



Higher National Unit specification

General information for centres

Unit title: Agroecosystems: Energetic Efficiency

Unit code: F2E5 35

Unit purpose: This Unit will equip the candidate with an understanding of energy flow in agroecosystems, with particular focus on energetic efficiency, support energy use and interactions with other environmental considerations. With this knowledge and understanding the candidate will be able to compare the performance of different agricultural production systems and develop measures to improve energetic efficiency. This Unit reflects the current crucial concerns over the monetary and environmental costs of energy use.

On completion of the Unit the candidate should be able to:

- 1 Explain the flow of energy through selected agroecosystems.
- 2 Evaluate the efficiency with which selected agroecosystems convert solar energy into the energy of agricultural products.
- 3 Evaluate the use of support energy in selected agroecosystems.
- 4 Discuss how change in husbandry to alter the flow of energy in agroecosystems affects other environmental considerations.

Credit points and level: 1 HN credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this Unit will be at the discretion of the centre, however it is recommended that candidates should have studied agricultural or biological subjects at SCQF level 7, as evidenced by one or more of the HN Units F2G8 34 *Environmental Awareness*, F21L 34 *Microorganisms: Growth, Activity and Significance*, DJ1K 34 *Cell Biology: Theory and Practice*, DH2J 34 *Biochemistry: Theory and Practice*, F21K 34 *Livestock Physiology*, F1Y4 34 *Arable Crop Production*, F2ED 34 *Livestock Production Systems* or any equivalent level of study.

Core Skills: There are opportunities to develop the Core Skill component Critical Thinking of the Core Skill *Problem Solving* at SCQF level 6, the component Working with Numbers of the Core Skill *Numeracy* at SCQF level 5 and the Core Skill component of Oral or Written Communication at SCQF level 6 although there is no automatic certification of Core Skills or Core Skills components.

General information for centres (cont)

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes. This Unit is appropriate for any land-based, biological or environmental Group Award.

Assessment: Each of these Outcomes could be assessed as separate tasks. Suggested assessment methods are a closed-book assessment for Outcome 1 and one or more reports covering Outcomes 2, 3 and 4.

Higher National Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Explain the flow of energy through selected agroecosystems

Knowledge and/or Skills

- ◆ Ecosystem concept
- ◆ Agroecosystems: Crop production and livestock production
- ◆ Trophic structure
- ◆ Energy flow
- ◆ Differences between agroecosystems and natural ecosystems

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can explain:

- ◆ the ecosystem concept
- ◆ the flow of energy through the trophic structure of one crop and one livestock agroecosystem
- ◆ three differences between agroecosystems and natural ecosystems

Assessment Guidelines

Evidence for this Outcome could be assessed by means of a closed-book, supervised test, with a recommended 45 minute duration covering all the above Evidence Requirements. Alternatively, evidence could be assessed by means of a report for which a word count of 500 is advisory. The candidate should be given sufficient time to collect and present evidence.

Higher National Unit specification: statement of standards (cont)

Unit title: Agroecosystems: Energetic Efficiency

Outcome 2

Evaluate the efficiency with which selected agroecosystems convert solar energy into the energy of agricultural products

Knowledge and/or Skills

- ◆ Solar energy
- ◆ Primary production
- ◆ Environmental factors
- ◆ Biological factors
- ◆ Energy loss
- ◆ Trophic levels
- ◆ Energy value of agricultural products
- ◆ Energy conversion efficiency

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ explain primary production
- ◆ evaluate how one biological and two environmental factors influence net primary production
- ◆ explain the loss of energy from each trophic level of two selected agroecosystems
- ◆ evaluate how one environmental and two biological factors influence the loss of energy from each trophic level of two selected agroecosystems
- ◆ explain the energy value of each saleable product from two selected agroecosystems
- ◆ evaluate the efficiency with which two selected agroecosystems convert solar energy into the energy of agricultural products

Assessment Guidelines

Evidence for this Outcome could be generated through a report which should be of sufficient length to satisfy Evidence Requirements of all Knowledge and Skills elements for two selected agroecosystems. A word count of 500 or equivalent for each agroecosystem is advisory. The candidate should be given sufficient time to collect and present evidence.

Alternatively Outcomes 2, 3 and 4 could be assessed by means of one holistic report for which a word count of 2,000 is advisory. The candidate should be given sufficient time to collect and present evidence.

Higher National Unit specification: statement of standards (cont)

Unit title: Agroecosystems: Energetic Efficiency

Outcome 3

Evaluate the use of support energy in selected agroecosystems

Knowledge and/or Skills

- ◆ Support energy inputs
- ◆ Agroecosystem productivity
- ◆ Energy ratio calculation

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ explain one direct and two indirect support energy inputs for two selected agroecosystems
- ◆ evaluate their effects on the productivity of two selected agroecosystems
- ◆ compare and evaluate the energy ratios for the two selected agroecosystems
- ◆ evaluate one approach to improve the efficiency of support energy use for two selected agroecosystems

Assessment Guidelines

Evidence for this Outcome could be generated through a report of sufficient length to provide all Evidence Requirements detailed. A word count of 750 words or equivalent could act as a guideline for candidates. The candidate should be given sufficient time to collect and present evidence.

Alternatively Outcomes 2, 3 and 4 could be assessed by means of one holistic report for which a word count of 2,000 is advisory. The candidate should be given sufficient time to collect and present evidence.

Higher National Unit specification: statement of standards (cont)

Unit title: Agroecosystems: Energetic Efficiency

Outcome 4

Discuss how change in husbandry to alter the flow of energy in agroecosystems affects other environmental considerations

Knowledge and/or Skills

- ◆ Biodiversity
- ◆ Inputs of raw materials
- ◆ Greenhouse gas emissions
- ◆ Soil organic matter
- ◆ Nutrient use and cycling
- ◆ Water use
- ◆ Pollution
- ◆ Husbandry

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can discuss how two changes in husbandry which alters the flow of energy in agroecosystems affect other environmental considerations. The discussion must include reference to two selected agroecosystems and to four other environmental considerations selected as appropriate by the candidate from the above Knowledge and/or Skills.

Assessment Guidelines

Evidence for this Outcome could be generated through a report which should be of sufficient length to satisfy all Knowledge and Skills elements for two selected agroecosystems. A word count of 750 is advisory. Alternatively Outcomes 2, 3 and 4 could be assessed by means of a combined report for which a word count of 2,000 is advisory. The candidate should be given sufficient time to collect and present evidence.

Administrative Information

Unit code: F2E5 35

Unit title: Agroecosystems: Energetic Efficiency

Superclass category: SB

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Version	Description of change	Date

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Higher National Unit specification: support notes

Unit title: Agroecosystems: Energetic Efficiency

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

Concerns about the rising demand for food and raw materials from the growing world population and the dependence of intensive agriculture on energy inputs from diminishing fossil fuel reserves provide the background for these studies. The Unit aims to provide candidates with an understanding of energy flow in agroecosystems, with particular focus on energetic efficiency, support energy use and interactions with other environmental considerations. This will enable candidates to consider the sustainability of different agricultural production systems and possible measures to improve the energetic efficiency of agriculture. These issues are particularly relevant to candidates interested in the production of energy crops and also to farmers attempting to reduce their energy costs. Candidates planning a career with agricultural support industries, renewable energy companies, environmental agencies or agricultural consultants, or those wishing to progress to higher education, will also find this Unit very useful.

Outcome 1 provides a brief introduction to the ecosystem concept and its application to different crop and livestock production systems. Candidates will then examine the flow of energy through the trophic structure of crop and livestock agroecosystems, and consider how agroecosystems differ from natural ecosystems in a similar physical environment because of the control exerted by man.

Outcome 2 evaluates the efficiency with which different agroecosystems convert solar energy into the energy of agricultural products. This begins with a study of the net primary production of agroecosystems, and how this is influenced by a number of biological and environmental factors. This leads to a consideration of how the energy is then transferred between the trophic levels of the ecosystem, how energy is lost at each trophic level and the environmental and biological factors that influence the extent of this loss. Agricultural products are considered in terms of their energy value, and the efficiency with which different agroecosystems convert solar energy into the energy of agricultural products is compared. A range of crop and livestock agroecosystems should be covered. These could include various crop species for the production of food, energy and bioproducts. Livestock agroecosystems could include those for the production of meat, milk and eggs, as well as systems involving ruminant and non-ruminant species. Comparisons could be made between grazing systems and systems using more concentrated feeds. Agroecosystems in different geographical locations and societies would also provide interesting examples. For assessment purposes candidates select two agroecosystems for individual study according to their particular interests and Group Award.

Outcome 3 evaluates the use of support energy in agroecosystems. The direct and indirect support energy inputs used to improve the productivity and biological efficiency of a range of different agroecosystems should be examined. In addition to the agroecosystems covered in Outcome 2, comparisons could be made between organic and conventional systems, between extensive and intensive systems, between field and glasshouse crops and between different systems of animal housing. Energy ratios for the selected systems will be calculated and compared and candidates will be challenged to consider how they would attempt to reduce support energy inputs, maintain or improve agricultural outputs and improve the efficiency with which support energy is used.

Higher National Unit specification: support notes (cont)

Unit title: Agroecosystems: Energetic Efficiency

Outcome 4 encourages candidates to take a holistic approach to considering the environmental impact of different agroecosystems. Having studied the energetic efficiency of agroecosystems and the use of support energy inputs in depth, candidates are asked to relate these aspects to other important environmental considerations. Candidates are challenged to consider and discuss how measures taken to minimise support energy use or improve the biological efficiency of the agroecosystem might influence other environmental considerations, resulting either co-benefits or adverse effects.

Guidance on the delivery and assessment of this Unit

This Unit is designed to form part of the Group Awards HND Applied Bioscience, HND Agricultural Science and HND Green Technology. Candidates should already have completed the first year of these awards. The Unit builds on environmental issues identified within the level 7 HN Unit F2G8 34 *Environmental Awareness*. With its clear and detailed focus on the energy efficiency of agricultural production systems, the Unit complements the HN Unit DP4X 35 *Terrestrial Ecosystems*.

Outcome 1 should be delivered first as this provides a brief introduction to the theoretical basis of the Unit. Outcomes 2, 3 and 4 could either be delivered sequentially or integrated with reference to particular systems. It is suggested that candidates are provided with links to study materials for detailed investigations into agroecosystems of individual interest and relevance to their Group Award.

The Unit will be delivered through a combination of lectures, seminars, tutorials, discussion groups and directed candidate-centred learning together with visits to selected agroecosystems.

Outcome 1 could be assessed by means of a closed-book assessment comprising restricted response questions. Outcomes 2, 3 and 4 could be assessed by means of one holistic report for which a word count of 2,000 is advisory. The candidate should be given sufficient time to collect and present evidence for two diverse agroecosystems concerning the flow of energy, an evaluation of the use of support energy and a discussion about how these relate to other environmental considerations.

Opportunities for developing Core Skills

There are opportunities to develop Core Skills in this Unit although there is no automatic certification of Core Skills or Core Skills components.

The Core Skill component Critical Thinking of the Core Skill *Problem Solving* at SCQF level 6 is developed in Outcome 3 when candidates identify approaches to improve the efficiency with which support energy is used. The component Working with Numbers of the Core Skill *Numeracy* at SCQF level 5 is developed by the calculations of biological energy efficiency in Outcome 2 and energy ratios in Outcome 3. The reports develop the Core Skill component of Oral or Written Communication at SCQF level 6. Oral communication is also developed through class and group discussions used as part of the approach to teaching and learning throughout the delivery of the Unit, but particularly in Outcome 4.

Higher National Unit specification: support notes (cont)

Unit title: Agroecosystems: Energetic Efficiency

Open learning

Since this Unit introduces a theoretical framework and is then applied to different agroecosystems, this Unit is highly compatible with delivery via distance learning. All Outcomes could be delivered via a combination of real-time lectures delivered over the internet, material posted on a VLE platform, CD-ROMs and paper-based study resources. One holistic report could be used for all Outcomes

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (www.sqa.org.uk).

General information for candidates

Unit title: Agroecosystems: Energetic Efficiency

This is a 1 credit SCQF level 8 Unit, intended to be delivered as part of an Applied Bioscience, Agricultural Science or Green Technology HND qualification. It will provide you with knowledge and understanding relevant to a career with agricultural support industries, renewable energy companies, environmental agencies or agricultural consultants, or in preparation for higher education. Concerns about the rising demand for food and raw materials from the growing world population, the dependence of intensive agriculture on energy subsidies from diminishing fossil fuel reserves and the cost and environmental impact of these energy inputs make the issues covered in this Unit of critical importance.

On completion of the Unit you should be able to:

- 1 Explain the flow of energy through selected agroecosystems.
- 2 Evaluate the efficiency with which selected agroecosystems convert solar energy into the energy of agricultural products.
- 3 Evaluate the use of support energy in selected agroecosystems.
- 4 Discuss how change in husbandry to alter the flow of energy in agroecosystems affects other environmental considerations.

Outcome 1

You will be introduced to the ecosystem concept and how this can be applied to agricultural production systems. You will consider how energy flows through the trophic structure of crop and livestock production systems and examine how agroecosystems differ from natural ecosystems in a similar physical environment because of the control exerted by man.

Outcome 2

You will evaluate the efficiency with which different agroecosystems convert solar energy into agricultural outputs. This will involve studying a diverse range of agroecosystems involving different species, products and geographical locations. For these agricultural production systems you will look at energy loss from each trophic level and the factors affecting the extent of this loss. A comparison will be made between the efficiency of crop production systems and livestock production systems. For this Outcome you will choose two agroecosystems for detailed individual study.

Outcome 3

Here you will look at the use of direct and indirect support energy inputs to increase primary production and improve the biological efficiency of the agroecosystem. A wide range of agricultural production systems will be examined. In addition to the systems covered in Outcome 2, comparisons will be made between organic and conventional systems, between extensive and intensive systems, between field and glasshouse crops and between different systems of animal housing. You will calculate and compare energy ratios for the selected systems, consider how you would attempt to reduce support energy inputs, maintain or improve agricultural outputs and improve the efficiency with which support energy is used. For this Outcome you will choose two agroecosystems for detailed individual study.

General information for candidates (cont)

Unit title: Agroecosystems: Energetic Efficiency

Outcome 4

Having studied issues of productivity, energy flow and the use of non-renewable energy inputs in depth, you will now consider how these relate to other important environmental considerations. Measures taken to minimise support energy use or improve the biological efficiency of the agroecosystem may result in either co-benefits or adverse effects in terms of other environmental indicators. It is important therefore to adopt a holistic approach to considering the agricultural impact of agroecosystems.

Each of these Outcomes could be assessed as separate tasks. Suggested assessment methods are a closed-book assessment for Outcome 1 and one or more reports covering Outcomes 2, 3 and 4.

There are opportunities to develop Core Skills in this Unit although there is no automatic certification of Core Skills or Core Skills components.