Elective 1:
Forests and Water
Agroforestry and Farm Forestry

Module No.	**Module name**
WP 1	Forests and Water

Module coordinator

Prof. Dr. H. Mayer

Email: helmut.mayer@meteo.uni-freiburg.de

Additional teaching staff

Dr. J. Lange, Prof. Dr. L. Jaeger

Syllabus

The module consists of three units.

"Forest microclimatology" deals with micrometeorological processes and phenomena, which are relevant to investigate the components of the water balance of forests by use of experiments and simulations.

"Water balance of forest stands" deals with the specific characteristics of the water balance of forests compared to other land use types. Differences caused by different tree species or climate conditions will be discussed. Key elements are: (a) different components of precipitation (gross precipitation, interception, throughfall, stemflow), (b) evapotranspiration of forests, (c) infiltration and groundwater recharge. At the end a simple water balance model is introduced.

"Hydrological processes in forests" enlarges the focus from single forest stands to larger scales of forested slopes or headwater catchments. It introduces different concepts of lateral water flows and runoff generation (e.g. saturation excess, quick interflow, piston flow effects, etc.). Examples from several research catchments around the world are given. These include semi arid, temperate and tropical forests.

Learning goals and qualifications

This module imparts knowledge on the importance of water being essential for forest ecosystems throughout the world. At its end students will be able to

- realise meteorological and climatic processes and phenomena significant to the water balance of forests
- understand the basic differences of the water balance in forests compared to other land use types
- apply relevant techniques to measure water balance components in forests
- give quantitative estimates for water balance components in forests of different climatic regimes
- Identify relevant water pathways in forests, dependent on the climatic regime
- apply simulation tools (mathematical models) to describe water balance components in forests

Teaching and learning methods

Lectures, tutorials, pracs

Prerequisites

none

Requirements for registration

none

Distribution of work load

Contact hours 65 h (Lectures, pracs, exam)

Student learning 60 h (Preparation, reading etc.)

Proposed assessment

Written exam

Link to learning resources

http://www.mif.uni-freiburg.de/index1.htm

http://www.hydrology.uni-freiburg.de/

Preliminary Reading

Bonell, M. Barnes, C. J., Grant, C.R., Howard, A. and Burns J. (1998): High Rainfall, Response-Dominated Catchments: A Comparative Study of Experiments in Tropical Northeast Queensland with Temperate New Zealand, in: Isotope Tracers in Catchment Hydrology (1998), C. Kendall and J. J. McDonnell (Eds.) Elsevier Science B.V., Amsterdam, pp. 347-390.

Geiger, R., Aron, R.H. and Todhunter, P. (1995): The climate near the ground, Harvard Univ. Press, Cambridge, Mass.

MacDonald, L.H. and Stednick, J. D. (2003): Forests and Water: A State-of-the-Art Review for Colorado, Colorado Water Resources Research Institute, Completion Report No.196.

McGlynn, B. L.; McDonnel, J. J.; Brammer, D. D. (2002): A review of the evolving perceptual model of hillslope flowpaths at the Maimai catchments, New Zealand. In: Journal of Hydrology 257, 1-26.

Post D.A. and Jones J. A. (2001) : Hydrologic regimes of forested, mountainous, headwater basins in New Hampshire, North Carolina, Oregon, and Puerto Rico, Advances in Water Resources 24, 1195 – 1210.

Comments

Module No.	Module name
WP 7	Agroforestry and Farm Forestry

Module coordinator

Prof. Dr. G. Kapp Email: <gerald.kapp@waldbau.uni-freiburg.de>

Additional teaching staff

Prof. Dr. A. Reif, Dr. B. Bösch (FVA)

Syllabus

Introduction to agroforestry and farm forestry. Production characteristics of farmsteads, ecological interactions in subsystems, co-generation of agricultural, pastoral and silvicultural products, including non-wood forest products and carbon sequestration

Overview of land use types of farm forestry and agroforestry in the tropics and temperate climates

Field visits to farm forestry and agroforestry sites

Case studies of selected examples of farm forestry and agroforestry

Analysis of systems of farm forestry and agroforestry through modelling: system concept and model. Interaction diagrams, modelling of dynamic systems (pasture models)

Computer exercise: development of different type of models, including spreadsheet programming, systems optimisation, theory of linear optimisation

Computer exercise: modelling of (agro-)forestry CO_2-sinks

Computer exercise: optimisation of tree pasture systems and management simulation of an agroforestry farmstead in a developing country

Conclusions regarding the development of farm forestry and agroforestry projects

Learning goals and qualifications

Knowledge of farm forestry and agroforestry systems with main emphasis on the tropics. Understanding of historic developments, ecological, technical and economic interactions, and development perspectives. Skills in analysis, modelling, simulation and evaluation of agroforestry systems with emphasis on plant production, economic optimisation, carbon sequestration, and project development.

Teaching and learning methods

Lectures, excursions, case studies, computer exercises

Relevance/use of the module

Professional development cooperation in rural areas requires an in-depth understanding of farm forestry and agroforestry systems, based on practical experiences and modelling. Moreover, the acquired knowledge, e.g. on model formulation, linear optimisation, or CO_2 sequestration are useful in many jobs.

Prerequisites

Basic computer literacy and basic English language skills

Requirements for registration

Distribution of work load

Contact hours	80 h (Lectures, practices, excursion, exam)
Independent learning	45 h (Preparation, reading, etc.)

Proposed assessment

Exam (partly using computer programmes)

Presentation of an excursion protocol

Link to learning resources

Preliminary Reading

Bösch, B.; Kapp, G. (2004): Modellbildung und Simulation agroforstlicher Systeme. Skript zum Blockkurs WS 2004/2005. 70 S. + Annex

Gordon, A.M; Newman, S.M. (eds.) (1997): Temperate Agroforestry Systems. CAB International, Wallingford, UK and New York, USA, 269 pp.

Kapp, G. B. (1998): Bäuerliche Forst- und Agroforstwirtschaft in Zentralamerika. Untersuchungen über forst- und agroforstliche Produktionssysteme unter besonderer Berücksichtigung des feuchten Tieflands von Costa Rica und Panama. Margraf Verlag, Weikersheim, 303 S. (Forstbibliothek)

Mac Dicken, K.G.; Vergara, N.T. (ed.) (1990): Agroforestry: Classification and management. John Wiley & Sons, New York, 382 p. (Forstbibl. LA 600/3)

Nair, P. K. R. (1993): An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, Boston, London in Cooperation with ICRAF, Nairobi, 499 pp. (Forstbibl. LA 600/14)

Further bibliographical references will be provided during the course.

Comments

Number of participants restricted by the number of computers available in the CIP room.