



*A curriculum guide on the  
Implementation of  
Class XI and XII*

# **Agriculture** for **Food Security**

**Royal Education Council**



*A curriculum guide on the  
Implementation of  
Class IX and X*

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**Royal Education Council  
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# Preface

Agriculture in Bhutan has been the main occupation of the majority Bhutanese in the past, present and is likely to be in the foreseeable future. Unlike in the past, the 21<sup>st</sup> century Bhutanese education is seen a way forward to support and enhance the occupation of majority Bhutanese population and regain the food security of our GNH nation. Agriculture for Food Security (AgFS) is a new subject in our education system and most of the teachers and students are aware of agriculture as the occupation of most of their parents or neighbors involve in tradition farming activities without theoretical background. Agriculture is sadly viewed as an occupation of drudgery and tend to shy away from or get discouraged. However, agriculture is an enterprising occupation and can be joyful, innovative, creative and prosperous occupation with the use of technology and practices of the modern world.

The AgFS curriculum guide has been developed to support teachers to facilitate students learning and to change their mindset towards agriculture as creative activity with numerous hopes of possibilities for sustainable living in a society of today's competitive world.

The guide sets tone and builds foundation for understanding the AgFS. It helps teachers to question themselves to clarify the purpose of school education, purposes of their teaching or facilitating students to learn AgFS as a subject that is designed to equip learners with the AgFS concepts, values, attitudes and skills of living a meaningfully and productive life in a society.

The guide also facilitates teachers to understand the teaching, learning and assessment processes of a technical subject which requires a different set of approaches and methods than that of other academic subjects. In technical subject like AgFS, assessment is an integral part of learning that supports learners to be progressive and facilitates learning for life. It is hoped that

this guide shall be used by the teachers to give life to the teaching and learning processes and practices.

# Forward

*Agriculture* is globally accepted as the Sciences and Arts of cultivating the land and rearing of animals for food, fibres, medicinal herbs, shelter, and other human needs, or economic gain. It is also technically defined as the science and art of producing crops and livestock from the natural resources of the earth for economic purposes. Agriculture is an occupation having to do with farming, *raising crops* or *livestock* for food, fibre or fur; or the industry which includes marketing, processing and trade in these products.

The Agriculture for Food Security (AgFS) was an initiative of the Ministry of Education, Royal Government of Bhutan, to improve the relevance of Secondary School Education through curriculum diversification project of the 9<sup>th</sup> Five Year Plan (2002 to 2007). The curriculum diversification project continued in the 10<sup>th</sup> Five Year Plan, as a spillover of the 9<sup>th</sup> FYP. In the 10<sup>th</sup> FYP, the Ministry of Education (MoE) collaborated with the Ministry of Agriculture and Forests (MoAF) and the Royal University of Bhutan (RUB) in the development of AgFS curriculum and its implementation in schools. A taskforce was formed to develop teaching and learning materials of AgFS for classes IX to XII.

The AgFS curriculum development was closely guided and monitored annually by the Curriculum Board of the MoE from 2007 to 2011 and approved for implementation by the 26<sup>th</sup> Curriculum Board meeting in 2012. Accordingly, AgFS has been implemented in schools from 2012 gradually preparing teachers, consolidating text materials developed suitable for the learners from classes IX to XII and its implementation guides for teachers, professionally trained but with little subject knowledge.

‘Agriculture for Food Security (AgFS)’ was adopted as the title to communicate a sense of purpose and value for Bhutanese society that has a small percentage of arable (4.5%) land area but capable of providing food, medicines, fibres, shelter and other needs, required by the small population (about 700,000). The AgFS is envisioned to address social issues such as

unemployment of literate youth, reduce import of agriculture products and gain self-reliance, mitigate rural-urban migration, and others, in the GNH society.

The study of ‘AgFS’ in classes XI and XII encompasses the art, science, and technology of: (a) sustainable practices in agriculture, that demands appropriate approaches of soil, water and plant nutrient conservation based on researches to be used, (b) principles of animals and plants breeding which can assist quality and more productive produce, with the help of protected cultivation technology to cultivate crops, fruits, vegetables, mushrooms and seeds/ saplings, in an improved environment, (c) *post-harvest technology and practices* of food processes and value addition, (d) *livestock* – ideas of rearing cattle, pigs, fishes, goats, and pasture development, (e) farm mechanization, perhaps, one of the most important motivation factor that can encourage Bhutanese youth to take agriculture in the 21<sup>st</sup> century. The AgFS in classes XI and XII is the foundational courses for university degree within and outside the country, at the same it prepares students to be more proficient in Agriculture for greater contribution to the development of GNH society.

This guide plays an important role in setting the tone for AgFS learning for life – greater depth in theory and practice of Agriculture with strong academic standard. Teaching and learning of AgFS approaches with ‘assessment for learning’ and ‘assessment as leaning’ are crucial for preparing students for university studies and to be professional in life.

Therefore, the REC recommends all implementers of AgFS to read the guide thoroughly to understand and carryout teaching and learning of AgFS processes creatively, and to share with others for effective implementation. It is hoped that teachers facilitating students learn AgFS will contribute to making this guide a living document that is useful in preparing students to take up Agriculture for self-employment and employment of others in the services of the ‘tsa-wa-sum’ and the prosperity of this great GNH nation.

‘Tashi Delek’  
**Director,**  
REC

# 1. Introduction to AgFS guide

‘A curriculum guide to implement AgFS in XI and XII’ is a guideline developed specifically for teachers to understand AgFS as a technical subject and how this subject needs to be implemented in schools. To help teachers or readers understand this guide, it is built on the curriculum framework of the subject (AgFS). However, it has additional information and detail write up explaining what each element of the framework of AgFS entails and needs to be understood for implementation. This guide sets tone for understanding the curriculum intention of the subject, which needs to be translated into (i) teaching intentions guiding teachers (ii) identify educational experiences and (iii) approaches and methods to be employed by the teachers in their teaching and learning processes, resulting into (iv) desirable learning outcomes of the students (v) assessed and certified by the school/BCSEA. Therefore, this guide starts with

- a. Rationale for AgFS as a subject,
- b. Principles of curriculum design,
- c. Curriculum standard of AgFS,
- d. Learning outcomes of different Classes,
- e. Educational experiences through learning outcomes are likely to attain in students,
- f. Approaches and methods of teaching and learning processes, and
- g. Assessment processes supporting student’s progressive learning and finally the
- h. Basic enabling conditions required for implementation of AgFS in schools

This guide can be meaningfully useful to the users only if it is read, understood, planned, prepared, reflectively and analytically utilized in the teaching and learning processes of AgFS. It is just a document and likely to remain in the book shelve collecting dust.

## 1.1 Rationale

The Agriculture Food Security Curriculum, at the pre-university degree is a continuation of AgFSC from IX and X, and an advance course that aims at preparing students to be more proficient in the areas that contributes to the development of agriculture related entrepreneurships. It prepares student graduates to be better farmers or professionals for starting enterprise in agriculture industries in Bhutan, addressing the unemployment of literate youth as well as uplifting the economic status of the farming community. It also prepares students for the university degree studies in Agriculture related branches of studies in the region.

## 1.2 Curriculum Design of AgFS

The AgFS curriculum in classes XI and XII is more complex, theoretical and more technical but essential for sustaining the Bhutanese agriculture in the ever expanding urbanization and the greater needs of food, medicine, fibre, shelter and other needs of the urban population. The AgFSC in these classes are designed based on the following principles.

### **1.2.1 Relevance – addressing the needs and aspirations of the society**

The AgFS of XI and XII are more complex to achieve proficiency in the agriculture grounded in sound theories. The subject challenges the learners to address more complex social issues of sustainability of Bhutanese society, threats to sustainability of Bhutanese Agriculture, use of Science and Technology in agriculture for more production verses production of healthy food for healthy Bhutanese society. The AgFS students need to be proficient in sustainable practices of agriculture and should be able to address sustainability threats through research and innovation.

### **1.2.2 Learning domains – Concepts, Affective and Psychomotor of Theory and Practice**

The AgFS as a technical subject at IX and XII, can only be useful if learners are provided with adequate conceptual knowledge, values and attitudes and psychomotor skills. The AgFS curriculum is designed to ensure adequate education of heads, hearts and hands of the learners which can make sense to them, help them change their mindset, and find AgFS worthwhile to learn and adopt it as a vocation for life. The AgFS inspires learners to explore the abundance of knowledge available, learn, analyse, reflectively practice and generate new knowledge for application in the changing environment, instead of *wasting time trying to recreate or reinvent what already exist*.

The AgFS textbooks contain adequate details of theory and procedural skills required to know by the students to be proficient and take agriculture entrepreneurship. They are used as a resource for teachers and students and not required to go through every page trying to make sense of them. If needs arise, teachers and students of different parts of the country have opportunity to avail the relevant information required from the textbooks at all times.

### **1.2.3 Progression and Standard**

The curriculum is developed appropriately for the students of classes XI and XII, maintaining the standard required at the level comparable to the standard of the other education system of the outside world. It has a standard of any pre-university students need to attain to be eligible for admission into any university of related to AgFS branches of studies in the university. The AgFS of XI and XII are progressively developed from X into XI and XII and what the students need to learn to be able to practice sustainable agriculture based on researches to conserve soil, plant nutrients and water, breeding plant and animal varieties that can cope up with the changing environment to produce food, medicines, fibre, shelter and others needs required by the growing urban population of the Bhutanese society and world outside.

### **1.2.4 Instructional time**

The AgFS curriculum is designed for the teachers to facilitate students to learn AgFS theory and apply the relevant theory into practices in the school campus or outside within in 87 hours of instructional time of 50 minutes of five periods in a week and 21 weeks in 150 instructional days in an academic year. The AgFSC implementation guidelines provides more details on time management.

### **1.2.5 Appropriate Approaches and Methods, and Assessment**

The AgFS as a technical subject is designed to prepare professional farmers with strong academic standard. It requires appropriate approaches and methods of teaching, learning and assessment processes. The approaches and methods identified to employ in deliberation of AgFS, need to challenge the learners to

- ✓ understand the knowledge, apply, analyse, create and evaluate the concepts of AgFS;
- ✓ receive the AgFS values, respond, value, organise and characterise the values and attitudes of AgFS to be part of life,
- ✓ imitate the practice of AgFS skills, manipulate to articulate the precision of skill performance till learners are able to perform naturally.

Similarly, the assessment in AgFS is an integral part of teaching and learning processes. Teaching and learning processes in AgFS requires the need to use assessment for learning to begin with, then use ‘assessment of learning’; and may be ‘assessment as learning’ to support students to begin with. However, progressively, the learners are prepared and provide ‘assessment as learning’ for life as a priority, then ‘assessment for learning’ to support students as per the needs and ‘assessment of learning’ since the students need to appear for class XII external examinations.

### **1.2.6 Using services of expertise outside school**

The AgFS as a technical subject, is designed to derive expert's input from the field trips to nearby (professionals of) Research and Development Centre (RDC) or RNR Centre of MoAF, incase teachers need professional input. Field trips are properly planned during the weekends to permit adequate time for extended discussions and for collecting data required for learning, for writing projects or field trip reports. Field trips are designed for either theoretical input or practical know how of the topics/ chapters, which schools are not in the position to organize.

### **1.2.7 Themes and topics of AgFS**

The AgFS materials are arranged in different chapters with themes. These themes are the learning areas of agriculture as well as they are the avenues of entrepreneurship opportunities for the students. The first chapters of the books from IX to XII have overarching themes that provide core ideas of why students need to take agriculture, and how the practices of the subsequent themes of the learning areas of agriculture are made more meaningful practices. The themes of the chapters are further divided into topics and subtopics with detail information on the concepts, values and attitudes, and skills of AgFS. The thematic approach of material development and presentation enable students to understand agriculture as a technical subject easier to learn and practice, and above all, making the AgFS enjoyable for the teachers to teach students learn AgFS. Students enjoy learning AgFS for life and to be productive in the society.

## 2. Learning Outcomes of AgFS

Learning outcomes of class XII graduates are broad expectation the kinds of graduates that the AgFS aspires to produce. To produce such graduates the agriculture experts developed content materials in great details which the students need to learn in AgFS. Teachers of AgFS are required to ensure that the students undergo these educational experiences of going through the text materials provided and do justice in facilitating students learn AgFS to arrive at the learning outcomes.

Learning outcomes are also consider as *curriculum standard (CS)*, a bench mark based on which quality of students are assessed and evaluated. The CS is the minimum standard of learning expected from the examinations points of view. The AgFS aspires students learn for life and do well in life.

The learning outcomes are the broad guides for teachers to get ideas of what type of students expected to produce from this curriculum. It is necessary to read the chapters and content materials of the topics and frame teachers' own learning outcomes for the chapters, topics and lessons. Remember to ask these questions 'What should student know, understand, and be able to do? What is worthy of understanding? What enduring understanding are desired?' (Grant Wiggins and Jay Mc Tyghe, 1998) to write the learning outcomes. Your students deserve to know more and should be able to do better than what and how learning outcomes have been framed and stated.

On completion of 2 years of AgFSstudy, the students:

- a) understand the principles and practices of sustainable agriculture is the only way to sustain Bhutanese society, support the government revisiting the Land Acts, Regulations, Policies, etc. to address the sustainability threats of the Bhutanese Agriculture.
- b) understand the impact of global warming, adopt research based agriculture management in their farms to cope up with the factors (such as the soil, climate, water, etc.).
- c) understand the rapid growth of urban population require more food, medicinal herbs, fibre and other needs, use technology– protected

- cultivation methods, farm mechanism, etc. in their farms to produce more.
- d) take advantage of the favorable AEZs of Bhutan and agriculture technology, produce a wide range of vegetables, fruits, cereals, medicinal herbs, animal products and make them available to the consumers all the year round, contributing to the nation's economic growth and self-sufficiency.
  - e) understand the scope of horticulture industry in Bhutan and in the global market, start entrepreneurship in mixed farming organic and food processing the farm produce creating self-employment, employment of others for the prosperity of the GNH nation.
  - f) apply their Scientific, Geography, Economic and Commercial knowledge and skills, etc. to enhance the knowledge and skill practices of Agriculture, making Bhutanese agriculture more scientific, artistic and joyous to farm.
  - g) have academically strong foundation for studying different branches of agriculture at the university degree in the country (CNR, RUB) and in the overseas countries and do well in their higher studies.

## **2.1 Learning outcomes of AgFS - XI**

The graduate of AgFSXI:

1. explains the concepts and values of the 'sustainable development' and advocates 'sustainable agriculture system' for Bhutan in attaining the food security required by the GNH society.
  - 1.1 addressing the threats to agriculture sustainability,
  - 1.2 Bhutanese growing their own healthy food resolving the 'food and nutrition security' and the sovereignty required by the GNH society.
2. discusses the basic soil and its properties, plant nutrients and water and their importance for the crops and animals, and adopt sustainable farm management of:
  - 2.1 physical soil and water conservation measures,
  - 2.2 biological soil and water conservation measures,

- 2.3 agronomical soil and water conservation measures in their farm.
3. classify food crops as per the AEZ, cropping system and the cropping pattern of food crops in Bhutan, and decide to grow:
  - 3.1 rice, following the production practices and management,
  - 3.2 maize following the production practices, and
  - 3.3 wheat, following the production practices in their farms and managing the control of pests.
4. describe the concepts and processes of Food Processing, Value Addition and Preservation and apply:
  - 4.1 principles of preservation in life.
  - 4.2 control micro-organism in preparing and processing food.
  - 4.3 use appropriate harvesting technologies and handling practices of transportation of the produce to the store.
  - 4.4 equip the store/pack house with facilities that can support prolong shelf life of vegetables and fruits before they are sold or consumed.
  - 4.5 process the produce to preserve and add value to the produce as per the choice of the consumers.
5. understand the concept of fish culture and the importance of fish in human diet, and business opportunity it provides, decide to:
  - 5.1 identify major species of carp that are cultured in Bhutan.
  - 5.2 select and start fish farming enterprise of farm-raised aquaculture species in pounds.
  - 5.3 manage fish culture as per the text guide, harvest and use post-harvest technology in enhancing the fish business sustainably.
6. explain ‘goat as poor man’s cow’ and also ‘goats are Swiss baby’s foster mother’ based on importance of goats and their milk, advocate:
  - 6.1 starting of goat farm as it is not costly,
  - 6.2 selecting appropriate goat breed, with breeding system on the farm,
  - 6.3 adopting good feeding practices and management of goats in a goat farm for successful business.

7. understand that the pasture development is a new idea in Bhutan but has immense business opportunity for the farmers, decide to:
  - 7.1 start pasture development on their farm.
  - 7.2 identify the improved pasture and fodder species.
  - 7.3 manage pasture development, conserve fodder before they are sold or used in the farm.
  
8. discuss climate change, causes of climate, the trends of climate change and its impact on agriculture, forest, water and human health, address:
  - 8.1 climate risk and vulnerability on agriculture, forests, water and health.
  - 8.2 adopt adaptation policy, plans and action of the RGB.
  - 8.3 individual participation and contribution of reducing emission of GHG and carry out remedial activities to cope with the changes.
  
9. understand the importance of research as an innovative approach, adopt:
  - 9.1 innovation system, social learning and participatory action research based management of sustainable agriculture on their farm.
  - 9.2 carryout action research of growing crops and rearing animals on the their farm.
  - 9.3 support the farming community sustain agriculture activities through innovative researches on agriculture practices and technology.

## **2.2 Educational Experiences – AgFS XI**

### ***1. Introduction to Sustainable Agriculture Development:***

- 1.1 Sustainable development, importance, Sustainable Agriculture System, Practices of sustainable farming.
- 1.2 Threat to agriculture sustainability, Food security, Food insecurity, Impact of food insecurity, Food Security Status in Bhutan.
- 1.3 Gross National Happiness and Sustainable Development, Sustainability concerns in Bhutanese agriculture.

### **2. Basics of Soil and Water Management**

- 2.1 Soil, Properties of soil and Types of soil.
- 2.2 Nutrient Management and Sources of plant nutrients.
- 2.3 Irrigation and water management.
- 2.4 Soil and water conservation practices

### **3. Growing Food Crop**

- 3.1 Crop Classification and Cropping System,
- 3.2 Food Crops of Bhutan:
  - 3.2.1 Package of Practices for cultivation of Rice.
  - 3.2.2 Package of Practices for cultivation of Maize.
  - 3.2.3 Package of Practices for cultivation of Wheat.

### **4. Food Processing, Value Addition and Preservation**

- 4.1 Concept and benefits of food processing, value addition and preservation.
- 4.2 Factors affecting food deterioration and strategies to reduce food spoilage and loss.
- 4.3 Principles and methods of food preservation.
- 4.4 Values added food products in the country.
- 4.5 Food quality and Safety Regulation Governance.

### **5. Starting a Fish Farm**

- 5.1 Fish culture and its importance.

- 5.2 Cultivable fish species in Bhutan.
- 5.3 Procedures of Fish Farming.
- 5.4 Post-Harvest Technology.
- 5.5 Preservation of fish.

## **6. Pasture Development and Management.**

- 6.1 Definition of pasture, importance, Improved Pasture and Fodder Species.
- 6.2 Pasture Management, Different fodder conservation methods practiced.
- 6.3 Good feeding practices

## **7. Starting a Goat Farm**

- 7.1 Goat breeds, Goat breeding and reproduction.
- 7.2 Procedure for breeding and management of goats.
- 7.3 Record keeping, culling and control of flock size/population

## **8. Climate Change and its impact on Agriculture Sector.**

- 8.1 Climate change, causes and the impact on Agriculture.
- 8.2 Climate and its links with agriculture, forest and water resources,
- 8.3 Climate Change Trend and Projection, Climate Risk and vulnerability.
- 8.4 Climate Change and Adaptation Policies, Plan and Actions,
- 8.5 How an individual contribute to reducing Green House Gas and other pollutants.

## **9. Research Approach of Sustaining Agriculture.**

- 9.1 Needs for research, Agriculture Research in Bhutan.
- 9.2 Innovation approaches of sustaining Agriculture, Innovation, Social learning through:
  - 9.2.1 Adaptive collaborative management,
  - 9.2.2 Participatory action research.
  - 9.2.3 RNR research in Bhutan, Institute under the Department of Agriculture, National Seed Centre, Institutes under the Department of Forestry and Park Services supporting Bhutanese agriculture.

## 2.3 Learning Outcomes of AgFS– XII

The graduates of AgFS curriculum XII:

1. Understand the importance of sustainable agriculture system, practice:
  - 1.1 the principles of sustainable food system with specific actions of good practices of sustainable agriculture.
  - 1.2 the principles of agro-ecological system, with specific actions of good practices such as:
    - 1.2.1 use of Renewable Natural Resources and conserve resources,
    - 1.2.2 manage ecological relationship, adjust to local environment, diversify (landscape, Biota and economics)
    - 1.2.3 empower people, maximize long term benefit, value health and minimize toxics use on their farms.
  - 1.3 sustainable agriculture to challenge the drivers of change in Bhutanese agriculture,
  - 1.4 strategies of adaptation policies and plans of the government and
  - 1.5 adaptation of Socio-Ecological System and advocate education on Socio-Ecological System for sustaining Bhutanese Agriculture serving the GNH society.
2. Advocate Bhutan’s Agro-Ecological Zones as most suitable for horticulture industry which can be greatly enhanced with protected horticulture technologies appropriate for different zones to:
  - 2.1 plan, construct suitable poly house /green-house and shade house for different kinds of horticulture farming,
  - 2.2 use appropriate equipment to control growing conditions of varieties of horticulture,
  - 2.3 grow horticulture vegetables, medicinal herbs, fruits, and flowers, etc.
  - 2.4 use integrated plant nutrients – organic manure, FYM, crop rotation/intercropping, and chemical fertilizer sustainably as recommended,
  - 2.5 create awareness of government’s strategies of developing Horticulture and initiatives to support farmers gaining livelihood security.

3. explain the concepts of Organic Agriculture (OA), its principles features, and its advantages for farmers, adopt Organic Farming ensuring:
  - 3.1 all natural resources are reused or, maintain bio-diversity in the farm, planting variety of crops for all purposes on farm for food, medicine, fodder, textiles, dyes, biomass, feed and shelter for animals.
  - 3.2 use of green manure and compost as manures for the crops on their farm,
  - 3.3 practices of organic approaches to managing pests, diseases and weeds maintaining perfect biodiversity /ecology system on the farm,
  - 3.4 participation in the marketing of organic produce maintaining quality of the produce sustainably.
  
4. Discuss the fundamentals of genetics, Mendel's Law of Inheritance determining the genetic traits of animal and plants species, advocate -
  - 4.1 the use of the principles of plants breeding and their needs in the agriculture farm.
  - 4.2 build genetic resources for crop development.
  - 4.3 adopting different methods of breeding of plants according to the reproductive system of crops and genetic engineering as a way forward for developing high yielding crops.
  
5. Understand the importance of dairy cattle and their breeds in Bhutan, decide to:
  - 5.1 plan to start dairy farm following the establishment procedures of dairy farm.
  - 5.2 constructshade following the construction blue print provided in the text analytically.
  - 5.3 start dairy farm with its own breeding system, care and management for clean production of milk, etc. enterprise generating employment of self and others.
  
6. Understand the importance of seeds, seed production and the opportunities for entrepreneurship, take up seed production enterprise

with the support available from the National Seed Centres of the MoAF.

7. Construct shed conducive for growing mushroom and grow mushrooms using the substrates that are locally available sustainably.
8. Explain the adoption of appropriate farm mechanization, is the only alternative solution to resolve drudgery in the Bhutanese farm, and mechanize farming to increase sustainable production of agriculture goods.
9. Discuss meteorology, water cycle, elements of weather and climate, factors affecting weather and climate of the world, weather forecasting and apply agro-meteorology in determining the annual farming activities.

## 2.4 Educational Experiences of AgFS XII

### **1. Good Practices of Sustainable Agriculture**

- 1.1 Sustainable Agriculture, its purposes, good practices of Agriculture.
- 1.2 Ecological footprints of global food system, agro-ecological system and principles,
- 1.3 Good practices of sustainable agriculture challenged by the drivers of change of Bhutanese Agriculture system.

### **2. Introduction to Advance Horticulture**

- 2.1 Horticulture definition, types and importance, Horticulture industry in Bhutan,
- 2.2 Protected Horticulture for sustainable agriculture in different climatic zones, planning for construction, materials, equipment for temperature and humidity management,
- 2.3 Plan nutrient management for different crops, MoAF's support policies of farming community.

### **3. Introduction to Organic Farming**

- 3.1 Definition, benefit of organic agriculture, features and principles of organic agriculture.
- 3.2 Composting and EM Technology for manures and pest control, and
- 3.3 Organic approaches to managing diseases and pests,
- 3.4 Converting farm to Organic,
- 3.5 Maintenance of an organic farm and certification.

### **4. Principles of Plants and Animal Breeding**

- 4.1 Genetics – basis of inheritance, cells, DNA, replication of DNA, genes and proteins,
- 4.2 Mendelian inheritance, principles of plants and animal breeding, Genetic resources for breeding,
- 4.3 Methods of breeding, introduction of plants, inbreed and hybrid, crop breeding in Bhutan,
- 4.4 Tissue culture, genetic engineering and GM crops and concerns.

## **5. Dairy Farming II**

- 5.1 Understanding dairy farm, and tasks involved,
- 5.2 Cattle breed – exotic dairy breeds, breeding system, advantages and disadvantages,
- 5.3 Basic requirement in establishment of dairy farm, construction of shed, good practice of feeding animals, clean milk production, farm herd improvement, health care of farm animals.

## **6. Seed Production and marketing**

- 6.1 Seeds, importance, Seed development, seeds and plant propagation methods,
- 6.2 Seed production Infrastructure and National Programme,
- 6.3 Registered seed growers and linkages with Institutions,
- 6.4 Seeds materials production methods and procedures.

## **7. Starting a Mushroom Farm**

- 7.1 Mushroom cultivation in Bhutan, definition of mushroom, importance in human diet,
- 7.2 Cultivation method, environment condition for mushroom growing, materials and equipment, procedures and management,
- 7.3 Management of diseases in Mushroom.

## **8. Farm Mechanization in Bhutan**

- 8.1 Farm mechanization, importance, mechanization of different farm activities, benefits,
- 8.2 Agriculture Machinery Center (AMC), mandates of innovation, propagation and
- 8.3 Supporting farming community.

## **9. Application of Agro-meteorology in Agriculture**

- 9.1 Definition, importance agro-meteorology to agriculturists.
- 9.2 Hydrological cycle, factors affecting weather and climate, elements of weather and climate.
- 9.3 Clouds and importance of rain on crops,
- 9.4 Weather forecasting, remote sensing and its application on agriculture, Agro-meteorology in Bhutan.

## 3. Teaching and Learning Methods

### 3.1 General guidelines

1. Teaching of AgFS as a vocational curriculum must be planned carefully before the start of the academic session allotting 60% of the time for theory and 40% for practice.
2. In one academic year (150 days) Agriculture in class XI and XII has 107 periods of contact teaching. However, teaching and learning of Agriculture theories and practical work may be flexibly implemented, since the Agriculture theories may be derived from practical work such as field trips to a RNR – Research and Training Centers or a farm nearby through investigative approaches and discussions.
3. All theory must be planned and taught through ‘interactive and compulsory participatory approaches engaging the learners at all times.
4. Dairy farming, seed production and marketing, mushroom cultivation, farm mechanization, etc. can be learned through investigative field trip methods. However, these topics must be thoroughly studied by the teachers and questions are framed for the students well before the field trips. This objective planning of field trips and writing report at the end will help students perform academically better than other students.
5. All practical works must be properly guided by the theories discussed and learned from different Chapters and their units. Adaptation may be made based on the experimentation or action research experiences.
6. Agriculture is a technical subject and what students learn in theory is expected to practice in the school or observe what others do in their fields. Therefore, Agriculture is not expected to be taught like academic subject. Both the teachers and the students need to read independently, understand and discussed the concepts and procedural skills of Agriculture in the class or at the site, share experiences of agriculture – growing and caring of crops and animals critically for betterment in light of changing climate and environment.

7. The ideas from the book are to be taken as a starting point for discussions and not as absolute knowledge and skills procedures. Future modern farmers need to experiment and do anything that will work better.
8. Students need to learn all the topics of Agriculture books of XI and XII. However, for gaining insight in practical work different students can be given different practical work of different chapters. Class may be divided into smaller groups for:
  - a. growing different vegetables by different groups (chili, sag, potato, tomato, etc.)
  - b. campus beautification design by a small group,
  - c. growing different fruits trees (by different group),
  - d. rearing livestock by another group,
  - e. forestry by another group, and so on.

This can help students focus on specific areas of their work for

- better learning and development of skills that can be shared in the class periodically for all to learn from each other.
- Time table can be prepared for group/peer teaching on their topics.
- Teacher can be a facilitator to:
  - moderate,
  - add comment and
  - assess their teaching of theory as well as procedural skills and experiences.

## **3.2 Suggested Interactive methods**

Professionally trained teachers are not short of ideas about teaching and learning approaches and methods.

### **3.2.1 Guided Discussions**

Guided Discussions in the class led by the teacher. This involves reading the text by the teacher and students before the class. Teacher instructs students to read a chapter from text well ahead of time, teacher also read

and prepare key structured questions for leading the discussions in the class. The sample lesson plan may be able to help you use this method effectively.

### **3.2.2 Presentation and discussion method**

Group/individual presentation and discussion method is a powerful method of teaching and learning process. This involves a group of students or individuals with experiences or interested in specific topics or chapter, read the chapter/topic, understand the content, prepare slides, and present in sequence to the class and lead discussions to learn more about the topic(s) based on individual experiences and background.

### **3.2.3 Experimentation method**

This method requires students to experiment their knowledge and procedural skills of the text analytically or try out different ways and come up with the ideas or procedural skills which work better. It may be taken up as a project with an aim of trying something different or trying theory into practice. The experiment must be small scale practical work without having to waste resources and also the result is observable or impact is noticeable. Experimental method needs to be tried out on agriculture practices.

### **3.2.4 Guided Discovery Method**

Guided discovery method may involve teacher's preparing a general guidelines for the students either in group or individually with specific objectives to achieve. Guidelines may be in the form of structured questions with logical sequence to collect information from a library or from a resource person/s at work during a field trip.

### **3.2.5 Presentation Method**

Presentation is one of the oldest ways of delivering information from a teacher to students or audience within a specific period. Presentation can be prepared on a piece of paper in detail. It can also be in a well-structure

form and read aloud. Alternatively, oral presentations use visual aids too. However, oral presentation using LCD, OHP or chart papers are more popular in the teaching profession these days. Thus, oral presentation with the help of visual aids is recommended.

### **3.2.6 Procedures**

The presentation method, like other methods, uses the same lesson plan format. However, in the presentation method, you only mention points on slides.

1. Read the topic, understand and set lesson objectives, introduce the lesson, develop content, monitor the understanding of and support students' learning progress. Assess learning outcomes to close the lesson. The lesson plan has to be written on slides in a different writing format.
2. Frame the statement of the theme/topic of the lesson on slides to display before introducing the lesson.
3. Write lesson objectives/learning outcomes intended to achieve at the end of the session, clearly and objectively.
4. Prepare an overview of presentation – a bird eye's view of what students /audience would be learning in order to achieve the lesson objectives. This can also be prepared at the end of planning the presentation as you would know better at the end.
5. Identify key points from the reading, which contribute to the development of concepts, values or skills of the topic/sub-topic that are likely to achieve learning outcomes. Structure the key points and arrange them in logical order for understanding.
6. Prepare slides for presentation in logical order. Avoid long sentences or phrases or use words that would require explanations, small fonts which audience would have difficulty reading. The illustration or pictures if required to use are relevant and not distracting the attention of the audience.
7. Prepare activities in between theoretical discussions for clarifications, reflections and assessment of understanding of concepts presented.

8. Explain each point or topic or sub-topic on the slide clearly and systematically for the learners to understand. Pause for a while to reflect and assimilate the ideas explained.
9. Presentation can be made interactive between the presenter and the audience. An idea can also be presented. Ask questions and probe to bring out/derive the explanation from the learners.
10. Check the understanding of learners with simple question such as ‘are you understanding what I am saying or explaining?’ and so on.

### **3.2.7 Field trips**

Field trip can be most meaningful teaching and learning method of vocational subject such as ‘Agriculture for Food Security, especially for the teachers who do not have background of the subject. Agriculture is a technical and vocational subject. However, interested teachers with interest in this subject can do pretty well. Field trips needs to be planned well to learn theatrical or practical knowledge from the experts outside schools system. Detail field trips may be planned as follows

#### ***3.2.7.1 Guidelines for planning a field trip***

- a. *Planning:*
  - i. Deciding which topics/sub-topics can be studies from the Field trips
  - ii. Allocating instructional time.
  - iii. Incorporating in the academic calendar
  - iv. Informing school authority.
- b. *Preparation phase:*
  - i. Approval of field trips
  - ii. Make appointment/permission of visit
  - iii. Choose a topic (s)/areas of study
  - iv. Frame lead questions covering areas of study (in logical order and covering all areas required to learn).
  - v. Brief to take note of information /responses to the question correctly, students on code of conduct and delegate work as to who is to ask question, speak for the group, etc.
- c. *Implementation phase:*

- i. Taking the trip,
  - ii. Meeting people having appointment
  - iii. Students asking questions in sequence and taking note of responses.
  - iv. Taking leave of people met after expression gratitude.
  - v. Returning to school
- d. *Follow up:* Sharing information, compiling and writing field trip reports.
- e. *Assessing field trip write up* with criteria – develop rubric of accuracy and completion of information, presentation and closure correctly.

# 4. Suggested Student Activity

## 4.1 AgFS class XI

*Chapter 1: Introduction to Sustainable Agriculture Development*

### Students Activity

Students can be assigned to do different activities to challenge them to use their understanding of ‘sustainable development’ and ‘sustainable agriculture’ in day to day life of the Bhutanese – working in the school (teachers, staff and students) and people living in the community around the school. Assign students to practice sustainable agriculture in the school garden. Different students can be assigned to try out different techniques of sustainable gardening in five groups with five different techniques continuing for two years to see results. The second part i.e. integrated pest/biological control is for emergency only.

### *Activity directions A – Growing of Vegetables and Herbs*

1. Plan to grow vegetables or herbs,
2. Divide students into 5 groups and assign,
  - a. Group one: Inter cropping and crop rotation + integrated pest control
  - b. Group two: Agro-forestry + integrated pest control
  - c. Group three: Green manure + integrated pest/biological control
  - d. Group four: Conservation tillage + integrated pest/biological control
  - e. Group five: Silvi-pasture + integrated pest/biological control
3. Identify areas and allot them appropriately to practice their sustainable gardening.
4. Prepare ground, add farm yard manure, make nursery beds, following the procedures of growing vegetables and fruits learned earlier.

5. Select seeds /seedlings,saw seeds and plant seedlings, mulch nursery beds and water.
6. Prepare plans to observe, record and care the garden.
7. Monitor, support group work and record observation of work being carried out by different groups.
8. Provide feedback for improvement and
9. Assess students carrying out groups

**Activity B** – Write assignment of 450 words based on the following questions:

- a. What do you understand by ‘sustainable development’?
- b. How,in your opinion do you think,the sustainable practices of ‘sustainable agriculture’ meets the requirement of sustainable development?
- c. What can you as a farmer do to promote sustainable agriculture?

Or

**Activity C** – Discuss the sustainability threats of Bhutanese Agriculture and advocate to address the threats through your influencing the political party especially your party member of your constituency.

### *Chapter 2: Basics of Soil and Water Management*

#### **Student Activity**

Design activities for the students though which they can apply their knowledge from the text materials to improve soil and water conservation in their gardening practices. Firstly to study the types of soil that they have, prepare soil appropriately for different crops, add plant nutrients required by different crops, and protect and conserve soil and water, applying physical, biological and agronomic methods for growing crops.

**Group work 1:** – to identify type of soil, prepare soil and nutrient for growing potatoes using *physical* soil and water conservation method.

**Group work 2:** -to identify type of soil, prepare soil and nutrient to grow chili using *biological* method for soil and water conservation.

**Group work 3:** - to identify type of soil, prepare soil and nutrient to grow radish using agronomic soil and water conservation method.

### *Chapter 3: Growing Food Crops*

#### **Students Activity**

Students can be assigned variety of tasks on growing of food crop in smaller groups to learn the practices of different crops in the school campus if feasible or participate in the community growing food crops from time to time, which can be beneficial for the community as well as for the students and writing assignment analytically on growing of food crops comparing the ideas of the text verses the practices in the community.

#### **Activity one – *Growing of food crop in the school campus***(for schools with space for gardening)

- a. Group students in three to four groups and assign them to grow food crops i.e. locally available and grown.
- b. Prepare plans of growing crops on small plots right from the beginning of the academic session, following the procedures discussed in the text.
- c. Record work involve, time of development and care required, production, etc.
- d. Arrange a presentation of their records of growing food crops – challenges and benefits, assess their tasks

#### **Activity two – *Invite an experienced farmer to the class and ask how food crops are grown in their community or Field trip to Learn growing food crop from the community:***

- a. Invite a farmer with prior information of what he/she needs to talk to the students or brief students to ask question on the growing of crops
- b. Arrange field trips cum helping farmers at different stages of work on growing of food crops.

**Activity three** – Assignment on growing practices of (one only)

*Rice/Maize/wheat/Oil seed.*

1. What do understand by cropping system and cropping pattern of Bhutanese society?
2. Why do Bhutanese farmers adopt cropping pattern in the manner they do?
3. Write cultivation procedures of any one of the food crops analytically – rice /maize/wheat/oil seeds and suggest how the farmers could do better farming.

*Chapter 4: Food Processing, Value Addition and Preservation*

**Student Activity**

Discuss with students the options of carrying out activities on this chapter, group them into manageable and assign them activities such as:

1. **Activity:** Survey to compare the cost of agriculture produce and the value added food products sold in the market, compare quantity and quality, choice of consumer against health benefits, date of expiry and the reason for the cost.
2. **Activity:** Prepare values added and preservation of agriculture produce of student's choice such as (a) Vegetables, (b) Fruits and (c) any other agriculture produce following the lesson learned from this chapter.
3. **Activity:** Organise value added food tasting competition and award prizes and marks.

*Chapter 5: Starting a Fish Farm*

**Student Activity**

1. Plan and start a fish culture in a pound (if your school is in the Southern region and if fresh water is not a problem).
2. Contact officials of the Fish Seed Production Centre at Gelephu or National Centre for Aquaculture (NCA), department of Livestock, Ministry of Agriculture and Forests, to support your experiment as a part of implementing AgFS in school.
3. Start fish culture on a small scale following the procedures of the text analytically.
4. Or plan a field trip to a fish farm and learn about aquaculture,

5. Or invite an expert from MoAF /NCA as a guest speaker to your school

#### *Chapter 6: Starting a Goat Farm*

##### **Student Activity**

1. Starting goat farm in the campus
  - a. Design housing for goats in the campus (if feasible) as an alternative to raising of pigs or cows and poultry farm or an option for some students.
  - b. Select appropriate goat breed and start goat farm through which students can learn about goats and their breeding, to take care of goats, milking the goats, sell milk, goats or for self-consumption.
  - c. Maintain records of care required (feed and medicines, etc.), investment made, work involve and the economic returns.
2. Invite a farmer who raise goats in their farm to talk to about raising goats, challenges, benefits and suggestions as to whether goat should be raised or not. Write a report and review on the talks that the farmer gave.

#### *Chapter 7: Pasture Development*

##### **Student Activity**

1. Carryout a small survey for the need of fodder by the community around the school campus and advocate the developing pasture or planting fodder trees on the unused /barren land or nearby government land.
2. If feasible, explore pasture development project trial in the school campus, discuss with the principal, prepare land and start pasture development on a small plot.
3. For the schools having huge campus with livestock can develop pasture and plan the harvest systematically and use fodder sustainably.
4. Plan a field trip to a nearby government farm and study the processes pasture development, care, use and management of fodder for the livestock.

*Chapter 8: Climate change and its impact on Agriculture*

**Student Activity**

1. Plan to carry out an advocacy survey to find out how many teachers, support staff and students are aware of climate change, causes of climate, risk and vulnerability climate change on agriculture, forests, water and health and what they are doing to reduce the GHG in the atmosphere.
2. Design a poster to educate teachers, staff and students to reduce GNH by changing our outlook on the nature and ourselves.
3. Write articles on climate change, factors, impact on our lives, and what everyone of us have to contribute to save ourselves and our world. Display the articles or read out on occasions.

*Chapter 9: Research Approach to Sustainable Agriculture*

**Student Activity**

1. Plan for a field to nearby ARDC to find out what type of researches have been done on agriculture and improvement the researches have made on agriculture.
2. Following the research procedures mentioned in the text, plan and carryout simple research to improve school gardening, Or
3. Carryout a survey to find how our farmers in the villages are coping up with climate changes and the changes that they have been made in the cropping system or cropping pattern for their sustenance.

## **4.2 For AgFS Class XII**

*Chapter 1: Good practices of sustainable agriculture practices*

**Student Activity**

1. Discuss with the students and carryout a survey to educate school staff, students and local community members on the ideas of sustainable development and what entails 'sustainable agriculture'.
  - a. Divide students into smaller groups and assign write on areas of sustainable agriculture practices such as:
    - i. characteristics of sustainable food system,

- ii. themes with specific actions,
  - iii. practices of agro-ecological principles,
  - iv. good practice of gaining food security and sovereignty,
  - v. conservation of agriculture land degradation,
  - vi. adaptation strategies practiced as per the law of the land, etc.
- b. Develop survey questionnaires of awareness and education in small group in their assigned areas, compile the questions, present and discuss compiled questionnaires to have same understanding.
  - c. Discuss strategies of how survey is to be carried out, conduct survey, gather data, compile, analyze, write report on finding and display for people to read and learn.
2. Discuss, plan and implement sustainable agriculture practices (agro-ecology system) in the school campus while gardening for AgFS practice.
  3. Discuss adaptation strategies of policies and plans of the government provided in the text, analyze and identify for practice in school gardening as responsible citizens of the GNH society.

*Chapter 2: Introduction to protected cultivation of Horticulture*

**Student Activity**

1. Discuss, with the class, to study the local climatic condition and horticulture crops that can be grown in protected cultivation, poly-house cultivation, green house cultivation and shade net house and
  - a. Plan, design and propose constructing poly-house/green house or shade net house in the school campus to the school management,
  - b. Construct green house or shade net house with locally available materials or materials available in the market,
  - c. Plan growing of horticulture plants in the green house /shade net house for sustainability of protected cultivation farming,
  - d. Prepare soil, water and plant nutrients appropriate for the horticulture crop,
  - e. Identify Horticulture (vegetables, medicinal herbs, fruits or flowering plants) to be grown in the green house /shade net house,
  - f. Install climatic condition control equipment appropriate to the crops, net for control of insects, regulation of fresh air, etc.

- g. Sow seeds or plant horticulture in the house or net shade and maintain growing conditions such as humidity, temperature, light and fresh-air.
  - h. Monitor and manage horticulture plants growing in the green-house or shade net house.
  - i. Market horticulture produce, or use of the produce, records expenses and economic returns from the protected cultivation. Or
2. Plan a field trip to a government farm or private farm where protected cultivation is practiced to:
    - a. study the work involved in protected cultivation, expenses, advantages and dis-advantages, economic return and challenges.
    - b. seek professional and technical support on starting protected cultivation of horticulture.

*Chapter 3: Introduction to Organic Agriculture*  
**Student Activity**

1. Discuss with the class to plan and grow vegetables, medicinal herbs or fruits as in the past years, and assign work:
  - a. in small groups,
  - b. growing different crops,
  - c. prepare (following the procedures from the text) and use manure from:
    - i. green manure,
    - ii. compost,
    - iii. vermi-compost,
    - iv. bio-digester, and
    - v. compost using EMT.
  - d. use organic approaches to managing diseases, pests and weeds.
  - e. Observe students' participation in their group work, monitor and support work to be carried out systematically, record development, and harvest.
  - f. Discuss challenges and issues in the class so that all will understand and resolve issues.

*Chapter 4: Fundamentals of Genetics and plants breeding*

***Student Activity***

1. Class can buy seeds and saplings – some hybrid seeds/saplings and local seeds/saplings, sow/plant them in different plot to experiment which seeds to better. Discuss with the class to:
  - a. Grow vegetables, medicinal herbs or flowers or fruits trees in the campus:
    - i. Smaller groups with different vegetable, medicinal herbs and flowers, etc.
    - ii. Allocate different plots and prepare soil with same conditions,
    - iii. Sow different seeds – local pure breed and hybrid seeds,
  - b. Care the plants, observe and record development and health, harvest/yield.
  - c. Compare, Analyze data, write which plants did better and justify the differences if any.
2. Discuss and plan for a field trips to nearby ARDC or government farm to study researches being done on plants and animals breeding, challenges and benefits.

*Chapter 5: Dairy farming II*

***Student Activity***

1. Discuss with the class, prepare proposal plans of starting dairy farm in the school campus (if it is feasible) and present to the principal on:
  - a. Objectives of starting a dairy farm on the campus,
  - b. location of the dairy house,
  - c. structure of the dairy house as given in this chapter, construction materials required, construction to be done by the class, when the work the will begin and aims to complete.
  - d. Proposal to develop pasture, sowing grass seeds, and planting fodder trees and developing other facilities.
  - e. Who and how cows care and feeding etc. will be managed.
  - f. How the dairy produce or economic returns will be utilized.
  - g. Identifying cattle breed for the farm and procuring through ‘gewog or dzongkhag’ agriculture sector.
  - h. Support required from the school management such as approval, location, capital for purchase of materials and cattle.

- i. Discuss and share responsibilities of construction work, start construction, procure feed, cattle, etc.
  - j. Discuss and managing the dairy after jointly by the class but with appointment of leaders who can ensure cattle farm is taken care with proper records.
  - k. Monitor and review cattle care and management of the farm regularly for further improvement.
2. If Cattle farm exists in the school (as many schools have), review the cattle house, care management and improve the existing dairy farm.  
Or
  3. Plan a field trip to a dairy farm (private or government) to learn all about dairy farm starting from establishment investment, costs, care management and return or economic benefits, write report and assess students' work.

*Chapter 6: Seed production and marketing*

**Student Activity**

1. Discuss with the class to start nursery for supply of seeds and seedling for school agriculture garden and prepare a proposal to be presented to the principal with:
  - a. What seeds /seedling/sapling of the crops to produce,
  - b. How to go about based on what school gardening requires,
  - c. Support required from the school management such as
    - ✓ Land /plot for nursery,
    - ✓ Materials for constructing nursery shade such as ploy-tunnel,
    - ✓ Procurement of seeds, equipment and tools,
    - ✓ Commitment to buy seedling/sapling from the nursery,
    - ✓ Some fund on returnable basis.
  - d. Seek approval to start nursery.
  - e. Discuss with the class and delegate responsibilities,
  - f. Start work on nursery referring the text materials whenever needs arise,
    - ✓ preparing of soil for the nursery,
    - ✓ testing the germination of seeds,

- ✓ sowing the seeds and caring for them,
  - ✓ observe and record work involve, development of seedling/sapling, etc., care required, etc.
  - ✓ harvest seeds, dry them, store and pack them for sale, etc. managing the nursery efficiently.
- g. Fix price and make the seedling/sapling available for the school gardening.
  - h. Calculate economic returns and return money to the school management.
2. Divide students into group and assign different but simple techniques of seed germination tests to individual groups. Calculate the % germination and compare the result among groups. Which method was the best?
  3. Tryout vegetative reproduction with the plants growing in the school campus without destroying them. Grafting same species of flowering with different flower or fruits trees yielding fruits at different time /season – summer and autumn, etc.

*Chapter 7: Mushroom Production and Marketing*

**Student Activity**

1. Discuss with the class to start a mushroom cultivation in the school campus and a plan to get endorsement from the principal and the school management with:
  - a. Objectives of growing mushroom in the school campus by AgFS students,
  - b. Plans of how to go about growing mushroom in the campus:
    - ✓ Construction of a mushroom shade with locally available materials,
    - ✓ Construction to be done by the class on the weekends and clubs periods,
    - ✓ Straw of Rice /wheat/grass to be used a substrate,
    - ✓ Seek support from the RNR centres, Gewog, Dzongkhags and National Mushroom Centre for seeds and other technical and professional ideas besides the textbook.

- ✓ Manage growing of mushroom and marketing with the guidance from the Principal and the management of school.
- c. Support required from the Principal and the management team:
    - ✓ Resources – a small plot but convenient for the class to work,
    - ✓ A small fund on returnable basis (from the sale of mushroom),
    - ✓ Official correspondence with officials of the gewog, dzongkhag and NMC,
    - ✓ Procurement of mushroom seeds and plastic sheets and bags, wax and resin (if oak trees are available),
    - ✓ Hire of experts making local bricks with mud,
  - d. Identify a land area for construction of mushroom shade,
  - e. Seek and hire a local expert to help build mushroom shade,
  - f. Procure materials for the construction, lighting and equipment for regulating temperature and moisture, mushroom seeds, substrate and plastic sheets and bags.
  - g. Rags or benches, knife for cutting straw, and pots for boiling straw,
  - h. Start construction on an auspicious day, disinfect the rooms and furniture and start growing of mushroom following the procedures in the text,
  - i. Monitor and manage mushroom cultivation, analytically, maintaining records of development and care required and provided,
  - j. Limit visitors into the mushroom shade, ensure visitors wear visitor's shoes and do not touch anything in the room.
  - k. Involve principal and the students in pricing the mushroom and marketing the mushroom.
  - l. Assess the experiences gained by the students and the economic returns of the mushroom cultivation.
2. Plan for a field visit to a mushroom cultivation centre to study the mushroom cultivation and marketing system, through questionnaires, observations and sharing of experts' ideas and experiences of mushroom cultivation in the country, write reports, assess students' knowledge, procedural skills and values and attitudes of growing mushroom.

*Chapter 8: Farm Mechanization elevating drudgery in Bhutanese farming*  
**Student Activity**

1. Discuss in the class to carryout and an awareness or advocacy survey on the use of farming technology in the community around your school on the farming tools and technology they use and available in the market.
  1. Identify areas of studies such as tools currently use, awareness of better tools and technology, willingness to explore for better tools and adopt better tools, requesting to help them supply better tools and technology, forming cooperatives to invest buying machinery for the community, awareness of farming mechanism available with the support from MoAF and its agencies in the gewogs and dzongkhags.
  2. Carryout survey, collect data, compile, analyse and display for students and teachers and also submit to the government through Gewogs and dzongkhags for supporting the farmer, if the report is worth sending.
2. Plan a field trip to nearby AMC to study the work on mechanizing the Bhutanese farming system, importance, how students can support the AMC and the farmers do better farming.
3. Discuss with class to explore scientific ideas of developing farming tools for digging, lifting, cutting, watering the garden, weeding, etc. from the internet that can be used on the land scape of Bhutan.

*Chapter 9: Agro-Meteorology*  
**Student Activity**

1. Discuss with the class on carrying projects that support agriculture work to face the challenges of uncertainty of weather due to climate change and the changes that human activities bring to the environment.
  - a. Divide the class into smaller group of five members,
  - b. Identify one or two factors such as too much rainfall or no rainfall (water shortage), windy, blazing sun or foggy, etc. affecting agriculture in Bhutan,
  - c. Groups need to innovate ways /technologies/ideas to address the factors and carryout agriculture in Bhutan. These ideas needs to be planned and modelled with landscape design for exhibition. It can be on an areas within school campus where students work will

- not be disturbed. A temporary shade may be built or use a room that is not used by others frequently.
- d. Permit students to use internet facilities to get the ideas and adapt to Bhutanese situation for agriculture in Bhutan.
  - e. Provide adequate time for the project work preparation.
  - f. Inform the Principal and the school management team about the exhibition well ahead of time, fix exhibition on a Saturday for staff and students.
  - g. Monitor and support groups in their work – especially to identify factors affecting agriculture, and ways of how Bhutanese can carry out agriculture without problems.
  - h. Prepare programme for exhibition on the date decided (Saturday), notify staff and students of the school, and start with a small opening of the exhibition programme welcoming the Principal, staff and the students, address by the principal and vote of thanks by the AgFS teacher/students,
  - i. Groups explain their own projects work and keep the exhibition on till the staff and students have visited and listen to their project.
2. AgFS teacher may assign any *conservation of soil, water and soil nutrient project* that can be tried out in the school campus in groups with different ideas to see which ones work better.

## 5. Mode of Assessment

The *assessment* in AgFS is an *integral part of teaching and learning processes*. The AgFS recognizes the importance of *assessment for learning (AfL)*, *assessment of learning (AoL)* and above all the *assessment as learning (AaL)*. Assessment is to facilitate objective teaching by the teachers and authentic learning in the learners for their application in day to day life and become lifelong learners. The AgFS teachers use *assessment for learning (formative)* to support students in their learning as they learn, *(summative)assessment of learning* at the end of every unit, or and topic or themes to certify how much students have learned, and use criteria for assessment for learning and of learning/rubrics for self and peer assessment for lifelong learning. This approach to education will generate interesting and meaningful teaching and learning the livelihood concepts, values and skills useful to the students in their lives for self-employment and employment of others.

The assessment gives appropriate emphasis to the domains of learning based on the activities of teaching and learning processes planned and implemented. In theory classes, students are assessed more on the understanding concepts of the lesson and in practical sessions emphasis is given in developing good habits, doing the practical work whole heartedly, willingly and the practice procedural skills correctly. It is essential for the teachers teaching AgFS to revisit and use Bloom's Taxonomy and the stages of learning that the students are taken through.

Here's summary of Bloom's Taxonomy based on which teachers may derive learning objectives and provide learning opportunities with due emphasis on the domains and their levels. The assessment need to ensure these domains receive due emphasis in AgFS, that can enable students to be able to *evaluate* (concepts) what they have learned, exhibit what they have learned as *character or behavior* (values) and *practice naturally* (skills) – mastering the highest levels of learning.

Concepts	Values	Skills
1. Knowledge	1. Receiving	1. Imitation
2. Comprehension	2. Responding	2. Manipulation
3. Application	3. Valuing	3. Precision
4. Analysis	4. Organizing	4. Articulation
5. Synthesis	5. Characterization	5. Naturalization
6. Evaluation		

## 5.1 Assessment for Learning (AfL) or Formative Assessment (FA)

*AfL/FA* here is referred to as the processes used by teachers and students to recognize and respond to students' learning in order to enhance that learning, during learning. The objective of this assessment is to support learners learn better. This enables authentic teaching by the teachers that support authentic learning by the students.

*Procedures of AfL/FA entails:*

1. A teacher plans AgFS lessons with appropriate approaches and methods which engages the learners in their learning.
2. A teacher prepares the students for the lesson and teaches students to learn concepts, procedural skills, and values and attitudes of AgFS (topic/theme) with specific criteria that contributes to forming concepts, procedural skills, and values and attitudes, in the learners.
3. The learners are engaged in their learning activities as the teacher teaches, makes sharp observation of how the students learn, assesses the student's learning using the same criteria (or questioning the learners) as learning takes place, and providing qualitative feedback to support students learn.
4. Depending on the learning activities of the students, a teacher's feedback is either oral (questions/answers & reinforcement), gesture, or written comments through which the student recognize and respond to his/her learning in order to enhance that learning, during learning.

5. The teacher takes note of the learning progress of the students or the difficulties of learning faced by the student and may record for additional support for the students on FA tool for different activities such as theoretical learning, practical work and values and attitudes development.
6. FA tools have appropriately developed rubrics (criteria) against which student's performance can be equated and simply ticked, for practicality of FA in the class.
7. FA rubrics or criteria are also the criteria or teaching points of concept learning, procedural skills and values and attitudes of AgFS, and are used as assessment criteria for summative assessment.

### **5.1.1 Use of AfL in Teaching and Learning Processes**

#### **5.1.1 Use of AfL in Theory Classes**

The teacher facilitating students learn AgFS, use a variety of teaching methods that are mostly interactive, demanding active participation from the students. Students are constantly challenged to reflect on their *comprehension* of the concept of the topic discussed, *analyze* the importance and the *creativity of enhancing the concept* of the topic discussed in the theoretical classes through questions. For example, the concept of 'sustainable agriculture (SA)' is familiar to them. However, they may not know what the sustainable agriculture entails, especially its impact of what kinds of thinking and actions that might require from an individuals and from the society as a whole.

Display definition of sustainable agriculture as

*"an agriculture that can evolve indefinitely toward greater human utility, greater efficiency of resource use, and a balance with the environment that is favourable both to humans and to most other species"*

Instruct the students to read to understand and ask a series of key questions to derive the concept of SA, importance and what can students do to attain SA for Bhutan. Questions such as

*Table with discussion questions and facilitation notes*

<i>Questions</i>	<i>Facilitation to get correct response</i>
a. What do you understand from the statement? b. Why is it important to go for SA? c. Do we have SA? Justify. d. When do you think we (Bhutan) can attain SA? e. How do we attain SA f. Taking the stock of what is happening in the society today, are we on the right path to SA? g. What should you as a citizen of a society to attain SA?	Ask the class to listen to the responses of different students, compare which responses make better sense, probe to improve till responses become acceptable, reinforce the correct response to support students the same understanding of SA, importance and how to attain SA.

Therefore, the AfL tool are used in the class to assess students' learning, during learning, support student learning by letting them know their weakness, and address them to correct their understanding. The AfL tool has rubrics describing the learning outcomes against equivalent marks are provided (for those parents /administrators who value marks more than the descriptions). Students' participation in the class discussion can be developed as below.

*Criteria for participation in theoretical discussion (25%)*

- Attendance (5%)
- Active participation (20%)
  - i. Note taking (6)
  - ii. Questioning (7) &
  - iii. Creative response (7)
- One assignment after topic – a short reflection paper (8%)

*Tool for assessing student's participation in Theory Classes*

Serial no.	Name	Teaching		Class discussions (award one of the four)					values
		Attends the class and passively takes notes,	Attends the class with interest and asks questions to learn more	Answers with a few points indicating little understanding of the concepts	Answers with some understanding of the concepts of the skill	Answers with complete & accurate understanding of the concepts of the skill	Answers analytically and creatively that the skills concepts are understood well & internalized.	Answers are presented well with careful choice of words indicating skills are appreciated.	
		4	6	5	7	8	10	5	

*b) Use of AfL in Practical Classes*

The practical classes of AgFS, is intended not only for the students to put the theory in practice but experiment growing, understanding care required by crops, develop positive attitude towards work and efforts, and above all for practical understanding of farming economy. Therefore, the school management shall ensure that the classes taking up AgFS:

- a. Have separate land allocated with proper fence.
  - b. Have land allocated for AgFS is not disturbed by other school activity throughout the year.
  - c. Are allowed to work (especially for care and record of development and experimentation) on their designated plot beyond the class period and clubs.
  - d. Are allowed to sell the harvest, after assessment of their project to the school, for generating fund for the class and for individual use.
  - e. All the practical work shall begin with proper plans for demonstration, if need arise from the tutor followed by guided practice and independent practice, assessed and supported till students master the skills and perform naturally at ease. The assessment will be based on the students' interest in the work, efforts put in, completion of the work and work ethics. Marks will also be given for attendance.
- f. Criteria for participation in practical work (25)*
- i. Participation (10)
    - ✓ Attendance (5)
    - ✓ Carryout practical work willingly and with interest (6)
  - ii. Practice of skills (10)
    - ✓ Handles tools carefully (3) ,
    - ✓ Follows procedures correctly (4)
    - ✓ Completion of task (3)
  - iii. Product (5)
    - ✓ Quality (3)
    - ✓ Quantity of work as required (2)

g. *Tool for the assessment of student's Practical work*

Name	Participation			Practice of skills			Product
		Comes to the class on time with interest	Listens to the instructions and starts work with interest	Starts the practical work keenly and conscious of time	Handles the tool(s) accurately as required by the skill on practice.	Keenly practices the skills accurately as it is required.	Completes the practice and carefully put away the tools and tidy the work place.
	5	7	10	5	7	10	5

## 5.2 Assessment of Learning (AoL)

AoL or SA in AgFS here is referred to as the assessment processes involved in assessing student's achievement of learning at the end of a dedicated instructional period. The objective of this assessment is to find out how much students have learned from a lesson, unit or topic/course for the parents, report for the government, teacher and the students. In AgFS, the results of the AoL/SA are to be used for supporting students' learning – a remedial learning support by the teachers.

***Procedures of AoL or SA:***

1. The AgFS teacher sets specific tasks (questions/phrases/statements) on concepts, skills, and values and attitudes of a completed lesson, unit or topic/course and assign to students to do at a given period of time.
2. Students carryout the assigned task within a given period of time and submit to the teacher.
3. The teacher prepares criteria for the assessment of the assigned task, assesses the work of the students using the criteria and provide qualitative feedback (achievement or improvement required), grades

- or marks based on criteria and maintains the records student's achievement.
4. The evaluated assignment or assessed task is returned to the students, either for record or to follow up on the feedback /comments for further work of improvement.
  5. Students assess their own work with comments from the teachers, recognize the strengths and weaknesses of their own work done, discusses with their teachers to follow up for improvement.
  6. The AoL or SA results (marks) are made available for school leadership, parents, other teachers and students on request.

a) *Use of AoL in Theoretical Learning*

Depending on the *concept, procedural skills, and values and attitudes* lesson, AoL is done by setting specific questions on the concepts, procedural skills or values and attitudes, expected to have learned by the students. Example of:

- *Concept* – What do you understand by the term ‘sustainable agriculture’?
- *Procedural skills* – How would you advocate the need for the farmers to take up sustainable practices of agriculture to serve the GNH nation?
- *Values and attitude* – what can you do as a citizen of a society to support sustainable agriculture?

b) *Use of AoL in Practical work*

- Practice of sustainable agriculture practically.
- Measure the quantity of work done by the students
- Measure quality of work done.

## 5.3 Assessment as Learning (AaL)

*Assessment as Learning* is the use of ongoing *self-assessment* by students in order to monitor their own *learning*, which is “characterized by students reflecting on their own *learning* and making adjustments so that they achieve deeper understanding. In AgFS, students monitor their own

learning, ask questions and use a range of strategies to decide what they know and can do, and how to use assessment information for new learning. Students are their own assessors or facilitators of their learning, as well as assessors of their peers. Students engagement in peer and self-assessment, help them learn to make sense of information, relate it to their prior knowledge and use it for new learning. They develop a sense of ownership and efficacy when they use teacher, peer and self-assessment feedback to make adjustments, improvements and changes to what they understand. Thus the students become lifelong learners.

### **5.3.1 Procedures of ‘assessment as learning’**

1. Teachers assign a task on AgFS topic/theme for the students to do it at home in group or individual.
2. Teacher explain the task and its learning objectives to the students.
3. Empower students to take responsibility for their own learning, by questioning their own learning, analyzing, reflecting and examining their learning.
4. Provide criteria for assessment of the task assigned and probable questions that can be asked to assess their learning or task outcome analysis, reflection and examinations.
5. Identify peer (s) for peer assessment of the task outcome, and feedback from the peers.
6. Explain the use peer assessment (feedback), self-assessment and reflection to improve their learning
7. Provides ways for students to use formal and informal feedback and self-assessment to help them understand the next steps in learning.
8. Set a deadline within which assigned task is to be presented for review in the class.

### **5.3.2 Use of AaL in Theoretical work**

Activity based learning is an example of assessment as learning. Set task of what students need to learn and how they might go about doing the task for learning.

### 5.3.3 Use of AaL in Practical work

#### a) AfL, AoL & AaL through student's Assignments

1. Specific tasks for each assignment shall be set by the tutor. These tasks shall demand students *explore* for better understanding of the concept, *analyze* its application, and *enhance its creativity* to promote the vocation in the ever changing world.
2. All assignment shall have datelines for *writing* the assignment, *submitting* of the assignment, *correcting /assessing* the assignments with specific assessment criteria and *returned the assessed assignments* to students with feedback for improvement and marks.
3. Assessment records shall be maintained by the tutor and submit to the school principal periodically.
4. *Criteria for Project work* – growing of one /two crops in a term / rearing of animals, campus beautification, orchard, etc. and maintain records of efforts put in, observation development, care and end product of the project.
  - a. the concept of farming used:
    - Accuracy
    - Completeness
  - a. the efforts put in the project:
    - Quantity
    - Quality
    - Care taken

*Criteria for assessing student assignment may be on theory or practice*

1. Presentation (5):
  - 1.1 *Submitted on time* (2)
  - 1.2 *Written neatly presented* (3)
2. Content matter (10)
  - 2.1 *Concepts are accurate* (3)
  - 2.2 *Analytically written* (4)
  - 2.3 *Task Completed* (3)
3. Values – enduring understanding (5)
  - 3.1 *Understanding the values behind* (2.5),
  - 3.2 *Commitment to take action/apply* (2.5)

Tools for assessing student's Assignments/project work (8%)

Sl. no.	Name	Presentation		Understanding of the Skill Concept and procedures			Values
		Assignment is submitted on time as per the schedule.	Assignment is neatly written and presented with appropriate and respectable form.	Assignment has all the information required by the task referred from the class notes	Assignment has all the information analytically written referring class notes and discussions, and accurately presented.	Assignment indicate a clear understanding of the task's concept and procedure skills, has referred authors to back up argument to	
		5	5	5	7	10	5

## 5.4 Exhibition of products

Exhibition on products of practical works such as vegetables, fruits, etc. and the field trip reports or project reports are organized once a term or at least once a year, in the school for educating other students and the general public. The professionals of local RNR centers are to be invited to support your exhibition and or assess products. The officials from the BCSEA may be invited at the Annual Exhibition of AgFS product of class XI and XII students as an external examiner, if possible. The best performer can be awarded with certificate or prizes.

## 5.5 Assessment Weightage of AgFS

- ✓ External Examination is 30% by BCSEA
- ✓ Internal assessment by schools 70%:
  - i. Assessment for Learning = 50% (25% theory & 25% practice)
  - ii. Assessment as learning =20% (10% theory &10% practice)
  - iii. Assessment of learning = 10% (5% theory & 5% practice)

Table 1: Internal Assessment and weighting%

<b>Internal Assessment (50%)</b>				
<b><i>I. Continuous Assessment (90% to 100%)</i></b>	<b>Concepts</b>	<b>Skills</b>	<b>Values</b>	<b>Total</b>
<b>Theory (45% to 50%)</b>	70%	10%	20%	100
a. Class participation	40	6	10	
b. Assignments (class /homework)	20	3	5	
c. Project /field trips (write up)	10	3	5	
<b>Practice (45% to 50%)</b>	10%	70%	20%	100
a. Class /garden	5	50	15	
b. Project /field trip reports	5	20	5	
<b><i>b. Examinations: (0 to 10%)</i></b>				
a. Theory: 80% of 10%	80%	5%	5%	100
b. Practical: 20% of 10%	5%	2%	3%	

All records of assessment for learning (AfL), assessment as learning (AaL) and ‘assessment of learning (AoL)’ are to be maintained by the AgFS teachers and use in supporting students learn AgFS better. The AoL records copy needs to be submitted to the examination committee of the school and send a copy to the BCESA at the end of October annually.

## **5.6 Blueprint for internal assessment**

The internal tests and examinations are to assess more on the concepts, since skills and values are more objectively assessed on practice. The ‘blueprint’ for internal assessment is provided in the Table 1, based on which tools are developed.

## **5.7 External Examinations by BCSEA**

The BCSEA as a responsible organization for examination and certification has its rules for setting standard for the conducting examinations and certifying students of them of their achievement at the terminal stages of education. However, the BCSEA has also the mandate to ensure that the curriculum implementation is not diverted from its design due to the importance given to the external examinations.

The examinations of AgFS need to cover all the domains and the stages of learning – concepts, values and skills, although more emphasis may be on the concepts. It is not to give less importance to the values and skills but it is due to the fact concepts can more objectively assessed through examinations questions compared to the values and skills. Attempts must be made to set questions to assess all the stages of learning, more appropriately on the higher levels since these courses are for pre-university standard. Important decisions to make are:

- a. Bloom’s educational objectives are to be considered in setting different types of questions

Table 2: *Bloom’s education objectives covering all the domains and learning stages and symbols representing types of questions to be used for different domains*

Concepts	Values	Skills
1. Recall (Cr) 2. Comprehension (Cc) 3. Application (Cap) 4. Analysis (Can) 5. Synthesis (Cs) 6. Evaluation (Ce)	1. Receiving (VR) 2. Responding (VRE) 3. Valuing (VV) 4. Organizing (VO) 5. Characterization (VC)	1. Imitation (SI) 2. Manipulation (SM) 3. Precision (SP) 4. Articulation (SA) 5. Naturalization (SN)

- b. Consider setting different levels of questions to examine the developmental stages with appropriate weight% as provided in the table below.

*Table 3: Levels of question to be considered while setting questions from concepts with w%*

1. Recall	<b>Low level questions (20%)</b>	The question patterns may follow approximate w% (around) for low to high questioning and may be flexibly use. It may be difficult to work out exact %.
2. Comprehension		
3. Application	<b>Average level questions (50%)</b>	
4. Analysis		
5. Synthesis	<b>High level questions (30%)</b>	
6. Evaluation		

c. **Question distribution W% amongst types of questions and symbols used:**

- i. Objective type (Oq):
  - 10 -18 questions of one marks (15-20%)
- ii. Short Answer question (Sq):
  - 9 -18 questions of 3 marks (20-30%)
- iii. Essay questions (Eq):
  - 8 - 9 questions of 6 marks (30-50%)

## 5.8 Blueprint for Assessment

d. Use Assessment ‘Blueprint’ designed for setting question AgFS as provided in the table below.

Table 4: ‘Blueprint’ for setting examinations questions for AgFS in XI and XII

Chapter	W%	Cognitive (90%)			Levels of questioning (low to high)						
		O	S	E	Rem	Un d	Ap p	An a	Eva	Cre	Marks
1	13%	1	2	1		1oq	1sq	1sq	1eq		13
2	12%	3	1	1		1oq	1oq	1sq		1eq	12
3	13%	1	2	1		1oq	1sq	1sq	1eq		13
4	10%	1	1	1	1oq		1sq		1eq		10
5	13%	1	2	1		1oq	1sq	1sq		1eq	13
6	12%	2	1	1		1oq		1sq	1eq		12
7	12%	2	1	1		1oq		1sq	1eq		12
8	10%	1	1	1		1oq	1sq			1eq	10
9	5%	2	1			1oq	1oq	1sq			5
100%		13 (13)	12 (36)	8 (48)	1	8	7	7	6	3	100

### e. Questioning pattern

The questioning pattern is similar to the existing BCSEA’s pattern of examinations. However, it is not same. It has compulsory question set from all the chapters and each question *has objective type question, short answer question and essay question*. For example - Question 1:

- a. Objectives questions
- b. Short answer questions and
- c. Essay questions from the same chapter.

Further, the paper work in setting the questions is expected to reduce. After all, examination is important but it is not the most important aspects of education. Learning for life is the sole purposes of education and these optional subjects need to ensure it is true in the lives of students. The AgFS also attempts to make examination system more objective and creative so that the examinations become interesting and meaningful activity in the process of children’s education. The sample question paper is provided here

under. It is important that the teacher teaching the AgFS invest adequate time to prepare questions for the term ending examinations carefully based on the blueprint above. *Sample question paper.*

## 5.9 Assessment tools

Tools may be designed by the teachers appropriately to assess students' progressive learning of AgFS in XI and XII. The assessment is continuous and it is reflected in the teacher's work plan of the academic year. The sample assessment format for recording class participation in theory classes, practical work and assignment are as follows.

### 5.9.1 Assessment Records

Theoretically, more weighting need to be given to assessment as learning since we need to encourage students develop independent learning for life. However, for students in classes XI, assessment for learning (30%) can be given less weighting and in XII students can be give more independent work therefore, more weighting (50%) on assessment as learning.

*Format for recording mark for different assessments (XI)*

#	Name (XI)	Assessment as learning (30%)		Assessment for learning (50%)		Assessment of learning (20%)		Total 100	Result
		Theory	Practice	Theory	Practice	Theory	Practice		
		20	10	30	20	10	10		

*Format for assessment records in class XII*

#	Name (XII)	Assessment as learning (50%)		Assessment for learning (30%)		Assessment of learning (20%)		Total 100	Result
		Theory	Practice	Theory	Practice	Theory	Practice		
		30	20	20	10	10	10		

## 5.9.2 Progress Report

9.1.1 30<sup>th</sup> June ...../15<sup>th</sup> November .....

#	AgFS XI-XII students	Internal Continuous Assessment (100% for the whole year)				Total	Result
		Theory		Practice	Test/ exams		
		Class Participation	Assign- ments	Class/ Volunteer work			
		20%	30%	40%	10%	100	

Signature of the teacher with date: .....



## 6. Enabling condition for AgFS Implementation

### *All Schools need to:*

1. Advocate on the awareness of AgFS as a vocational/technical subject available for students from Classes IX to XII, which provides employment for the literate youth and enhance food security for the sovereignty of the GNH nation.
2. Encourage teachers to teach AgFS, reduce work load of teaching other academic subject (s) and school administrative work.
3. Offer AgFS subject to the students who are interested in the subject.
4. Establish institutional linkage with ARDC, *Gewog* RNR centres, School Agriculture Programme (SAP) unit of Department of School Education, Ministry of Education, and the SAP focal department of Department of Agriculture, MoAF, Dzongkhag Livestock Officer, and Dzongkhag Agriculture Officer for collaboration to implement AgFSC in schools.
5. Budget to implement AgFSC in schools.
6. Provide resources for AgFS curriculum implementation such as:
  - a. *Land for AgFS for practical work* include space for gardening, space for constructing shed for livestock and horticulture, proper fence,
  - b. *Agriculture Tools* for different agriculture activities such as:
    - i. Spades, pick axes, crowbars, racks, weeding hoe, shovel, sickle, knives, water pipe, watering can, knapsack, wheel barrow, and any other tools required for AgFS students proportionately.
    - ii. *Horticulture* – pruning and grafting tool sets.
7. Facilitate AgFS Class to use the services of Agriculture experts available in the locality through field trips and guest speakers.