productivity of the smallholders; and
- Conduct research into fabrication of affordable hand operated processing equipment for use by small farmers.

The pilot phase has ended and evaluation indicated that the TVETs recommended that the time frame for the course should be revisited with the view of reducing/compressing the course to one semester instead of the two semesters as originally designed.

This revised curriculum is presented as an alternative one semester training that incorporates both the rubber culture and the RSS production components. The course is structured for 4 periods, each consisting of 3 weeks of theoretical lectures plus 1 week of practical field exercises. This will be followed by a 2-3 week internship at rubber farms or at an RSS production facility.

Guidance Note for Teachers

The curriculum below is intended to be used in TVETs that have existing agriculture training programs. Following a two semester pilot phase in which the course was originally spread over two semesters, it was agreed by the consultants and the participating TVET partner institutions that the course be compressed into one semester. The curriculum is intended to be used as a modified course in Rubber Culture that will replace the existing courses already taught in the agriculture programs at the TVETs. The components of agronomy (rubber culture) and natural rubber processing focusing on the production of ribbed smoked sheets (RSS) have been merged with greater emphasis on field practical skills development and practicums in value addition. The methodology to be used is focused on the practical aspects of rubber culture and RSS processing. To this end, the course has been structured to hold a full week of intense practical activities every fourth week with concentration on topics and exercises covering rubber culture for the first twelve weeks of a sixteen week semester whilst the last four weeks will concentrate on latex collection, handling and processing of ribbed smoked sheets.

In all instances, practical demonstrations and field studies will be emphasized with visitations/excursions to farms, concessions, processing establishments and 4-6 weeks of internships urged. The flexibility in the structure should allow institutions to plan and schedule the field studies to fit the students' schedules. A modification of this could also be used, notwithstanding.

COURSE:	RUBBER AGRONOMY AND RSS PROCESSING (One Semester)
COURSE TITLE:	NATURAL RUBBER CULTURE AND PROCESSING
CREDIT HOURS:	4 (12 WEEKS THEORY; 4 WEEKS PRACTICAL)
COURSE CONTENT:	AGRONOMY COMPONENT-NATURAL RUBBER CULTURE (9 WEEKS OF INSTRUCTION PLUS 3 WEEKS OF FIELD EXERCISES) PROCESSING COMPONENT- PRODUCTION FOR RIBBED SMOKED SHEETS (3 WEEKS OF INSTRUCTION PLUS 1 WEEK OF PRACTICAL FOLLOWED BY 2 WEEKS OF INTERNSHIP)
DURATION:	16 WEEKS (12 WEEKS OF INSTRUCTION PLUS 4 WEEKS OF PRACTICAL/FIELD OPERATIONS)
GOAL:	TO TRAIN STUDENTS IN THE THEORY AND PRACTICE OF NATURAL RUBBER CULTURE AS IT APPLIES TO THE LIBERIAN SETTING AND PROCESSING & QUALITY CONTROL OF RSS
GENERAL OBJECTIVES:	TRAINING RUBBER FARMERS, FACTORY MANAGERS AND HIGH SCHOOL LEAVERS SEEKING FOR JOBS IN RUBBER FARM MANAGEMENT AND RIBBED SMOKED SHEETS PRODUCTION

UPON COMPLETION OF THE COURSE THE STUDENT WILL:

- Have a basic understanding of the economics of natural rubber production in Liberia;
- Have a basic knowledge and understanding of the agronomy, anatomy, and physiology of the rubber tree;
- Have acquired basic agronomic skills as well as processing techniques and knowledge of the cultivation of natural rubber;
- Have an understanding of the composition and properties of natural rubber latex;
- Have a grasp of the quality control methods of latex collection and treatment required for RSS production;
- Understand the steps involved in RSS processing, drying and grading;
- Be familiar with the design and operation of smoke houses;
- Have an understanding of the environmental waste control measures for water from the processing operations/activities.

Course Overview

WEEK 1: 3 Hrs. lecture

- World Natural rubber supply and demand;
- Establishment, cultivation and development of natural rubber in Liberia;
- Economics of rubber production and distribution in Liberia;
- Structural Organization and Holdings of the Rubber Sector/Sub-sector.

WEEK 2: 3 Hrs. lecture

PRE-PLANTING OPERATIONS: SITE SELECTION AND LAND PREPARATION

- Soils for Rubber cultivation and their Characteristics;
- Climatic Conditions and Rainfall Pattern for rubber growing;
- Land suitability, selection and soil conservation:
 - For Root stock production
 - For budwood production
 - For field planting
- Contour planting and terracing and draining to minimize soil erosion;
- Rubber Growing Soils;
- Suitable Clones for conditions in Liberia;
- Legume Cover Crop establishment.

WEEK 3: 3 Hrs. lecture

FIELD PLANTING

- Field Planting
 - Planting and establishment of tree architecture plantation;
 - Legume Cover Crop/ What are quality plants/ High yielding clones and their importance to increase productivity;
 - Planting distances contour planting and terracing and draining to minimize soil erosion
- Intercropping
- Correct agronomic practices to be followed in field preparation for new planting/ replanting of rubber and elimination of root diseases.

WEEK 4: 3hrs. Practical /Field exercises

Topic: Plantation visit /Nursery development.

WEEKS 5-6: 6 Hrs. lecture

- Field Maintenance and Care/Nursery establishment
 - Weeding Management /slashing/pruning/pest and disease control/cover crop maintenance;
- Bud wood nurseries, stock nurseries and quality plant production;
- Establishment, development and management of root stock and bud wood nurseries;
- Bud grafting techniques, clones or types of planting materials.

WEEK 7: 3 Hrs. lecture

- Nutrition in natural rubber;

- Fertilizer types and application;
- Fertilization, Manuring, mulching and weed control;
- Chemical applications
 - Environmental considerations.

WEEK 8: 3hrs. Practical /Field exercises

Topic: Nutrition/Fertilization.

WEEKS 9-10: 6 Hrs. lecture

- Disease symptoms, identification of diseases;
- Insects, pests and diseases important to rubber cultivation;
- Introduction to breeding methods.

WEEK 11: 3 Hrs. lecture

TAPPING AND STIMULATION

- Marking trees for tapping at the correct girth using a stencil; bark consumption and marking trees for tapping at the correct height;
- Tapping task, marking yielding trees and the role of supervisors;
- Field processing of latex and quality control in the field;
- Importance of hygiene, Cleaning collecting cups and strainers and adding anti-coagulants to prevent pre- coagulation of latex and to control VFA number of latex.

WEEK 12: 3hrs. Practical /Field exercises

Topic: Diseases-and pests/Hygiene/Quality Control.

WEEK 13-14: 6 Hrs. lecture

- Composition of latex;
- Reception of latex;
- Standardization calculations and purpose of standardization;
- Coagulation of latex:
 - Pan and Tank coagulation;
 - Preparation of stock solution of formic acid;
 - Dosage of acid for coagulation;
 - Detection of end point.

WEEKS 15-16: 6 hrs. Practical/Field operations

- Collection of latex in the field;
- DRC estimation using the Metrolac;
- Coagulation;
- Milling and Washing;
 - Flattening the coagulum to facilitate feeding it into the mill,
 - Passing through the rolling battery without over lapping,
 - Thorough washing in fresh flowing water,
- Air drying
- Smoke house operation (**INTERNSHIP TO BE ARRANGED AT PRODUCTION FACILITY (2-3 WEEKS).**)

Course Content: Combined Agronomy and RSS Processing

	THEORY			PRACTICAL (EVERY 4 WEEKS)		
Wk	Topics /Specific Learning Objective	Teaching Activities / Methodology	Learning Resources	Specific Learning Objective	Teaching Activities /Methodology	Learning Resources
1	<p><u>GENERAL INTRODUCTION TO RUBBER CULTURE</u></p> <ul style="list-style-type: none"> World Natural rubber supply and demand Cultural practices in the establishment, cultivation and development of natural rubber in Liberia. Economics of rubber production and distribution in Liberia. Structural organization & Categories of holdings in the Rubber Sector Liberia 	<p>Students will study:</p> <p>Trends in worldwide & local rubber production; Historical contribution of rubber to Liberia’s GDP; Results of SWOT analysis of the rubber sector. Characterize rubber sector holdings in Liberia</p>	<p>Charts showing:</p> <p>Worldwide rubber production Historical Importance of rubber in Liberia. National Rubber Development Plan Documents on rubber related organizations in (RDF, RPAL, etc.)</p>	<p>Student will:</p> <p>Get an overview of the rubber sector within Liberia and worldwide;</p>	<p>Field trip to small holder rubber farm; large plantations and concession areas to compare and contrast various categories of holdings and management practices;</p>	<p>Statistics, survey reports and databases on the rubber sector</p>
2	<p><u>PRE-PLANTING OPERATIONS: SITE SELECTION AND LAND PREPARATION</u></p> <ul style="list-style-type: none"> Soils for Rubber cultivation and their Characteristics. Climatic Conditions and Rainfall Pattern for rubber growing in Liberia. Land suitability, selection and soil conservation <ul style="list-style-type: none"> For Root stock production For budwood production For field planting Contour planting and terracing and draining to minimize soil erosion. 	<p>Learners are asked to:</p> <p>Give reasons for site selection and discuss the steps in site selection. Discussion on criteria for selecting land suitable for rubber planting</p>	<p>Soils Maps of Liberia Training Manuals, Books Rainfall data on Liberia (historical rainfall and new data if available) Diagrams showing site selection processes and steps Diagram/chart illustrating land preparation for various types of planting configurations</p>	<p>Enhance learners’ ability to practice basic site selection principles in the field.</p>	<p>Identify suitable land. Field layout techniques</p>	<p>Diagrams/ Illustrations & examples of site selection methods Maps showing rainfall patterns, soil and topography of Liberia</p>

	<ul style="list-style-type: none"> ○ Rubber Growing Soils ○ Suitable Clones for conditions in Liberia ○ Legume Cover Crop establishment 					
3	<u>FIELD PLANTING</u> <ul style="list-style-type: none"> ● Planting and establishment of tree architecture in plantation. ● What are quality plants? ● High yielding clones and their importance to increase productivity. ● Planting distances ● Intercropping ● Elimination of root diseases. 	Students will develop planting skills for: Proper plantation architecture/Selection of quality planting materials such as high yielding clones/ Planting distances for various clones/ Removal of old roots to eliminate diseases	Training Manuals, Books on characteristics of various clones suitable for Liberia	Enhances learners ability to practice these basic principles on their own	Identify tools and implements for land clearing/Field layout techniques Ensure getting rid of old roots affected with white root disease when replanting is done.	Tools/implements used in land clearing (manual and mechanized) Field trip to identify suitable land and clearing activities and operations
4	<u>PRACTICALS/ FIELD EXERCISES</u> <ul style="list-style-type: none"> ● Field visits to plantations/farms ● Field exercises at Nursery established at TVET. 	Field trip to small holder rubber farm; large plantation and concession area to compare and contrast various categories of holdings. Field work at nursery established at TVETs	Training Manuals, Books and Charts/Diagrams illustrating rubber planting methods.	Field lay-out/ Plantation architecture/ Field Planting/ Importance of selection of quality plants /Correct agronomic practices to be followed in field preparation for new planting/ replanting of rubber.	Enable learners to carry out individual planting operations in the field Knowledge on bud-grafting and its importance. Enhance basic field design such as lining, pegging and hole digging	Field trip to demonstrate the practice and usage of tools in measurement and planting: bud grafting knife, tape lines, twine, ping-a-ling, etc.
5-6	<u>FIELD MAINTENANCE AND CARE</u> <ul style="list-style-type: none"> ● Weeding Management /slashing/pruning/cover crop maintenance <u>NURSERY ESTABLISHMENT, OPERATION AND MAINTENANCE (O&M)</u> <ul style="list-style-type: none"> ● Bud wood nurseries, stock nurseries and quality plant production 	Weeding/slashing Pruning to make taping panel above 68" / Benefits (economic and agronomic) of intercropping in rubber farms. Teach trainees the agronomic importance of mulching, shading	Diagrams illustrating: Composting/Weeding methods/Mulching, Maintenance of plant density/ population per acre/hectare Rubber seedling in polybags for classroom demonstration. Photos of operational nurseries.	Field examples of Planting distance Lining/Pegging/ Holing/Planting methods such as Triangular planting; Square planting; Planting materials; Bare rooted stumps; Poly bags plants;	Students will learn how to: Identify quality planting material in order to maintain growth for maximizing yield. Identify appropriate clones Calculate plant population density per	Facilitators ask learners to write short notes on what they have learned in the field. Brainstorming on field planting, vis-a-vis incorrect field planting to

	<ul style="list-style-type: none"> Establishment, development and management of root stock and bud wood nurseries. Bud grafting techniques, clones or types of planting materials. Introduction to breeding 	<p>and white washing Bring rubber seedling to class for individual learners to observe and participate in the demonstration of bud grafting; Learners are asked to explain the steps in carrying out budding.</p>		<p>Advanced planting; materials Legume Cover crop maintenance</p>	<p>acre / hectare Basic field measurements Techniques of planting poly bags and bare rooted stumps</p>	<p>correct field planting techniques.</p>
7	<p><u>NUTRITION AND FERTILIZATION</u></p> <ul style="list-style-type: none"> Nutrition in natural rubber Fertilizer types and application Fertilization, Manuring, mulching and weed control Chemical applications Environmental considerations 	<p>Learners are provided different types of fertilizer materials and methods for application;</p>	<p>Books, Training manuals, audio-visual aids</p>	<p>Students will learn the practice of: Nursery establishment Site selection Types of nurseries and area required for each type; Nursery Management (O&M); Preparation of nursery and seed germination beds; Planting in nurseries; Bud-grafting</p>	<p>Field activities to nurseries to observe/study various nurseries types including: Seedling nursery Bud wood nursery Polybag nursery. Discussions with nursery managers/</p>	<p>Land and materials to set up a small nursery Polybags, fertilizer, Tools and implements, bud grafting knives</p>
8	<p><u>FIELD EXERCISES/PRACTICALS</u></p>	<p>Site visits to concession area/ plantation to observe the calculation of dosages and the methods of application of fertilizers; Practice the correct application of fertilizer. Enable trainees to do fertilizer rate calculation; Know when and how to apply the right fertilizer and at which stage of plant growth cycle</p>	<p>Training manuals, books. Samples of various fertilizers Diagrams/charts of fertilizers and methods of applications</p>	<p>Census and infilling Soil & Foliar analysis Mulching, Shading and whitewashing</p>	<p>Field trips to illustrate basic crop husbandry techniques, e.g. regular weeding composting, correct pest control among others. Importance of regular application of fertilizer Importance of soil & foliar analysis for cost reduction in fertilizer application</p>	<p>Field trip to practice field application of fertilizer Fertilizers for trainees to carry out the process with teachers facilitating the methodology.</p>

9-10	<u>FIELD MAINTENANCE AND CARE</u> <ul style="list-style-type: none"> • Diseases and Pests • Infestation Symptoms & Identification & Control • Categories of diseases: <ul style="list-style-type: none"> ○ Foliage ○ Root ○ Panel • Distribution/Disease cycles • Epidemiology /Symptoms and diagnosis • Disease symptoms, identification of diseases/Insect pests and diseases important to rubber cultivation/ • Teach the mode of transmission and life cycle 	Class lectures on integrated pest management (IPM) with illustrations; Brainstorming sessions to formulate practical pest control measures and how to identify the various diseases of rubber. Discuss the economic importance of rubber diseases and pest	Training Manuals, Books, diagrams illustrating the life cycle of major insect and other pests. Photos showing: Various pests / Effects of common rubber diseases	Effects of pests and diseases on rubber tree. Identifying the diseases by diagnosing their symptoms and signs. Practical pest and disease control methods	Field observations to identify various pests and diseases and observe the symptoms and effects.	Diagrams/photos showing pests and diseases symptoms, signs and effects;
11	<u>TAPPING AND STIMULATION</u> <ul style="list-style-type: none"> • Enhance trainees ability with the basic operational activities prior to and during tapping including: • Mapping/Marking/Panel marking/Tasking/Opening/ • Opening Height/Girth measurement/Time of tapping/ collection/Tapping materials/Tapping cuts/Tapping quality 	Students will learn the correct methods of: Determination of correct time/ conditions when trees are ready for opening. Correct tapping methods; Identify the right instruments and tools for tapping; Basic latex collection techniques	Training Manuals, Books Tapping utensils Panel markers, spouts, wires hangers, cups, buckets, among others.	Field trips to observe: Mapping/Marking Panel marking/ Tasking/Opening Opening Height Girth measurement Time of tapping/ collection Tapping Materials Tapping cuts & panel Tapping quality- depth of tapping & bark consumption; Stimulation	Identify correct tapping methods; Identify the right instruments and tools for tapping enhance trainees ability with the basic field operation activities prior to and during tapping Teach basic latex collection techniques	Tapping utensils Panel markers Training manuals, books,
12	<u>FIELD EXERCISES/SITE VISITS:</u> <ul style="list-style-type: none"> • Enhance trainees ability to identify symptoms, signs and physiological disorders of rubber plants affected by pest, disease and/or stress; 	Site visits to view examples of pests and diseases at selected farms. Arrange visit to farm being opened to observe tasking,	Illustrations, Manuals, tapping tools, books	Enhancing students field and practical knowledge of mature rubber stands on disease, pest and latex harvesting;	Making observations, note taking, making inquiries and participating in field discussions;	Notebooks, cameras, recorders, Manuals;

	<ul style="list-style-type: none"> Observe and participate in farm opening exercises Including tapping and stimulation 	marking/stenciling				
13-14	<u>FIELD MANAGEMENT OF LATEX</u> <ul style="list-style-type: none"> Latex Processing: Quality control and making of various rubber grades; Processing at Smallholders' farms (Cup lump, coagulum, RSS, crepe) Processing at Large Plantation plant (Latex concentrates, Crumb rubber, RSS); Use of Metrolac to estimate DRC of field latex 	Trainees are taught the various methods for production of desired end product (latex for RSS, latex for coagulum, cup lump, etc). Quality control methods stressed;	Training Manuals, Books Metrolac, Field preservative Latex collection utensils A diagram/flow chart of the process starting at the tree up to the delivery of latex to farm factory	Correct methods of collection and preparation of latex in the field, practice of QC in the field	Field observation of latex management Cleaning of tapping utensils	Tapping and collection utensils, Metrolac and table for DRC estimation. Field trip to observe and study field quality control
15	<u>STEP-BY STEP PROCESS INVOLVED ON THE COAGULATION OF LATEX FOR RSS PRODUCTION:</u>	Dilution of formic acid to 1%. Calculation of the volume needed for coagulation Incorporation of acid. Mixing and removing froth on the surface, covering the pans to prevent contamination	Manuals, Books Tapping Utensils Rubber utensils cleaning materials	Safety rules Environmental considerations Cleaning techniques for each type of tool. Straining of latex in the field	Field demonstrations of environmental and safety measures How to clean tools used for tapping. Use of the Metrolac and table to determine DRC	Tapping utensils and materials; Training Manuals, Books, Anti-coagulants, scales to weigh latex, Metrolac, sieves to strain latex.
16	<u>PRACTICALS/RSS PRODUCTION AT TVETS</u> <ul style="list-style-type: none"> Rolling of rubber into sheets Drying of rubber concepts:/smoke house operation Environmental Considerations Waste Management 	CARRY OUT LABORATORIES ON COAGULATION, MILLING AND DRYING	Metrolac Table, pH paper, Bench and/or hand-held pH meters, Bromocresol-green (BCG) and other acid-base indicators	Effects of pH, temperature and time on latex quality Knowledge on application of preservatives.	Observation of auto-coagulation & pre-coagulum (i.e. Cup-lump formation) Preparation of anti-coagulant solutions and incorporation in to latex.	Samples of fresh latex, acids and bases, beakers, hot plate, pipette, etc Training Manuals, Books
17-18	<u>INTERNSHIP AT FACTORY: SORTING:, GRADING, BALING, PACKING, STORING</u>	Learners are to fully participate in the step by step practical sequence	Metrolac tables Latex receiving pans SOP manuals for Wet sheet	Field weighing of latex, DRC estimation using Metrolac, Field quality	Field observation to ensure that: 1. Latex is free of	Training Manuals, Books, Metrolac;

	<ul style="list-style-type: none"> • Students practice the proper methods used in preparing RSS for drying and the reasons why each step is necessary. • Practical (hands on) knowledge of the field activities involved in: wet sheet production, • Dilution of acid and Latex for the production of wet sheets including acid addition, mixing and removing of froth, • Water consumption <ul style="list-style-type: none"> ○ Waste water generation <ul style="list-style-type: none"> ▪ Treatment systems ▪ Rubber trap ○ Anaerobic treatment ○ Aerobic treatment ○ Clarification of treated water • Solid wastes <ul style="list-style-type: none"> ○ Trap rubber ○ Sludge <p>Students will learn:</p> <ul style="list-style-type: none"> • The factors affecting drying • Drying characteristics of sheet rubber. • Smoke house operation and smoke drying of sheets/Loading & unloading. • Sorting methods; • Criteria used to grade RSS sheets; • The standard weight of a bale of RSS • Internationally accepted packaging of RSS for shipping; • Criteria for storage areas for RSS 	<p>of activities for RSS processing utilizing the small hand mills at TVETs and compare this to activities when visits are made to larger RSS processing plants;</p>	<p>production Calibrated tools from National Standards Laboratory (see attached specs)</p>	<p>control methods</p>	<p>clots or coagulum pieces 2. Bark is clean of over slap coagulum How to fabricate a small simple filter for purification of water.</p>	<p>Scales for field weighing Dilution table Aluminum and plastic pans Small barrel, gravel of varying size, sand & regulator/tap.</p>
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Recommended Texts, Resources, and Supplementary Lecture Notes

- Introductory Rubber Agronomy
- Processing methods
- Handbook of Rubber (Volume 1-Agronomy), RRI Sri Lanka
- Handbook of Rubber (Volume 2-Processing); RRI Sri Lanka
- Any pertinent literature on natural rubber production, exploitation and processing.
- Listing of materials from curriculum.
- Laboratory Manual to Accompany Natural Rubber Production and Ribbed Smoked Sheets (RSS) Processing Course
- Power Point Presentations from Consultants
- Lecture/supplementary notes-agronomy
- Lecture/supplementary notes- processing
- Laboratory Manual to Accompany RSS Training.

General Teaching Aids and Materials to be sourced for RSS Training at TVETs

- Acids and bases
- Agro-chemicals , spraying cans
- Air-circulation laboratory oven
- Balance and others
- Basic tools and agro-chemicals
- Beakers
- Bench and/or hand-held pH meters
- Chemicals (formic and, acetic acid)
- Hot plate
- Indicators
- Pesticides and Spraying cans
- pH paper
- Burette, Pipette, etc.
- Stopwatch
- Thermometers
- Record books.

Rubber Culture Materials

- Bud wood plants including tools
- Budded rubber seedlings
- Budding knife and other materials
- Implements and tools: lining ropes, measuring tape, shovels
- Nursery trays, boxes
- Panel markers, marking stencils, spouts, wires hangers, cups, buckets
- Pests and disease samples

- Polythene bags and rubber seeds
- Polythene bags
- Rubber implement cleaning materials
- Rubber seedlings
- Rubber seeds
- Samples of fresh latex
- Sieves for straining latex
- Tapping utensils and materials
- Weed plants in rubber
- Young rubber seedling.

Rubber Processing Materials

- Metrolac
- Anti-coagulants, latex preservatives
- Baling scale
- Latex receiving pans
- RSS Packaging materials
- Scales for weighing of latex.

Specialized RSS Requirements

- Access to an RSS smoke house
- Access to an operating RSS factory or a demonstration facility with hand mills
- Calibrated tools from National Standards Laboratory
- Metrolac tables.

Training Manuals and Books

- Quality control manual for RSS
- SOP Manual for Smoking of sheets
- SOP manuals for Wet sheet production
- Training Manuals.

Audio Visual Aids

- Charts showing socio-economic importance of rubber
- Diagrams showing the principles and practices associated with establishment of rubber farms (site selection, land preparations, planting etc.)
- Diagrams showing the steps in field maintenance and upkeep
- Pictorial of the operation of RSS processing machinery including power and hand mills
- BCG color coding showing effect of pH ranges on latex
- Video displays, Charts & Diagrams depicting all aspects of rubber value chain.

The Curriculum Development Committee

No	NAME	INSTITUTION	POSITION
1	Terry N. Dologbay	Nimba County Community College	Instructor
2	Justin G. Luo	Nimba County Community College	Coordinator
3	Darlington Kilay	Nimba County Community College	Instructor
4	Jacob B. Swee, Sr.	Booker Washington Institute	Vice Principal for Instruction
5	Galimah G. Taylor	Booker Washington Institute	Instructor
6	Joseph D. Adebodun	Tumutu Agriculture Vocational Training Center	Director
7	William S. Kessellie	Tumutu Agriculture Vocational Training Center	Assistant Director
8	Sokowuah K. Subah	Grand Bassa Community College	Director
	George G. Williams	Grand Bassa Community College	Instructor
10	William Vonyegar	Grand Bassa Community College	Instructor
11	Jeremiah Swinteh	Grand Bassa Community College	Instructor
9	Philip Ndaloma	Bong County Technical College	Dept. Head/Agriculture
10	Emmanuel Gbarajah	Bong County Technical College	Instructor, Chemistry
11	Daniel B. V. Wrayee	Ministry of Agriculture	Assistant Director
12	Alieu L. Kemokai	Ministry of Youth and Sports	Admin Assistant
13	Roland C. Massaquoi	College of Agriculture /University of Liberia	Associate Prof. Agronomy/Consultant
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16	Eric G. Eastman	WRTCAF/UL	Professor of Agricultural Engineering
17	Franklin Philips	WRTCAF/UL	Asst. Professor of Agronomy and Pathology
18	Patrick Blamo, Jr.	National Standards Laboratory (NSL)/MOCI	Laboratory Analyst
19	Adolphus Collins	MOE	Bureau of TVET
20	Patrick Anderson	MOE	Director
21	Sarath Kumara	GROW	International Consultant
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25	Renee A. Murray	GROW	Intervention Manager-Rubber Sector
27	Derrick Nyumah	GROW	Senior Intervention Manager-Rubber Sector
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