SYLLABUS

Masters of Science in Watershed Management

2024

Tribhuvan University
Institute of Forestry
Kirtipur,
Kathmandu

FOREWORD

The Master of Science degree in Watershed Management, conferred by Tribhuvan University, stands as an advanced educational milestone designed to cultivate adept professionals in the field of watersheds. This academic journey has been shaped by a commitment to excellence, and the number of curriculum revisions ensures that the course is aligned with the changing context. The curriculum overhaul is an integral part of the Institute of Forestry's (IOF) comprehensive review process. This revision aims to fortify the students' proficiency in applying fundamental principles of watershed management to address contemporary challenges in professional practice.

At the heart of this revision process lies a collaborative spirit, with experts and stakeholders engaged at both national and international levels. Leveraging their insights, the curriculum has been crafted aiming that equip students to confront the evolving issues within watershed science. The courses introduced are strategically designed to tackle the myriad challenges associated with watershed management, environmental pollution, and climate change, particularly in the face of escalating global changes. The envisioned outcome is to empower students with analytical skills, decision-making abilities, and the capacity to address the multifaceted nature of problems inherent in the field of environment and watershed management while balancing the trade-off between ecological and societal needs.

Embarking on this new academic journey, the subjects are identified considering these multiple roles of watershed management, where the subject committees and faculty board of the IOF took a leadership role in shaping it. Moreover, many individuals and institutions have contributed directly and indirectly to bring this curriculum to this shape. This is also an outcome of the consultative processes carried out at different levels. I express my sincere thanks to internal and external experts, subject committee chairs and members, and the Faculty Board for their kind cooperation and contributions. Special appreciation is extended to the ALIGN project WWF Nepal for their financial support in the preparation of the syllabus. Further, I would like to extend my special thanks to the Academic Council of Tribhuvan University for approving this curriculum. I appreciate the contribution of curriculum revision committee members Associate Prof. Dr. Sony Baral, Prof. Dr. Krishna Raj Tiwari, Prof. Dr. Rajesh Kumar Rai, Associate Prof. Dr. Narayan Prasad Gautam and Associate Prof. Dr. Menuka Maharjan, IOF for revising the M.Sc. syllabus with leaving no stone unturn.

I am confident that our students will serve as warriors for addressing the planetary crisis, that we are now facing, such as global climate change, biodiversity losses, and environmental issues. Moreover, they will serve in the sustainable management of the global commons. As we step into this renewed academic chapter, we remain committed to upholding the highest standards of education and fostering a learning environment that prepares our students to be leaders and innovators in their respective fields.

Prof. Bir Bahadur Khanal Chhetri, PhD
Dean

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1. INTRODUCTION

Watershed management is currently grappling with a confluence of challenges, including climate change, biodiversity loss, and the need for sustainable production and development on a global scale. This has led to an escalating level of pressure and threats on forests, which serve as pivotal entities in addressing numerous national and international challenges. The role of the academics is pivotal in addressing these global challenges. In response to the evolving demands of the market, the Master's program in watershed management has been revised to enhance the skills of students and preparing them to navigate the diverse aspects of technical, field, and policy dimensions within the watershed management sector. The program is designed not only to equip students with the knowledge necessary to address complex national and international forest challenges but also to empower them to seek, negotiate, and implement solutions in the face of a rapidly changing world.

The Institute of Forestry (IOF) aims to provide high quality education, developing critical thinking skills, and preparing students for their future careers in forestry and natural resources sectors. This is achieved through a multifaceted approach encompassing extensive field research, a dynamic forest lab, an on-campus museum, and impactful outreach programs. Established in 1947 AD, the IOF is the pioneer institute dedicated to imparting comprehensive knowledge and technical expertise in Forestry and allied sectors. As a hub for advanced education in forestry, the Institute of Forestry continues to play a pivotal role in developing skilled professionals and the sustainable management of Nepal's rich natural resources.

The IOF has been offering academic degrees, Bachelor's in forestry, Masters and PhD programs in various fields of Forest Science, including Forestry; Community Forestry; Wildlife Management and Biodiversity Conservation; Mountain Environment and Development Studies; Watershed Management and Environmental Science; and Natural Resource Management and Rural Development. The IOF periodically revises the curriculum, engaging academicians, development practitioners, researchers, and policymakers to provide students with the current state of knowledge on forestry sciences and allied sectors and make them competent to address the emerging issues and challenges within it. The M.Sc. programs have been designed as per the increasing needs of the diverse areas and expanding context and career landscape at the national and international levels. Considering the forest is key to addressing many of these national and international challenges diverse Master programs have been introduced and revised as per the need.

The updated course streamlines the learning process by introducing a unified first-year curriculum, ensuring that students, regardless of their specialization (Forestry, Wildlife Management and Biodiversity Conservation, Natural Resources Management and Rural Development, Watershed Management and Environmental Science, Mountain Environment and Development Studies, Community Forestry), develop a foundational understanding of crucial interdisciplinary concepts against the backdrop of pressing issues such as policy, forestry, climate change, biodiversity loss, and pollution. The program is designed to produce skilled human resources with technical

competency in integrated watershed management and Environmental Science. The other specific objectives of the course are:

- To provide knowledge and skills to address problems related to watershed degradation caused by soil and water issues,
- To produce competent human resources capable of planning and executing water and soil conservation strategies

For this program adopts a pragmatic, field-based teaching approach, emphasizing applied learning structures. Our graduates will be equipped with a versatile skill set that positions them to ascend in government service, attain notable success in academic pursuits, establish themselves as successful entrepreneurs, and secure high-profile green jobs. The comprehensive academic journey will prepare them to thrive in various career paths and to contribute significantly to their chosen fields.

PROGRAM DURATION AND ACADEMIC SESSION

The Watershed Management and Environmental Science program will span two academic years, comprising a total of four semesters. The First semester focuses on the theoretical aspects of forest and natural resource management. The Second semester emphasized on tools and techniques required for data collection and analysis. The Third semester focuses on integrated watershed management, watershed modeling, and watershed induced disaster and management. The Fourth semester is allocated for conducting research and sharing their findings.

COURSE CODE AND CODE NUMBERS

The course code provided in this curriculum comprises a concise representation of the Subject Matter Committee, including a number and additional information enclosed in parentheses. The initial abbreviated text within the course code signifies the specific Subject Committee category to which the course belongs. The abbreviations corresponding to the course codes are outlined below:

PWM: Park Recreation and Wildlife Management
SFB: Silviculture and Forest Biology
SFM: Social Forestry and Forest Management
WME: Watershed Management and Environmental Science
FPE: Forest Products and Engineering
BSH: Basic Science and Humanities

ADMISSION, EVALUATION AND AWARD OF DEGREE

The candidate must hold a Bachelor's degree of at least four years in B.Sc. Forestry, Engineering/ Agriculture and Science degree from either Tribhuvan University or any institution acknowledged by Tribhuvan University. All students must appear in the entrance examination administered by the Examination Section of the IOF and are selected for admission based on their merit score. Both academic achievements and performance in the entrance examination will play a crucial role in the admission process.

Evaluation and Examination System

Students are internally and externally evaluated each semester. Forty percent marks are set aside for 40% marks for internal assessments and 60% marks for the final exam. To pass the examination, students must secure 50% marks in the final exam, internal assessment, and practical examinations separately. A statement of marks is issued to students after the result is published for that particular semester. However, the internal examination marks will be given to the students by the respective course coordinator after the completion of the task. Students must appear in the final written examination scheduled at the end of the semester. Students cannot attend the final examinations without passing the internal assessment. Students who do not pass the regular semester examination can appear in the make-up examination. However, the students must fill up the examination form for the respective semester to enter the next semester.

The internal assessment can be divided into different activities such as assignments and attendance. Assignments include fieldwork, laboratory work, term papers, class presentations, unit tests, report writing, project work, and home assignments. The internal assessment will be evaluated by the responsible faculty. The responsible faculty will, in advance, notify the students of the criteria of evaluation for the respective courses.

The internal evaluation of the student will be monitored by the external expert(s). Expert(s) will be assigned by the exam control division based on the relevancy of the subject area. The expert(s) will facilitate to improvement of the evaluation process, coverage, relevancy and assigned tasks to the students from the internal evaluator(s)/faculties. S/he does have the authority to change the marks given by the internal evaluator if needed.

The thesis of the student will be evaluated by the Research Assessment Committee (RAC) coordinated by the main supervisor, and internal and external experts. The internal expert will be nominated by the respective campus and the external expert will be nominated by the exam control division based on the relevancy of the subject area.

Attendance Requirement

A student must attend at least 80% of classes in each subject. Attendance carries 20% marks on the internal assessment. Failure to fulfill the attendance requirement by a student may result in his/her disqualification to appear in the final examination. But, in specific cases (seriously ill, out-of-control situations) students having 70% attendance are allowed to appear for the final examination. In this case, the student should submit a medical certificate for the seriously ill, and a certificate of the concerned authority in other cases.

Academic Transcript and Grading System

After the successful completion of all the requirements prescribed by the course curriculum, a student will be eligible for the award of an M.Sc. degree in the respective programs. An academic transcript is issued by the Controller of Examination of Tribhuvan University to students who have fulfilled all requirements. The academic standard of students is based on the cumulative percentage of marks secured in all examinations. The IOF adopted the grading system indicated in credit transfer, grading system, and the academic transcript study report of 2020 approved by TU Academic Council decision no 64 on 2078/1/14 [Table 1].

Table 1: Grading System for M.Sc Program

Grade	**GPA**	**Grading Scale (in %)**	**Performance**
A	4.0	90-100	Outstanding
A-	3.7	80- less than 90	Excellent
B+	3.3	70-less than 80	Very good
B	3.0	60- less than 70	Good
B-	2.7	50 -less than 60	Satisfactory
F	0.0	Less than 50	Fail

In this system, a student has to receive a minimum of 2.7 GPA or letter "B-" grade to pass each course.

In every semester, students will be given Semester Grade Point Average (SGPA) using the following calculation

$$\text{SGPA} = \frac{Total\ Grade\ Point\ earned\ in\ a\ semester}{Total\ Number\ of\ credit\ registered\ in\ a\ semester}$$

Based on the grades earned in each semester, Cumulative Grade Point Average (CGPA) will be calculated as follows:

$$\text{CGPA} = \frac{Total\ Grade\ Point\ earned}{Total\ Number\ of\ credits\ completed}$$

SEMESTER-WISE COURSE BREAKDOWN

Semester I	Course	Credit	Page Number
SFM 501	Forest and Environment Policy	3	
SFM 502	Nature and Society	3	
WME 503	Water- Energy-Food- Ecosystem Nexus	3	
PWM 504	Landscape Management and Biodiversity Conservation	3	
SFM 505	Natural Resource Management in Changing Environment	3	
Semester II			
WME 551	Geoinformatics for NRM	3	
BSH 552	Research Design and Scientific Writing	3	
BSH 553	Advanced Statistics	3	
SFM 554	Natural Resource Economics	3	
SFB 552	Landscape Restoration	3	
Semester III			
WME 631	Integrated Watershed Management	3	
WME 632	Watershed Modeling	3	
WME 633	Water Induced Disaster and Management	3	
WME 634	Watershed Engineering	3	
WME 635	Water Resource Management (Optional)	3	
SFM 606	Natural Resource Professional Ethics (Optional)	3	
Semester IV			
WME 651	Proposal	2	
WME 652	Pre-defense	2	
WME 699	Dissertation	9	
WME 653	Manuscript of Research Work	2	

COURSE DESCRIPTIONS

SEMESTER I

COURSE TITLE: FORESTS AND ENVIRONMENT POLICY

Course Code	Credit (Theory and Practical)	Lecture Hours (Theory +Practical)	Total Marks (Final Examination +Internal Assessment)
SFM 501	3 (2+1)	48 (32+16)	45+30

Note: 1 credit= 16 lecture hours

SCOPE: Forest and other environmental policies play an important role in sustainable resource management. This course is designed to introduce students to the contextual understanding of policies that have shaped the management of renewable resources (i.e., forest, wildlife, water, etc.) in Nepal and beyond. Throughout the course, students will learn ideas behind natural resource policies and try to understand their role in broader natural resource decision-making.

OBJECTIVES: The objectives of this course are to:

- To facilitate student learning in forest and environmental policymaking and be able to apply this understanding to case studies of environmental and natural resource policy issues.
- To familiarize students with the development of key national and international policies for natural resources and environmental sustainability.
- To familiarize students with the organizational and administrative structure and policy-making processes of the major federal natural resource management agencies in Nepal.
- To facilitate students in their ability to critique and evaluate policy processes and policy outcomes in the context of emerging market issues and changing natural resource conditions.

LEARNING OUTCOMES: Upon the completion of this course, the students will be able to

- Have a clear understanding of the evolution and administrative functionalities of major forest and environmental policies in Nepal.
- Understand the public policy formulation process in national and international contexts.
- Understand the evolution of environmentalism in national and international contexts.
- Be familiar with the various policies and regulations in Nepal pertaining to environment and natural resources.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO FOREST AND ENVIRONMENTAL POLICY (6)

1.1 Natural Resource Management and Politics
1.2 Importance of Public Policy
1.3 Evolution of Environmental Policy (forest, watershed, wildlife)
1.4 Global Challenges in Natural Resource Management / Planetary Crisis
1.5 Tragedy of the Commons
1.6 Externalities and Market Failure

UNIT 2: POLICY PROCESS MODELS (8)

2.1 Economic, Political, and Ethical Perspectives on Environmental Policy
2.2 Natural Resource Policy as a Process
2.3 Public (forest/watershed/wildlife) Policy Formulation Process in Nepal
2.4 Environmental Sustainability and Natural Resource Policies
2.5 Criteria for Policy Analysis

UNIT 3: ENVIRONMENTALISM AND ENVIRONMENTAL POLICIES (8)

3.1 Environmentalism and its Impact on Policies
3.2 Theoretical Foundation: Ecocentrism, Anthropocentrism, and Deep Ecology
3.3 Emergence of Environmental Impact Assessment as a Policy Tool
3.4 Endangered Species Conservation and International Trade

UNIT 4: INTERNATIONAL CONSERVATION POLICIES (4)

4.1 International Convention Joining and Withdrawal Process
4.2 Earth Summit 1992 and its Outcome Conventions
4.3 International Climate Agreements and their Effectiveness

UNIT 5: SECTORAL POLICIES IN NEPAL (6)

5.1 Constitutional Provisions Related to Natural Resources
5.2 Sectoral Policies (Other) and Natural Resource Conservation
5.3 Synergies in Natural Resource Related Policies (Climate, Environmental, Forests, Watershed, Wildlife)
5.4 Natural Resource Revenue Sharing Mechanism

PRACTICAL (16)

Contents	**Equipment/tools**	**Methodology/methods**	**Link to Unit(s)**
History of policies (Sectoral) in Nepal	Literature	Literature Review and Presentation	Unit 1, 4
Policy analysis of Nepal Forest/Environment/Watershed/ climate policy (Outcomes)	Policy document	Group work / Report	Unit 2
Improving EIA in Nepal	Expert Consultation	Group work / Critiques and Suggestions	Unit 3
Status and Challenges of International Treaties in Nepal	Literature, Expert Consultation	Group work/ Report	Unit 5
Policies in Nepal	Literature	Review / Class Discussion	Unit 6

KEY REFERENCES

Unit 1

1. Askari, H., Iqbal, Z., & Mirakhor, A. (2014). Significance of Public Policy. In: *Challenges in economic and financial policy formulation: An Islamic perspective*. New York: Palgrave Macmillan.
2. Dolzer, R. (2001). Environmental Policy. *International Encyclopedia of the Social & Behaviroral Sciences.* 4638-4644.
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6. Natural Resource Management's' Nature'and Its Politics. *Communication, Politics & Culture*, *42*(1), 3-18.

Unit 2

1. Bromley, D. W., & Paavola, J. (2002). Economics, ethics and environmental policy. *Economics, ethics, and environmental policy: contested choices*, 261-276.
2. Cubbage, F. W., J. O'Laughlin, and M. N. Peterson. 2017. Natural Resource Policy. Waveland Press, Inc. 10-digit ISBN: 1-4786-2965-X; 13-digit ISBN: 978-1-4786-2955-9.
3. de Anguita, P. M., Alonso, E., & Martin, M. A. (2008). Environmental economic, political and ethical integration in a common decision-making framework. *Journal of environmental management*, *88*(1), 154-164.
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Unit 3

1. Balistrieri, Carlo A. "CITES: The ESA and international trade." *Natural Resources & Environment* 8, no. 1 (1993): 33-76.
2. Bullard, R. D., & Johnson, G. S. (2000). Environmentalism and public policy: Environmental justice: Grassroots activism and its impact on public policy decision making. *Journal of social issues*, *56*(3), 555-578.
3. Grey, W. (1993). Anthropocentrism and deep ecology. *Australasian Journal of Philosophy*, *71*(4), 463-475.
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Unit 4

1. Almer, C., & Winkler, R. (2017). Analyzing the effectiveness of international environmental policies: The case of the Kyoto Protocol. *Journal of Environmental Economics and Management*, *82*, 125-151.
2. Bang, G., Hovi, J., & Skodvin, T. (2016). The Paris Agreement: Short-term and long-term effectiveness. *Politics and Governance*, *4*(3), 209-218.
3. Parson, E. A., Haas, P. M., & Levy, M. A. (1992). A summary of the major documents signed at the Earth Summit and the Global Forum. *Environment: Science and Policy for Sustainable Development*, *34*(8), 12-36.
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6. United Nations (1992). Agenda 21.
7. United Nations (1992). United Nations Framework Convention on Climate Change.
8. United Nations. (2015). Paris Agreement (Articles 20, 21, 28).

Unit 5

1. Constitute of Nepal 2015.
2. Nepal Kanun Kitab Byabastha Samiti (Acts – Land, Infrastructure, Mine, Industry, Hydropower).
3. National Natural Resource and Fiscal Commission Act.
4. Recommendation on the Distribution of Royalties from Natural Resources Mobilization by National Natural Resource and Fiscal Commission.

COURSE TITLE: NATURE AND SOCIETY

Course Code	Credit (Theory and Practical)	Lecture Hours (Theory +Practical)	Total Marks (Final Examination +Internal Assessment)
SFM 502	3 (2+1)	48 (32+16)	45+30

Note: 1 Credit= 16 Lecture Hours

SCOPE: This course covers key theoretical concepts and approaches in social sciences as they relate to understanding and describing the relationship between society and nature. It is intended to help students develop contemporary knowledge and practical skills in assessing and analyzing the causes and solutions of natural resource problems by integrating concepts and foundational theories in social science disciplines.

OBJECTIVES: The objectives of this course are to:

- Foster an understanding of the evolution of human-nature relationships
- Develop a deeper understanding of the complex dynamics of coupled human and natural systems
- Enhance knowledge regarding various social science theories in explaining and predicting human behavior in the context of natural resource management
- Develop a critical foundation for further research on human-nature interactions with using the concepts and skills of conservation social science

LEARNING OUTCOMES: Upon the completion of this course, the students are expected to be able to:

- Know a range of foundational theories in social science to explain and predict the interaction between humans and nature
- Understand the evolving complexity of human and natural systems, including disturbance and adaptation
- Identify and evaluate the importance of cultural and economic institutions in the sustainability of natural resources
- Become familiar with diverse ways human values, beliefs, and norms relate to their behavior toward nature and,
- Integrate ideas and practices from contemporary social science in planning, decision-making, and policy regarding sustainable management of natural resources.

COURSE CONTENTS

UNIT 1: FOUNDATIONS OF NATURE AND SOCIETY (5)

1.1 Human History and Nature
1.2 Equilibrium and Non-Equilibrium Ecology
1.3 Philosophical Foundation of Nature-Human Relationship (Eco-centric, Anthropocentric)
1.4 The Social Construction of Nature
1.5 Nature and Culture

UNIT 2: CHANGES, CHALLENGES, AND PARADIGM SHIFT IN CONSERVATION (6)

2.1 Anthropocene Biosphere
2.2 Planetary Boundaries
2.3 Limits to Growth
2.4 Ecological Modernization
2.5 Bright Green Environmentalism
2.6 Eco-centric vs Anthropocentric

UNIT 3: HUMAN NATURE INTERACTION (8)

3.1 Social-Ecological Systems
3.2 Common Property Regimes
3.3 The Community Capital Framework
3.4 Collective Actions and Impact
3.5 Intermediate Disturbance Hypothesis

UNIT 4: SOCIAL CONTEXT OF NATURE-BASED SERVICES (5)

4.1 The Worth of Nature to Humans
4.2 Ecosystem Marketplace as a Solution
4.3 Climate Change and Social Cost of Carbon
4.4 Opportunity Cost Approach in Conservation Priorities
4.5 Environmental Consumerism

UNIT 5: CULTURE AND WORLDVIEWS (8)

5.1 Drivers of Human Behaviors
5.1.1 Theory of Behavior
5.1.2 Value-Belief Norm Theory
5.2 Demographic Influences on Conservation Values
5.3 Nature-Culture/Indigenous People Relationship
5.4 Social Trust in Natural Resource Management

PRACTICAL (16)

Contents	**Equipment/tools**	**Methodology/methods**	**Link to Unit(s)**
Indigenous community (ethnic group) and nature relationship (Ethnicity/culture-wise group)	Literature review/ reading materials	Group discussion	Unit 1
Influence of human-nature Interaction on Nepal's Forest/environment/wildlife /Watershed Policy Development	Literature review	Group presentation	Unit 2
Social-ecological system	Field	A report on SES / Group	Unit 3

KEY REFERENCES

TEXT BOOK

1. Misiune, I., Depellegrin, D., & Egarter Vigl, L. (2022). *Human-Nature Interactions: Exploring Nature's Values Across Landscapes* (p. 438). Springer Nature.

Unit 1

1. Kai N. Lee, W. R. Freudenburg, and R. B. Howarth. 2013. *Humans in the Landscape: An Introduction to Environmental Studies*. Pages 258-86.
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3. Mol, A. P. J., G. Spaargaren, and D. A. Sonnenfeld. 2014. Ecological Modernisation Theory: Where Do We Stand? In M. Bemmann, B. Metzger, & R. von Detten (Eds.), *Ökologische Modernisierung - Zur Geschichte und Gegenwart eines Konzepts in Umweltpolitik und Sozialwissenschaften* (pp. 35-66). Campus Verlag.
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Unit 2

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Unit 3

1. Ostrom, E., J. Burger, C. B. Field, R. B. Norgaard, and D. Policansky. 1999.Revisiting the Commons. *Science* 284: 278-282.
2. Rights and Resources Initiative. 2018. At a Crossroads. Consequential trends in recognition of community-based forest tenure from 2002-2017. Washington, DC. pp. 1-25.
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Unit 4

1. Stern's review
2. Dasgupta Review
3. Westman, W. E. 1977. How Much Are Nature's Services Worth? *Science* 197: 960-964

4. Costanza, R., R. de Groot, P. Sutton, S. Van der Ploeg, S. J. Anderson, I. Kubiszewski, S. Farber, and R. K. Turner. 2014. Changes in the Global Value of Ecosystem Services. *Global Environmental Change* 26: 152158
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6. Pizer et al. 2015. Using the improving the social cost of carbon. *Science* 346 (6214): 1189-1190.
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Unit 5

1. Morford, S., D. Parker, H. Rogers, C. Salituro, and T. Waldichuk. 2003. Culture, worldviews, communication styles, and conflict in forest management. *BC Journal of Ecosystem and Management* 3(1): 1-7.
2. Vaske, J. J., M. P. Donnelly, D. R. Williams, S. Jonker. 2001. Demographic influences on environmental value orientations and normative beliefs about national forest management. *Society and Natural Resources* 14(9): 761-776.
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9. Larson, L. R., R. C. Stedman, C. B. Cooper, and D. J. Decker. 2015. Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of environmental psychology* 43: 112-124.
10. Steg, L., and C. Vlek. 2009. Encouraging pro-environmental behavior: An integrative review and research agenda. *Journal of environmental psychology* 29(3): 309-317.

COURSE TITLE: WATER-ENERGY-FOOD-ECOSYSTEM NEXUS

Course Code	Credit (Theory and Practical)	Lecture Hours (Theory +Practical)	Total Marks (Final Examination +Internal Assessment)
WME 503	3 (2+1)	48 (32+16)	45+30

Note: 1 credit= 16 lecture hours

SCOPE: Water, energy, land/food, and ecosystems (WEFE) are critical for nutrition and food security, healthy ecosystems, resilient economies, and sustainable development. Single disciplinary (or silo) approach has limitations to achieve the interconnected development goals (e.g., sustainable development goals) in inclusive manner whereas the nexus approach considers the interconnections among the sectors, quantifies synergies and trade-offs of an intervention, and also has the potential to serve as a climate change adaptation and human security solutions. However, governments, stakeholders, and investors are struggling to manage systems change in the WEFE nexus and ensure that the changes are robust under changing climate and evolving interactions among natural and human systems. In this context, this course starts with the context of natural resources under stress, introduces associated concepts, and then evolves into the system approach, nexus concept and principles, entry points for inclusion, system interactions, nexus assessment tools, nexus in practice and nexus future perspective. It includes theoretical sessions, assignments, practical/presentation sessions, and field studies. The course is divided into 5 chapters and 20 sub-chapters, with four sub-chapters in each chapter.

OBJECTIVES: This course aims for the following learning objectives

- To familiarize with the fundamentals of WEFE nexus in the context of natural resources management and climate change
- To enhance knowledge and skill in nexus assessment
- To provide exposure to practical cases and challenges for implementing WEFE nexus using context-specific and participatory approaches
- To deepen understanding of institutionalizing WEFE nexus
- To provide a future outlook of WEFE nexus as a sustainability agenda from people-centric lenses and Gender Equality, Disability and Social Inclusion (GEDSI) perspectives

LEARNING OUTCOMES: Upon the completion of this course, learners are expected to

- Internalize the nexus concept and apply as a solution in planning and designing natural resources development and management problems
- Develop interdisciplinary programs in a professional career with a focus on broader national goals rather than sector-specific goals
- Develop skills to engage with stakeholders to develop sustainable and participatory practices for WEFE nexus management
- Develop number of demonstrated cases of nexus solutions during professional practice and share in public domain

COURSE CONTENTS

UNIT 1: UNDERSTANDING OF NEXUS (6)

1.1 Stress in Natural Resources: Trends in Natural Resources Availability and Demand; Concept of Footprints (water, energy, and carbon footprints); Planetary Boundaries
1.2 System Approach: Understanding of a System and System Approach; Need of Integration Across Sectors; Evolution of the Nexus Thinking Approach (limits to growth, sustainability, and nexus)
1.3 WEFE Nexus: Concept, Principles, and Added Benefits
1.4 Entry Points for Inclusion in Nexus Interventions

UNIT 2: SYSTEM INTERACTION (6)

2.1 Water-Energy
2.2 Water-Food
2.3 Food-Energy
2.4 Interdependences and Inter-Linkages Across Multiple Systems (e.g., water, energy, food, ecosystem/biodiversity): Tradeoff and Synergies

UNIT 3: ASSESSMENT TOOLS (9)

3.1 Assessment Process and Information Flow: Steps, Actors, Location, and Sectors
3.2 Various Types of Tools and Data
3.3 FAO Rapid Appraisal Tools and WEF Nexus Tool 2.0 (including demonstration of tool)
3.4 Scenario Analysis and Practical Challenges: Evaluating Impacts in the Changed Context (institutional changes, climate/environmental/socio-economic changes, policy changes, etc.)

UNIT 4: NEXUS IN PRACTICE (6)

4.1 Dissecting Nexused Relationships on Existing Practices: Case Studies Highlighting Different Aspects of Nexus in Practice
4.2 Risks and Costs to Different Social Groups
4.3 Policy and Institutional Reforms
4.4 GEDSI and Indigenous Knowledge

UNIT 5: NEXUS FUTURE PERSPECTIVE (5)

5.1 Nexus Governance: Fundamentals of Governance and Nexus Governance; Frameworks for Governance Analysis; Improving Sectoral Governance and for Nexus Gains
5.2 Streamlining WEFE Nexus as a Common Agenda: Promoting Dialogue (between science, policy, practice/industry, private sector); Nexus Mainstreaming
5.3 Addressing Bottlenecks for Implementing Inclusive Solutions for WEFE Nexus Gains: Technical/Engineering Solutions; Nature-Based Solutions; Governance Solutions
5.4 Monitoring, Evaluation, Accountability and Learning (MEAL) Framework for Maximizing Nexus Gains

PRACTICAL (16)

- **Group assignment**: Divide the participants into different groups, each consisting of 3-5 persons. Ask the participants to identify one practical case that they are engaged with, characterize the WEFE nexus in that case, and then submit an assignment report as well as a presentation in class. There will be more discussions and inputs in the class from the instructor as well as other participants (beyond that particular group) to visualize the practical cases of the WEFE nexus. (4 hrs)

- **Assignment on application of FAO tool and WEFE nexus 2.0**: Based on data provided for a real or hypothetical case study for simulating WEFE nexus 2.0, and demonstration made in Chapter 3, students will prepare and submit a report on analysis of trade-offs and synergies and recommend potential solutions for minimizing tradeoffs and maximizing the synergies. (4 hrs)

- **Field study**: Students will join to 1-2 days field study in nearby areas to select 1-2 cases of different orientations (e.g., water, energy, food, ecosystem) but have nexuses relationships and dissect nexuses relationships in those cases, prepare a report and present in the class as post-field study report. (8 hrs)

Contents	**Equipment/ tools**	**Methodology/methods**	**Link to Unit(s)**
Dip dive nexuses relationship in existing approaches	Reference materials, Analytical thinking	Literature review to understand nexuses relationship Selected a couple of cases of different orientation Think critically to visualize interlinkages (trade-offs and synergies) Identify challenges and opportunities	Unit 1, 2, 4
Visualize nexus governance and explore the potential of WEFE nexus as a future security agenda	Field logistics, Reference materials, Analytical thinking	Field visits, Interaction with related stakeholders, Critical thinking to visualize interlinkages (trade-offs and synergies), and governance Identify the challenges faced and ways they are managed	Unit 5
Perspectives, cross-fertilization, and synthesis	Field data, Critical thinking	Analyses of field visit/data, Perspectives from different cases explored (e.g., management, policy, governance), Synthesis	Unit 1,2,3,4,5

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Unit 4

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COURSE TITLE: LANDSCAPE MANAGEMENT AND BIODIVERSITY CONSERVATION

Course Code	Credit (Theory and Practical)	Lecture Hours (Theory +Practical)	Total Marks (Final Examination +Internal Assessment)
PWM 504	3 (2+1)	48 (32+16)	45+30

Note: 1 Credit= 16 Lecture Hours

SCOPE: This course is designed to develop an understanding of issues on conservation landscape (hereafter referred to as landscape), landscape ecology, and biodiversity conservation. To prepare for careers in landscape and biodiversity conservation, students must attain academic skills and knowledge (both theoretical and technical) related to landscape management and biodiversity conservation. This course will help enrich student's understanding of biodiversity conservation at the landscape level. It enhances students' capacity to identify the prospects and challenges of biodiversity conservation and management in multiple-use landscapes.

OBJECTIVES: The objective of this course are to:

- Familiarize students with key technical terms related to landscape ecology, and biodiversity conservation.
- Enrich students' knowledge on landscape principles, and best conservation practices at landscape levels.
- Increase students' understanding on the causes and consequences of biodiversity loss in human-dominated landscapes.
- Enrich student's knowledge and skill in landscape planning, management, and biodiversity conservation.

LEARNING OUTCOMES: At the end of the course, students will be able

- To understand the basic landscape and biodiversity-related key terminologies
- To explore and understand landscape-level conservation values and challenges
- To learn the theories and principles related to landscape ecology
- In planning and implementation of landscape-level conservation initiatives
- To gain knowledge on biodiversity conservation and management in a human-dominated landscape

COURSE CONTENTS

UNIT 1: INTRODUCTION (6)

1.1 Landscape

1.1.1 Concept of Landscape and Landscape Ecology

1.1.2 Review of the Key Terms: Habitat, Eco-region, Biomes, Biodiversity Hotspots, Biodiversity Cold Spots, Habitat Fragmentation, Edge Effect, Corridors and Connectivity, Upstream-downstream Linkages, Landscape Integrity and Functions

1.1.3 Epistemology of the Landscape

1.1.3.1 The Nature of Landscape (material and conceptual)

1.1.3.2 Role of Landscape (domain, system, Unit)
1.1.3.3 Description of Landscape (ecological and cognitive)
1.1.4 Landscape Functions and Dynamics: Linkages with Species and Human Culture (IT/TK)

1.2 Biodiversity
1.2.1 Components of Biodiversity (genetic diversity, species diversity, ecosystem diversity, functional diversity)
1.2.2 Species Richness Over Geological Time Scale (rates of species formation, rates of species extinction, current pattern of species richness)
1.2.3 Values and Importance of Biodiversity (consumptive and non-consumptive use values, productive use values)
1.2.4 Patterns of Diversity (variation along climate and environment, variation in topography, geological age, and habitat)
1.2.5 Concept of Climate Change Refugia

UNIT 2: THEORIES AND MODELS IN LANDSCAPE ECOLOGY (6)

2.1 Driving Forces for Landscape Approach (international dialogue, conservation debate, innovations)
2.2 Landscape Stability Principle and CBD Malawi Principle 1995
2.3 Theories Incorporated in Landscape Ecology: Complexity Theory, Information Theory, Cognition and Autopoiesis Theory, Hierarchy Theory, Percolation Theory, Resource Theory
2.4 Landscape Ecology Models
2.4.1 Metapopulation Model
2.4.2 Source-sink Model
2.4.3 Island Biogeography Equilibrium

UNIT 3: PRINCIPLES FOR LANDSCAPE CONSERVATION, MANAGEMENT AND DESIGN (10)

3.1 Landscape Evaluation (creating and quantifying landscape patterns)
3.2 The Cultural (human-dominated) Landscape (interaction between natural and cultural landscapes, fragility of the cultural landscapes, cultural keystone species, landscape indicators, predictive landscape models)
3.3 Principles for Landscape Management
3.4 Landscape Ecology (landscape principles for natural reserves, disturbance regime, and reserve design indications, inter-refuge corridor design)
3.5 Principles of Landscape Classification (structural patch, functional patch, resource patch, habitat patch, corridor patch)
3.6 Landscape Level Conservation
3.7 Ecosystem Processes on Landscapes
3.8 Hierarchical Structure of the System and Biodiversity Conservation
3.9 The Landscape-level Species Conservation Approach
3.10 Transborder Landscape Conservation Approaches

UNIT 4: BIODIVERSITY CONSERVATION IN HUMAN-DOMINATED LANDSCAPE (4)

4.1 Biodiversity Conservation (with examples: in-situ and ex-situ)
4.2 Issues of Biodiversity Conservation
4.3 Urban Biodiversity Conservation Challenges
4.4 Green Infrastructure: Linking Landscape and Community
4.5 Roles of Ecosystem Management in Landscape Integrity: Protected Area: Core and Buffer Zone, Habitats Outside PAs, MAB (Man and Biosphere Reserve), Other Effective Area-Based Conservation Measure (OECM)
4.6 Importance of Landscape-level Biodiversity for Promoting Ecosystem Services and Local Livelihood in Developing Countries

UNIT 5: LANDSCAPE MANAGEMENT FOR BIODIVERSITY CONSERVATION (6)

5.1 Evolution and Practices of Landscape Management Models (global to national)
5.2 Conservation Landscapes of Nepal (TAL, CHAL, Kanchenjunga, SHL, and Kailash)
5.3 Prospects and Challenges of Landscape Management and Biodiversity Conservation
5.4 Land Use Planning and Conservation
5.5 Landscape Effects: in Individuals, Populations, and Organisms
5.6 Landscape Management Approaches and Strategies
5.6.1 River Basin Approach
5.6.2 North-South and East-West Landscape Approach
5.7 Case Studies
5.7.1 Nepalese Model: Landscape (e.g., TAL, CHAL) and Corridor (e.g., Khata Corridor, Barandabhar Corridor)
5.7.2 North American Model: (e.g., Yukon to Yellow stone)
5.7.3 South African Model: (e.g., Great Limpopo Transfrontier Park)

PRACTICAL (16)

Contents	**Equipment/tools**	**Methodology/methods**	**Link to Unit (s)**
Measuring biodiversity	Silva compass, measuring tape, crown-densiometer, Abney level	3 days Field Diversity index (Simpson, Shannon Wiener) Observation, FGD, meetings with nearby community, KIS, Literature review, Report writing	Unit 1
Designing biodiversity conservation activities in the urban landscape	Reports, related literature		Unit 1, 3
Study linkages with species and human culture	Checklist		Unit 1
Review of CBD Malawi Principle1995	Related literature	Group presentation, report	Unit 2
Study on urban biodiversity challenges and threats ranking	Related literature	Excursion, Observation, Review of literature, Assessment by pairwise ranking, Report writing	Unit 4

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1. Acharya, K. P., Tripathi, D. M., Joshi, J., & Gurung, U. M. (2011). Leveraging the Landscapes: Conservation beyond the Boundaries. *Kathmandu: Nepal Foresters Association*. **(Unit 3, 4 too)**

COURSE TITLE: NATURAL RESOURCE MANAGEMENT IN CHANGING ENVIRONMENT

Course Code	Credit (Theory and Practical)	Lecture Hours (Theory +Practical)	Total Marks (Final Examination +Internal Assessment)
SFM 505	3 (2+1)	48 (32+16)	45+30

Note: 1 Credit= 16 Lecture Hours

SCOPE: Changing the environment has jeopardized human-nature interaction, which has created a lose-lose scenario. This course focuses on understanding the changing context, its impacts on natural resources, and their mitigation, adaptation, and management strategies.

OBJECTIVES: The objectives of the course are to:

- To understand the changing context
- To understand key environmental issues and their effects on nature and society
- To assess appropriate strategies for natural resource management in the changing contexts
- To understand the issues in changing contexts in NRM in Nepal

LEARNING OUTCOMES: On completion of this course, students should be able to:

- Understand the changing contexts and its effects on natural resources
- Analyze the natural resource management related issues in the changing contexts,
- Develop a conceptual and practical understanding of strategies for natural resource use and management in the changing environmental conditions
- Apply the learned concepts to a natural resource management problem of particular interest to them.

COURSE CONTENTS

UNIT 1: UNDERSTANDING THE CHANGING CONTEXT (5)

1.1 Theoretical context – Change Theory

1.2 Global Environmental Changes: Climate Change, Land use and land cover change, Invasive Species

1.3 Social Changes- Demographic Shifts, Cultural Transformations, Technological Advancement, Urbanization, Gender Roles and Equality, Environmental Movement

1.4 Economic Changes – Technological Transformations, Globalization, Labor Market Change, Financial System, Environmental and Sustainable Practices, Income equality, Global Economic Shift

UNIT 2: EFFECTS OF CHANGING ENVIRONMENT ON NATURAL RESOURCES (7)

2.1 Effects on:

2.1.1 Water Resources – Glacier's Retreat, Precipitation Pattern, Sea Level, Spring, Rivers, Groundwater, Wetlands

2.1.2 Agricultural Resources– Agro-Biodiversity, Cropping Pattern, Pest and Diseases

2.1.3 Forest and Biodiversity– Shift in Habitat Ranges, Increased Wildfire, Invasive Alien Species
2.1.4 Wildlife
2.1.5 Rangelands
2.1.6 Landscape

2.2 Alteration of Human-Nature Interactions Due to Changing Context

UNIT 3: MITIGATION AND ADAPTATION STRATEGIES (5)

3.1 Sustainable Land and Water Management
3.2 Biodiversity Conservation and Restoration
3.3 Climate Resilient Infrastructure
3.4 Traditional Knowledge, Practices, and Technologies
3.5 Renewable Energy Transition

UNIT 4: ISSUES IN NRM IN CHANGING CONTEXT IN NEPAL (5)

4.1 Shift in Demand for Natural Resources
4.2 Land Abandonment
4.3 Human-Wildlife Conflict
4.4 Governance Conflict
4.5 Level of Participation in Natural Resource Management

UNIT 5: MANAGING NATURAL RESOURCES IN CHANGING ENVIRONMENT (10)

5.1 Ecological Principles and their Application to Natural Resource Management
5.2 Adaptive Management
5.3 Forest-Landscape Restoration
5.4 Invasive Species Management
5.5 Nature Based Solutions
5.6 Disturbance-based Ecosystem Management

PRACTICAL (16)

Contents	**Equipment/tools**	**Methodology/methods**	**Link to Unit(s)**
Drivers of changing context	Field /Checklist	Prepare a list of drivers and strategies to address them (Group work)	Unit 1, 2
Issues of NRM in Nepal and potential solutions	Literature review	Group / Class presentation	Unit 4
Enlisting mitigation/adaptation/management interventions in own locality	Interview (Telephone), Field observation	Individual - list of interventions	Unit 3, 4, 5

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Unit 2

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Unit 3

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Unit 4

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