DEPARTMENT OF AGROFORESTRY
Bangladesh Agricultural University
Mymensingh

Curricula for M.S. in Agroforestry

July – December Semester

A. Compulsory Courses (8 Credit hour)		
Course No.	Course Title	Cr. hr.
AF 501	Agroforestry Systems and Practices	3
AF 503	Agroforest Botany	3
AF 505	Agroforestry Research Methodology	2
B. Elective Courses (At least 4 Cr. hr. to be taken)		
AF 513	Silvicultural Practices in Agroforestry	2
AF 515	Medicinal Plants and Non-wood Products	2
AF 517	Soil Productivity and Conservation in Agroforestry	2
AF 519	Pest Management in Agroforestry	2
AF 502	Research work (3 Credits)	3(S/U)
Total credit		15

January – June Semester

A. Compulsory Courses (8 Credit hour)		
Course No.	Course Title	Cr. hr.
AF 507	Agroforest Management Technology	3
AF 509	Social Forestry and Rural Development	3
AF 511	Component Interaction in Agroforestry	2
B. Elective Courses (At least 4 Cr. hr. to be taken)		
AF 521	Wood Quality and Wood Technology	2
AF 523	Land-use Planning in Agroforestry	2
AF 525	Environmental Protection in Agroforestry	2
AF 502	Research work (3 Credits)	3(S/U)
Total credit		15

Thesis Semester:		
AF 502	Research Work	2(S/U)
AF 504	Evaluation of Thesis	5
AF 506	Thesis defense	3
Total credit		10
Grand Total		**40**

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AF 501: Agroforestry Systems and Practices

Credit hour: 3

- Introduction: Nature, attributes and potential roles of Agroforestry.
- Agroforestry systems and Practices: Traditional and other relevant agroforestry systems, practices & technologies-Agrisilvicultural systems, Silvopastural systems, Agrosilvopastural systems, Aquasilvicultural systems and other Agroforestry systems.
- Agroforestry systems practiced in Bangladesh.
- Agroforestry systems practiced in other tropical countries: India, China, Indonesia, Pakistan, Nepal, SriLanka and Philippines.
- Agroforestry systems in Temperate region: Agrosilvicultural uses of windbreaks & shelterbelts, silvopastoral system in woodland, livestock grazing in managed plantation, current temperate-zone agroforestry systems and intercropping under hardwood species.
- Evaluation of Agroforestry systems: Methodology for evaluating Agroforestry systems, Productivity evaluation, Sustainability evaluation, and Adoptability evaluation.

References:

- Huxley, P. A. 1999. *Tropical Agroforestry.* Blackwell Sciences.
- Haque, M. A. (ed.) 1996. Agroforestry in Bangladesh. VFFP, BAU, Mymensingh and SDC, Dhaka.
- Jha, L. K. 1995. *Advances in Agroforestry.* APH Publishing Corporation, New Delhi.
- Nair, P. K. R. 1993. *An Introduction to Agroforestry.* Kluwer Academic Publishers.
- Mellink, W; Y. S. Rao and K. G. MacDicken (eds), 1991. *Agroforestry in Asia and the Pacific.* RAPA, FAO and Winrock International, Bangkok, Thailand.
- Zabala, N. Q. 1990. *Development of Professional Education in the Forestry Sector.* IFCU, Chittagong and FAO, Rome, Italy
- Zhaohua, Z; C. Mantang; W. Shiji and J. Youxu (eds.), 1991. *Agroforestry Systems in China.* The Chines Academy of Forestry and IDRC, Canada.
- Nair, P. K. R. 1987. *Agroforestry Systems Inventory.* Agroforestry Systems 5: 301-317.

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AF 503: Agroforest Botany

Credit hour: 3

- Woody Perennials in Agroforestry: Classification, characteristic and uses in various agroforestry systems.
- Multipurpose Trees & Shrubs (MPTS) in Agroforestry: Concepts, and variable uses of indigenous and exotic multipurpose trees; selection of MPTS and other woody perennials for different agroforestry systems in different agroecological zones of Bangladesh.
- Characteristic features of selected species: Botanical features, adaptability, propagation systems and uses of the selected species, their rootspread, canopy growth, litterfall and phenophases.
- Introduction and improvement of selected species: Improvement of varieties through selection procedure, introduction of adaptable exotic species,; their production & distribution, tree improvement through vegetative propagation and grafting techniques.

References:

- Bandyopadhyay, A. K. 1997. *A text Book Agroforestry with Applications.* UBS Publishers Distributors Ltd. New Delhi, India.
- Khan, M.S. and M. K. Alam. 1996. *Homestead flora of Bangladesh.* BRAC, IDRC, SDC, Dhaka, Bangladesh.
- Jha, L. K. 1995. *Advances in Agroforestry.* APH publishing Corporation, New Delhi.
- MacDicken. K. G. 1994. *Selection and Management of Nitrogen-Fixing Trees.* Morriltion, Arkansas: Winkrock International, and Bankok : FAO.
- Nair, P. K. R. 1993. *An Introduction to Agroforestry.* Kluwer Academic Publishers.
- Das, D. K. 1990. *List of Bangladesh Village Tree Species.* Forest Research Institute, Chittagong.
- Huq, A. M. 1986. *Plant Names of Bangladesh.* Bangladesh National Herbarium, 220, Green Road, Dhanmondi, Dhaka.
- Hartmann, H. T. and D. E. Kaster. 1978. *Plant propagation: Principles and Practices.* Prentice Hall, New Delhi.
- Mukherji, H. 1974. *Plant Groups,* Books to Allied (p) Ltd. 8/1, Chintarnidas Calcutta 9, India.

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AF 507: Agroforestry Management Technology

Credit hour: 3

- Structural management of Agroforestry systems: Brief outline on structural development of important agroforestry systems, modification and replacement of existing systems in farmland and homestead plantations.
- Management systems for sustainability and productivity in agroforestry: Sustainable management of different agroforestry systems for increased production; NFTs for soil conservation and fertility maintenance, management of degraded lands for maximizing outputs, byproduct utilization and nutrient recycling.
- Tree management technologies in Agroforestry: Plantation, establishment & replacement techniques, nursing and protection of saplings, training and pruning for desired canopy structures, root & shoot management techniques under different Agroforestry systems.
- Harvesting & Processing of agroforestry products: Harvesting of woody perennials, severe branch pruning for forage and fuel woods, lopping, pollarding and tree felling techniques, harvesting of crops and other non-wood products under different agroforestry systems, post harvest processing of agroforestry products.
- Functional aspects and economics of Agroforestry systems: Inputs, labour utilization, system dynamics, affective factors, land-man ratio, economic policies and evaluation of individual systems, marketing of agroforestry products, risk and remedies.

References:

- Alam, M.K.; F.U. Ahmed and S.M.R. Amin (eds.), 1997. Agroforestry: Bangladesh perspective. APAN, NAWG and RARC.
- Haque, M.A. (ed.). 1996. Agroforestry in Bangladesh. VFFP, BAU, Mymensingh and SDC. Dhaka.
- Nair, P.K.R. 1993. *An Introduction to Agroforestry,* Kluwer Academic Publishers.
- Jha, L. K. 1995. *Advance in Agroforestry. APH Publishing Corporation, New Delhi.*
- Mellink, W; Y.S. Rao and K.G. Macdicken (eds.), 1991. *Agroforestry in Asia and the Pacific.* RAPA, FAO and Winrock International, BHangkok, Thailand.
- Zhaohua, Z; C. Mantang; W. Shiji and J. Youxi (eds.), 1991. *Agroforestry Systems in China,* The chinese Academy of Foresrt and IDRC, Canada.
- Pirone, P.P. 1978. Tree Maintenance. Oxford Univ. Press. New York.

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AF 509: Social Forestry and Rural Development

Credit hour: 3

- Introduction: Concepts, principles of social forestry, criteria and requisites for social forestry, factors of social forestry, ideal social forestry program, background of social forestry in Bangladesh.
- Elements of social forestry: Physical and socio-economic environment of social forestry; targets, goals and objectives of social forestry, production systems and appropriate technologies for social forestry.
- Social forestry program and project development: Planning, designing, monitoring and evaluation of social forestry programs.
- Social forestry for rural development in Bangladesh: Gender issues in social forestry; Women's role and participation in social forestry; Role of NGOs for social forestry development in Bangladesh.
- Tools and Techniques for rural appraisal: Rapid Rural Appraisal (RRA), Participatory Rural Appraisal (PRA), Participatory Action Research (PAR).

References:

- Ahmed, M.R. (ed.). 1994. *Social Forestry and Community Development.* Proceedings of a national workshop held at the IFCU, Chittagong University, Bangladesh on 5-10 October 1991.
- Ahmed, M.R. 1991. *Social Forestry: Theories, concepts and Application,* Paper presented at Seminar on "Management of Social Forestry Projects" held on Feb. 17-20, 1991 in Dhaka Organized by World Food Program.
- Magno, V.C. 1986. *Community Forestry Handbook.* Field Document No. 1. ADB community Forestry Project (UNDP/FAO/BGD/81/028).
- Bandhu, D. and R.Q. Garg. 1986. *Social Forestry and Tribal Development.* New Delhi: Indian environmental Society.
- FAO, 1985. *Tree Growing by Rural People.* FAO Forestry Paper No. 64. Rome Italy.
- FAO, 1985. *Monitoring and Evaluation of Participatory forestry Projects.* FAO Forestry Paper No. 60, Rome Italy.
- Prashad, V.N. 1985. *Principal and Practice of Social-cum-community Forestry.* Dehra Dun: International Book Distributors.

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Syllabus for M.S. in Agroforestry

AF 511: Component Interaction in Agroforestry.

Credit hour: 2

- Introduction: Concept, nature and type of interactions.
- Ecological interactions between Agroforestry components, competition between the components for growth resources.
- Principles of Resource capture and utilization of light, water and nutrients.
- Microclimate modification in Agroforestry.
- Efficient use of growth resources for maximizing the overall productivity.
- Tree-Soil-Crop interaction on slopes.
- Root distribution of trees and crops: Competition and / or complementary.

References:

- Ong, C.K. and P.A. Huxley. 1999. *Tree-crop Interaction: A Physiological Approach.* CABI Publishing.
- Huxley, P.A. 1999. *Tropical Agroforestry.* Blackwell Sciences.
- Alam, M.K.; F.U. Farid and S.M.R. Amin (eds.). 1997. *Agroforestry: Bangladesh Perspective.* APAN, NAWG and BARC.
- Nair, P.K.R. 1993. *An Introduction to Agroforestry,* Kluwer Academic Publishers.
- Vandermeer. J. 1989. *The Ecology of Intercropping.*

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AF 505: Agroforestry Research Methodology.

Credit hour: 2

- General discussions on research issues in Agroforestry; principles of field experiment in Agroforestry.
- Problem identification, developing program of research with written study plan.
- Implementation of Agroforestry research.
- Designing and management of Agroforestry experiment.
- Procedure of data collection.
- Data analysis and interpretation of results: Orientation to computer system for data analysis with computer package program.

References**:**

- Avery, M.E.; M.G.R. Cannell and C. Ong (eds.). 1990. *Biophysical Research for Asian Agroforestry.* Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Burch, W.R. (ed.), 1990 *Applications of Social Science: Theory and Methods to Agroforestry Research.* Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Raintree, J.B. 1986. *D & D user's manual: an introduction to Agroforestry diagnosis and design.* ICRAF, Nairobi.
- Huxley, P.A. (ed.), 1986. *A manual of methodology for the exploration of multipurpose trees (MPTs).* ICRAF, Nairobi.
- Bentley, W.R. 1985. *Agroforestry: a strategy for research and action in India.* Ford Foundation New Delhi.

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AF 511: Silvicultural Practices in Agroforestry.

Credit hour : 2

- Introduction: Concepts and basic principles of silviculture, concepts of Bangladesh forest and need for silvicultural practices in Agroforestry.
- Silvicultural systems: Clear felling system, uniform system, group system, irregular shelter wood system, strip system. wedge system and selection system.
- Regeneration, Nursery operation & establishment technology: Natural and artificial regeneration: seed collection, processing and storage; pre-sowing treatments, germination and nursery operation, raising of polybag & bare-rooted seedling, vegetative propagation, artificial seed production & micropropagation, plantation & establishment of saplings, tending operation and protection of planting stocks.
- Forest management in Bangladesh: Silvicultural management in forestland agroforestry with particular reference to hill forest, mangrove forest, sal forest and homestead forest.
- Measurement of trees and forest: Measuring of diameter and girth, height, tree stem form, volume biomass, age and growth.

References:

- Mayhew, J and A.C. Newton. 1998. *The silviculture of Mahogony.* CABI publishing.
- Srivastava, M.B. 1997. *Introduction to Forestry.* Vikas Publ. House, Bangalore, India.
- Philip, M.S., 1994. *Measuring Trees and Forests. 2nd Edition. CABI Publishing.*
- Dwivedi, A.P. 1992. *Agroforestry: Principles and Practices.* Oxford & IBH Publ. Co.
- Matthew. J.K.; C.L. Bruce and D.O. Chaduick. 1992. *The Ecology and Silviculture of Mixed-species Forests.* Kluwer Academic Publishers.
- Savill, P.S. 1991. *The silviculture of Trees used in British Forestry.* CABI Publishing.
- Zabala, N.Q. 1991. *Silvicultural Systems.* IFCU, Chittagong and FAO, Rome, Italy.
- Zabala, N.Q. 1990. *Principles and Practice of Silviculture.* IFCU, Chittagong and FAO, Rome Italy.
- Shepherd, K.R. 1986. *Plantation Silvicuture.* Kluwer Academic Publishers.
- Duryea, M.L. and T.D. Landis. 1984. *Forestry Nursery Manual: Production of Bareroot Seedling.* Kluwer Academic Publishers.
- Prakash, R. and L.S. Khanna. 1983. *Theory and Practice of Silvicultural Systems.* International Book Distributions. Dehra Dun, Indian.

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AF 521: Wood Quality & Wood Technology.

Credit hour : 2

- Introduction: Concept of soft wood and hard wood, their types, classification and uses.
- Wood structures and Wood textures: Structural nature of woody plants, sap wood and heart wood at early and later stages of maturity, textural qualities with ageing of the trees.
- Tree abnormalities and Wound healing: Causes of abnormal tree growth and their remedies; non-parasitic injuries, lightening & electric injuries; gas, fire, smoke and soot injuries. girdling and other mechanical injuries, their remedies through management practices, grafting, wound treatments, cavity treatment, bracling and cabling.
- Harvesting, seasoning and preservation of wood: Tree felling and conversion of woods, wood transporting and processing, different methods of seasoning, preservation and storing system.

References:

- Shrivastava, M.B. 1997. *Introduction to Forestry.* Vikas Publ. House, New Delhi.
- Negi, S.S. 19986. *A Hand Book of Forestry,* International Book Distribution. Dehra Dun, India.
- Hartmann, H.T. and D.E. Kaster. 1978. *Plant Propagation: Principles and Practices.* Prentice Hall, New Delhi.
- Pirone, P.P. 1978. *Tree Maintenance.* Oxford Univ. Press. New York.
- Esau, K. 1965. *Plant Anatomy,* John Wiley, New York.
- Fahn. A. 1967. *Plant anatomy.* Pergaman Press. Oxford.

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AF 523: Land-use Planning in Agroforestry.

Credit hour : 2

- Land and land-use: Ownership use and characteristics of land, combined use as a land management policy, the multiple problem of multiple uses, land & tree tenure.
- Planning & development of land-use systems in Agroforestry: Existing land-use system in Agroforestry, planning and development of wasteland, fallow land, roadsides, riversides & degraded land, desert land, saline & coastal areas, dry & rocky areas, marshy lands following technologies.
- Windbreaks and shelterbelts: Designing of windbreaks and shelterbelts, coastal windbreaks and shelterbelts, wind erosion control and shifting sand dunes, control ravages of wind in farms, houses, roads & other constructions, increase yield of agricultural & pasturelands.
- Agroforestry in institutional premises: Land-use system in the institutions today, future planning and development of institutional models for aesthetic & production purposes.
- D & D and other appraisal tools for agroforestry systems and land-use planning: Prediagnostic & diagnostic steps, technology design and redesigning of models and their implementations in different farm categories and other places.

References:

- Singh, P.; P. P. S. Pathok and M. M. Roy, (eds.) 1999. *Agroforestry for Sustainable Land use.* Oxford and IBH Publishing Co.
- Alam, M.K.; F. U. Ahmed and S.M.R. Amin (eds.).1997. *Agroforestry: Bangladesh Perspective.* APAN NAWG and BRAC.
- ICRAF, 1990. *Agroforestry Research for Development.* ICRAF, Nairobi.
- Raintree; J.B. (ed.). 19986. *D & D users manual: an Introduction to Agroforestry Diagnosis and Design.* ICRAF, Nairobi.
- Davidson, D.A. 1982. *Soil and Landuse Planning. Second Edition,* Longman Press, London, U.K.
- Davis, P. 1976. *Land Use.* Mcgraw Hill Book Company, New Delhi, India.
- FAO. 1988. *Land resources Appraisal of Bangladesh for Agricultural Development.* UNDP/FAO Project BGD/81035, Technical Reports, FAO, Rome.
- FAO, 1988. Land Resources Appraisal of Bangladesh for Agricultural Development. UNDP/FAO Project BGD/81/035, Technical Reports, FAO, Rome.

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AF 515: Medicinal Plants AND Non-wood Products

Credit hour : 2

- Introduction to common medicinal plants, their role in herbal medical science.
- Morphophysiological characteristics, propagation and growth of medicinal plants commonly found in Bangladesh.
- General introduction on useful parts of selected medicinal plants used in treating common diseases.
- Selection and improvement of medicinal plants regarding its medicinal value.
- Accommodation, production and conservation of medicinal plants in different Agroforestry systems.
- Medicinal plants in the development of herbal industry.
- Non-wood products in Agroforestry.

References:

- Alam, M.K.; F. U. Ahmed and S. M. R. Amin (eds.). 1997. *Agroforestry: Bangladesh Perspective.* APAN, NAWG and BRAC.
- Jha, L.K. 1995. *Advance in Agroforestry.* APH Publishing Corporation, New Delhi.
- Wagner, H and N.R. Farnsworth (eds.). Economic and Medicinal Plant Research. Academic Press Limited. U.K.
- Ayensu, E.S. 1985. The Healing Plants. Unasylva.
- Dastur, J.F. 1977. Medicinal Plants of India and Pakistan. D.B. Taraporevala Sons & Co Pvt. Ltd., India.
- Baquar, S.R. and M. Tasnif. Medicinal Plants of Southern West Pakistan, Central Laboratories, Pakistan Council of Scientific and Industrial Research, Karachi, Pakistan.
- Ahluwalia, K.S. 1962. British Pharmaceuticals Codex Plants and Their Indian Substitutes. Ministry of Health, Govt. of India.
- Batter, E.; J.F. Caius and K.S. Mhaskar. Indian Medicinal Plants. Periodical Experts, D-42.Vivek Vihar; New Delhi.

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AF 517: Soil Productivity and Conservation in Agroforestry

Credit hour : 2

- Introduction: Role of Agroforestry in soil conservation and sustainability.
- Agroforestry practices for soil erosion control.
- Agroforestry for maintenance of soil fertility and productivity: soil fertility and degradation, effect of trees on soil, trees and shrubs for soil improvement, Agroforestry practices for soil fertility, nutrient recycling in Agroforestry system.
- Agroforestry for soil conservation: Hypothesis for soil-agroforestry research related to soil conservation, management of upland soils of Bangladesh.

References:

- Young, A. 2000. *Agroforestry for Soil Management, 2nd Edition.* CABI Publishing.
- Singh. P.: P.P.S. Pathok and M. M. Roy. 1999. *Agroforestry for Sustainable Land Use.* Oxford and IBH publishing.
- Young, A. 1989. *Agroforestry for Soil Conservation.* CABI Publishing and ICRAF, Nairobi.
- Lal. R. (ed.). 1988. *Soil erosion Research Methods.* Soil and Water conservation Society of North America. Ankeny, IOWA, USA.
- Moldenhauer, W.C. and N. W. Hudson (eds.). 1988. *Conservation Farming on Steep lands.* Soil and water conservation Society of North America, Ankeny, IOWA, USA.
- Greenland, D.J. and R. Lal (eds.). 1977. *Soil Conservation and Management in the Humid Tropics.* Wiley, Chichester, UK.

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AF 525: Environmental Protection in Agroforestry

Credit hour : 2

- Introduction: Concepts, principles and objectives of environmental conservation and management.
- Nature and major component of environment: physical, chemical, biological, and meteorological environment.
- Environmental issues: Deforestation & desertification, CO_2 and other green house gas emission, global warming, sea level rise, ozone layer depletion, acid rain etc.
- Environmental Impact Assessment (EIA): Principles and methods of EIA, EIA guides prescribed by FAO, EIA on natural and plantation forests.
- Environmental policies: National Environmental policy 1992, National conservation strategy 1992, National environmental Management Action Plan (NEMAP) 1995, Chronology of major environmental initiatives, environmental conservation Act 1995.
- Environmental protection and biodiversity management through Agroforestry.

References:

- Innes, J.L. and H.A. Hasan (eds.). 2000. *Air pollution and the Forests of Developing and Rapidly Industrializing Countries.* CABI Publishing.
- Angelsen, A. And D. Kaimowitz. 1999. *Agricultural Technologies and Tropical Deforestation.* CABI Publishing.
- Miller. G.T. 1999. *Environmental Science.* Longman Group Ltd. England.
- Timothy O'Riodran, 1995. *Environmental Science for Environmental Management.* Longman Group Ltd. England.
- Trivedi, R. N. 1993. *A Text Book of Environmental Sciences.* Anmol Publishing Pvt. Ltd., New Delhi.

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AF 527: Water Conservation and Watershed Management

Credit hour : 2

- Introduction: Concepts, principles and objectives of watershed management; importance of watershed management in Bangladesh.
- Hydrological cycle: Hydrological cycle of forests, precipitation interception, surface flow, infiltration, percolation, ground water, stream flow etc.
- Erosion: Geologic and accelerated erosion; agents, types and causes of erosion; forms of water erosion; estimating rate of erosion; universal soil equation and its development basis; erosivity and erodibility; causes and control measures of wind erosion; causes, effects and control measures of shifting cultivation.
- Planning for watershed management: Need for planning and procedure of watershed management; data requirements for integrated plan and economic analysis; preparation, of watershed workplan.
- Integrated watershed management: Watershed classification; organization and institutional coordination for watershed management; background, approach, strategy, conceptual framework for integrated watershed management.

References:

- Jha, L.K. 1995. *Advances in Agroforestry.* APH Publishing Corporation, New Delhi.
- ASEAN-US Watershed Project, 1988. *Abstracts of Watershed management Research and Related Studies in the ASEAN Region.* Vol. 1. Laguan, Philippines.
- Panday, K. and L. Wenhua, 1987. *Watershed management Experience in the Hindu-Kush-Hunalaya Region.* ICIMOD, Katmandu, Nepal and Commission for Integrated Survey of Natural Resource, Chinese Academy of Science, Beijing, China.
- Beattie, B.B. 1979. *Watershed Conditions and watershed research needs.* Chittagong Hill Tracts Project. Report No. 2. IFCU.

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AF 519: Pest Management in Agroforestry

Credit hour : 2

- Introduction and scope of pest management in Agroforestry, importance of insects and diseases in Agroforestry.
- Common insects and disease occurring on important agroforest species.
- Methods of pest management: cultural, chemical, biological and IPM technologies related to Agroforestry and other forestry systems.
- Biology, nature, extent of damage and control of the major insects and diseases of important Agroforestry species.

References:

- Speight, M.R. and F.R. Wylie. 2000. *Insects Pests in Tropical Forestry.* CABI Publishing.
- Raychaudhuri, S.P. 1999. *Forest Trees and Palms-Diseases and Control.* Oxford and IBH Publishing Co. Pvt. Ltd.
- Jha, L.K; 1995. *Advance in Agroforestry.* APH Publishing Corporation, New Delhi.
- Browne, F.G. 1968. *Pest and Diseases of Forest Plantation Trees.* Clarendon Press, Oxford.
- Findley, W.P.K. 1967. *Timber pests and diseases.* Pragman Press.
- Graham, S.A. and F.D. Knight. 1965. *Principles of Forest Entomology.* McGraw Hill Book Co.