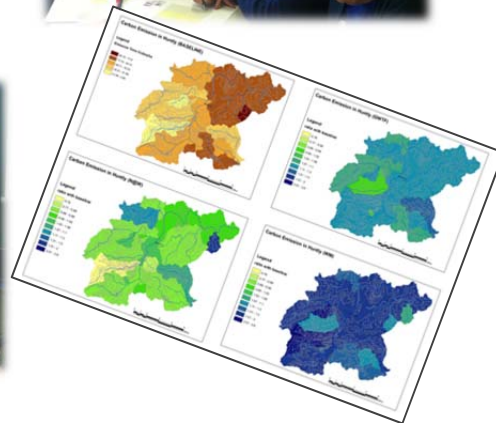


Land Use Scenarios Workshop Report

Workshop held at the Linden Centre, Huntly

30th October 2014



Acknowledgments

Thanks to the participants for their insightful and useful comments and good humoured energy during the activities. The James Hutton Institute's research and staff time, which allowed us to attend the workshop, was supported through the Scottish Government's Research Rural and Environmental Science and Analytical Services Division 2011-2016 (RESAS). The report reflects the views of the authors and not necessarily those of Aberdeenshire Council or the James Hutton Institute. A draft was sent to participants and feedback has been incorporated to this final version.

Executive Summary

The third and final workshop to support Aberdeenshire's Regional Land Use Pilot was held in Huntly on 30th October 2014, attended by 15 participants representing a range of perspectives on local land use issues.

The workshop focussed on discussing three scenarios representing possible futures for the Huntly area. The scenarios were based on three developed as part of the National Ecosystem Assessment process for the UK and consider global and national drivers of change, providing three contrasts – a world following our current trajectory 'Go with the Flow'; a world where Scottish Government has promoted protection of ecosystem services 'Nature@Work' and a world where Scotland is much more exposed to market forces 'World Markets'.

The participants used a Multi-Criteria Decision Aid (MCDA) process to compare the effects of these scenarios on 21 criteria covering economic, environmental and social issues (e.g. availability of labour and skills; ecosystem resilience; cost of living for local residents). Overall, Nature@Work received the highest average score based on the degree to which participants thought it met the 21 criteria and how important these criteria were to each individual. However, the MCDA process was interesting in illustrating which criteria were important to everyone; and where there were divergent opinions about the importance of criteria, or how they might be affected by the scenarios. Despite the differences in scenarios, the discussions illustrated some common themes around how the Huntly area might respond to changes such as how to reconcile competition for land between arable expansion, housing and flood protection.

The participants were then shown the results of a Bayesian Belief Network (BBN) model, which calculates potential changes in variables if another variable in the 'network' were to alter. Using the same three scenarios, the BBN suggested whether land managers might change their land use in response to drivers; how land use might change; and what effects these changes might have on ecosystem services. Overall, the BBN suggested there would be little land use change in the area, with the most occurring under a World Market scenario, but even then only 1 in 4 land managers might change. Land use changes would generally see increases in arable and improved grassland at the expense of semi-natural and rough grazing land uses, with woodland neither contracting nor expanding by much in any scenario. Increases in arable and improved grassland would lead to increased food production. These results were then used to generate results regarding 'regulating' ecosystem services. In all three scenarios, the model suggests that carbon, nutrient and sediment emissions will increase, albeit Nature@Work shows the lowest increase. In particular, the model suggests that World Markets could see a considerable increase in carbon emissions.

Participants provided many useful comments on the model results and suggestions for future refinements. The results were not intended to be accurate predictions but to provide material for debate. Overall, the combination of participants' knowledge and their responses to the scenarios and modelled results did stimulate new ways of thinking about the complexities of land use change and the trade-offs that are involved. The results from the evaluation of the workshop suggest that the three workshops had increased people's ability to think about multiple issues associated with land use and that the material could be used as part of a wider process to consider how perceptions of land use benefits could inform policy making and grant appraisal processes.

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Introduction

This report reflects the results of a workshop held in the Linden Centre, Huntly, on the 30th October 2014. The workshop was part of the Aberdeenshire Regional Land Use Pilot. Aberdeenshire is one of two areas in Scotland piloting the Scottish Land Use Strategy (the other area being the Scottish Borders).

The Scottish Land Use Strategy aims to promote the inclusion of multiple benefits from the land into land use decision making based on an ‘Ecosystem Approach’, which has been defined in the following way:

“A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way, and which recognises that people with their cultural and varied social needs are an integral part of ecosystems.”
(Scottish Government, 2011)

The workshop was organised and implemented by researchers from the James Hutton Institute, and was the last in a series of three workshops carried out in two local areas in Aberdeenshire, Huntly and Ballater.

The overall aim of the workshops was to elicit local input and feedback to the Aberdeenshire Regional Land Use Pilot and to get a local perspective of issues surrounding land use, land use decisions, benefits and services provided by the land and how these are influenced by policies and other factors such as climate change.

The first workshop focused on i) the benefits and services provided by the local area, and ii) the factors influencing land managers’ decisions about land use. In the second workshop the focus was on i) a conceptual model illustrating the links between decision making and benefits and services from the land, and ii) the goals of the land use strategy and how particular policies might help reach these goals and what impacts they might have at the local level. The third and final workshop focussed on possible future scenarios and the implications these might have on land use and benefits, and also revisited the model of decision making and land use. The aim at this stage was to encourage participants to evaluate potential future scenarios in a systematic way, and to present and gather feedback on the predictions the decision making and land use model made for these future scenarios. The structure and results of this last workshop are presented in more detail below.

Participants

Table 1 below highlights the types of stakeholders who attended the workshop. A full list of the participants can be found in Annex 1.

Table 1. Types and numbers of workshop participants.

	Numbers attending the workshops
Land managers	3
Community groups	2
National agencies/ NGOs	4
Local agencies/ NGOs	4
James Hutton Institute	2 (+4 facilitators)

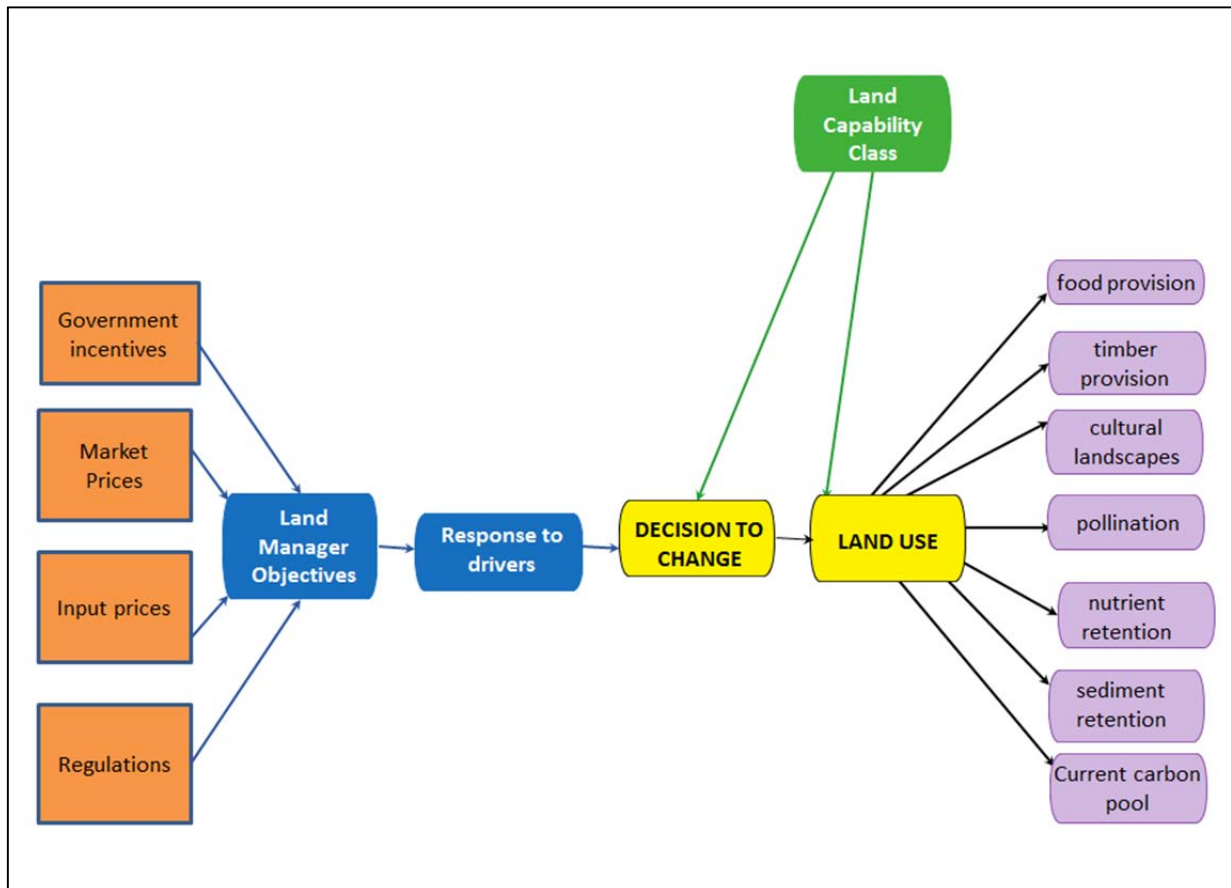
Part 1: Presentation and feedback on the baseline model

In the first part of the workshop participants were presented with the refined version of the decision making and land use model. The structure of the model had been changed (Fig. 1) to take account of some of the suggestions from the second workshop. However, it had not been possible to incorporate all the suggestions and feedback from the second workshop as this would have made the model too complex and models such as this are limited both with regard to the number of factors and with regard to the types of connections between individual elements that they can handle.

The model thus constitutes a hugely simplified representation of land use in the Huntly area. However some of the suggestions and feedback on the model structure received during the second workshop were instead used in the construction of the future scenarios or as evaluation criteria for the scenarios (see Part 2 of this report, below) and were therefore still incorporated in the workshop activities. Other suggestions will be used to inform further developments of the model and research in this area over the next few years.

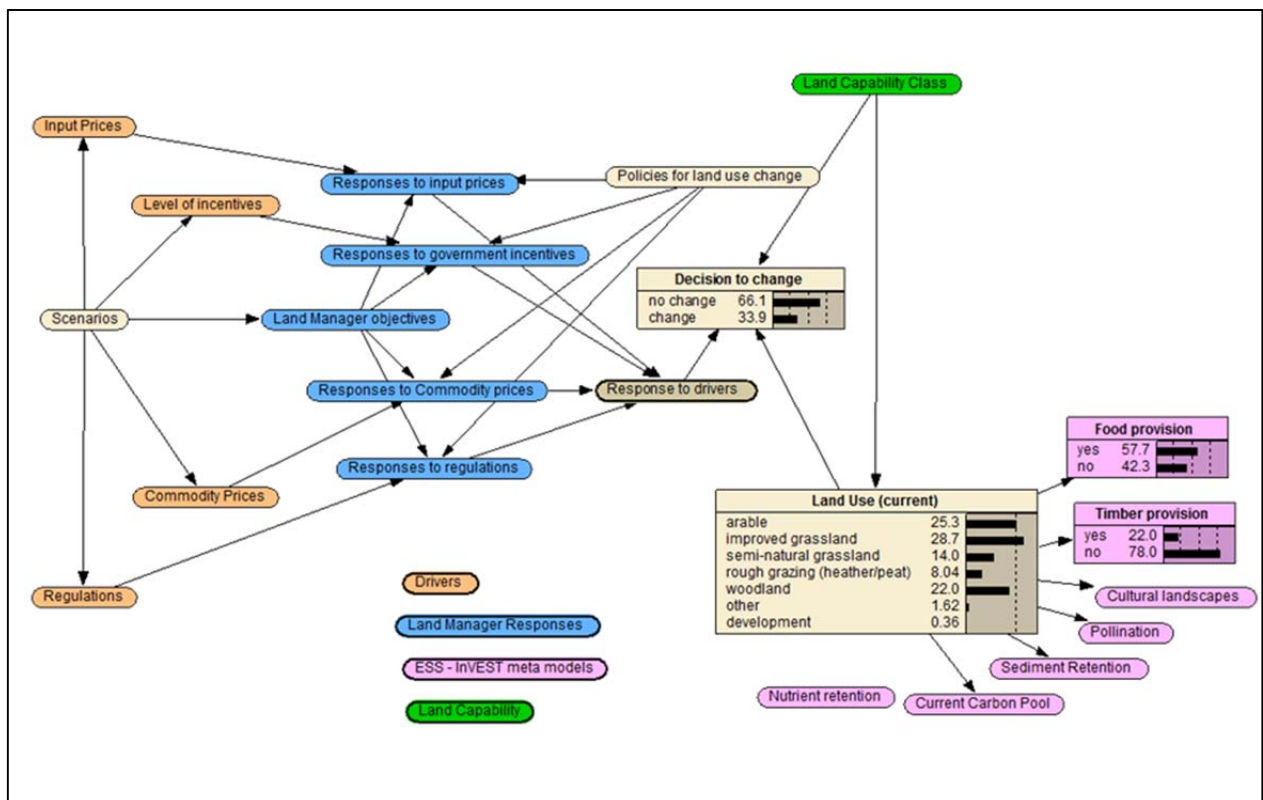
Appendix 2 lists the modifications to the model participants had suggested at the second workshop and how this information had been used.

Figure 1: Structure of the model of land use decisions, land use and benefits & services from the land. The arrows in the diagram show the direction of influence which are captured in the model.



The model was converted into a 'Bayesian Belief Network' (BBN) (Fig. 2). This type of model attempts to show how different influences (factors) affect the likelihood of something happening or changing. It does not make absolute predictions about what will happen, but predicts the probability of different outcomes as the result of a change in one factor. Each 'box' represents a 'variable' in the model and the connecting arrows represent the relationships between these variables. The model result can be modified by changing the values in one of the boxes. This will update the probability for the remaining variables in the model. For example, if changes are made in the regulation box, the model takes account of the fact that different land managers will respond in different ways to this change. In turn, the land use box will take account of the likely different responses by land managers to changes in regulations and will show the likelihood of change in the proportions of land used for different purposes.

Figure 2. The baseline structure of the Bayesian Belief Network for the Huntly area showing the probabilities of different types of land use currently occurring in the area and the probabilities for the land to provide food and timber, respectively. This diagram represents the modelling structure illustrated schematically in Fig 1



Following the presentation of the model participants asked clarifying questions and raised some important points in relation to the model and about land use in general. Participants pointed out that land use will often change even without external factors pushing for change due to succession and change in land owners (i.e. due to cultural factors rather than biophysical or policy drivers). It was also pointed out that land use categories such as 'woodland' include a variety of things, and that differences between for example a conifer plantation and a mixed woodland need to be taken into account when talking about land use and how this influences services and benefits from the land. Likewise, it was pointed out that *management* activities such as establishment and maintenance of drains will have a large impact on, for instance sediment export, which the model and existing land use maps cannot capture.

Part 2: Evaluating potential scenarios for the future

In the second part of the workshop participants were presented with three potential scenarios for the future. These scenarios were not predictions about the future, but 'what if' thought experiments. Using this kind of scenario can help participants to think about the potential impacts of different development paths. The three scenarios presented in the workshop were modified versions of scenarios developed by the UK National Ecosystem Assessment Follow-on work (UK NEAFO 2014). All three scenarios were for the year 2050. All of them included the same projected changes in climate (based on median predictions from the Intergovernmental Panel on Climate Change) and in summary involved milder, wetter winters and dryer summers, with more frequent extreme rainfall events.

Scenario 1: Go with the Flow

This describes a scenario in 2050 in which the current policy and economic drivers continue as they are in now in 2014. It is not a 'do nothing' storyline, but a projection to a future resulting from current trends in these policies and drivers. The tension between the need to maintain livelihoods based on productive use of the land (for agriculture and timber) and environmental improvement continues. In Aberdeenshire the following trends continue

Population is similar to current levels with a similar proportion living in urban and rural situations. Land ownership patterns remain similar to today with tenant farmers, owner occupiers, absentee land investors and sporting estates. Rural businesses diversify where possible to capture tourism demand for 'engaging with nature.'

Policies try to promote progress towards a low-carbon economy and better environmental standards, but progress is slow and bumpy. The government maintains woodland expansion targets but it proves difficult to ensure that they support other incentives such as biodiversity conservation. Commercial forest for timber is encouraged alongside multifunctional woodland.

Energy costs are partially offset by support for renewables such as small scale farm based turbines but turbine expansion is limited in order to protect viewpoints.

Climate change increases the area of prime land: some areas of improved grazing become suitable for arable crops. This new prime land is safeguarded from conversion to woodland except where there is a

good case made for planting trees to reduce flood risk in downstream settlements. Commercial forests are limited in areas with acidified catchments.

The prices for commodities such as grain, meat and timber are increasingly related to world market prices as subsidies for production are slowly replaced by incentives related to environmental outcomes.

Subsidies are increasingly targeted towards multiple benefits and encourage landscape scale collaboration but single farm payments continue to underpin more marginal producers.

Input costs for fertiliser, fuel and agrochemicals continue to rise. Efficient use of inputs is aided by advances in drought tolerant and pest resistant cultivars but policies prevent the use of GM.

Regulations remain in relation to water quality, however, outside protected areas, other biodiversity and ecosystem service targets rely on the uptake of incentives and subsidies.

Community engagement in local decisions is encouraged for landscape scale planning. Communities gain access to small areas of community owned and managed land such for community gardens and community run farms that provide some income for local projects.

Scenario 2: Nature@work

This is a scenario in 2050 where Scottish society has decided to increase regulation and incentives in order to maintain and enhance the output of the ecosystem services and benefits that are regarded as important.

Population of Aberdeenshire remains similar but there has been a shift to more people living and working in rural areas. There is an increase in small holdings and community owned land although large long-term landowning patterns remain on productive land and marginal areas. Domestic tourism is more important than international with rural livelihoods marketing opportunities to engage with land management as a recreational activity.

Low-carbon economy is a priority with incentives to convert land of low agricultural capability to woodland (building on the expansion achieved up to 2020). Higher subsidies are attracted if the planting also benefits other ecosystem services such as habitat connectivity, flood risk and water quality. Multifunctional native woodlands are encouraged (provide timber, energy biomass, biodiversity and recreation). No incentives exist for forests solely managed for commercial timber production.

Increases in costs for inputs such as fertiliser and agrochemicals drive technological advances in arable farming on prime land. These include precision farming (placement of seed and fertiliser) as well as improved plant breeding and cultivars that are more drought resistant and more efficient in the uptake of nutrients and resistant to plant pests and pathogens.

Prime land is protected from land use change to safeguard food production and protection is only relaxed to reduce the risk of downstream flooding, reduce nitrogen run-off and improve habitat connectivity. Incentives for this are based on payments for yield but also on associated water quality, flood mitigation, carbon storage, biodiversity and habitat condition in these catchments as well as

maintaining landscape character for recreation. There is support to help land owners collaborate across landscapes to deliver regional planning targets.

The prices for commodities such as grain, meat and timber increase as the products are marketed to global customers willing to pay for positive environmental standards.

Land reform effectively imposes responsibilities on land owners to maintain the multiple benefits their land provides as identified in regional planning. Whilst these strategies are influenced by the needs of the urban majority, actions and priorities within a particular landscape or sub-catchment are set in collaboration with local stakeholder (land managers and others in the community) knowledge.

Regulations are tightened to reduce the negative impacts from intensive management. This is based on the “polluter pays” principle and builds on the powers organisations like SEPA have over water quality so that other statutory bodies can also fine land managers where ecosystem service delivery falls below levels agreed in regional plans.

Upland areas will be incentivised to manage for venison and lamb production at stocking rates that ensure the upland habitats are in good condition (reduce trampling damage on blanket bog, improve the condition of heather, allow tree regeneration in designated sites).

Communities have access to funding to increase engagement with the environment for health benefits with money available to increase core paths and funding to set up community based businesses based around food and food related products. These are funded by feed-in tariffs from initiatives such as community owned renewable operations (large scale wind farms are prevented to reduce impacts on viewpoints).

Scenario 3: World Markets

This scenario for 2050 results from the push for economic growth based on free world markets. International trade barriers have dissolved and subsidies have disappeared. Policies do not take into account the effect on other services and benefits but rely on the assumption that successful management will be the most efficient.

Most of the population lives in urban areas because the costs of commuting are high. Planning restrictions are relaxed allowing development on green belts and flood plains to feed the demand for urban housing. Private land owners enjoy strong property rights. Land holdings used mainly for agriculture have become bigger in size in response to economies of scale and have been industrialised with only the most productive land cultivated. The domestic market for tourism is limited and relies on international visitors.

Progress towards a low carbon economy is no longer a societal objective although energy sources are driven by costs so that the increase in the price of oil has promoted the use of cheap gas from fracking. Incentives for renewable energy have been cut and power is increasingly supplied from centralised nuclear power stations. Incentives for woodland expansion have disappeared.

Input costs (fertilisers and agrochemicals) have decreased due to technological development (often funded by business rather than government) and intensification. High yields are needed if production is to be competitive on the world market. GM cultivars that reduce input costs are broadly accepted.

Food is cheap and plentiful, but mostly of low quality and mostly imported to supply the bulk of the population. However, there is a market for high quality locally produced food which is maintained by the wealthy in society. Therefore, generally market prices for commodities have decreased.

Land holdings on non-productive land also remain in private hands. The uplands continue to be managed for recreational field sports with limited venison production but land abandonment has increased with much of the grazing land (land capability 3.2 or poorer) reverting to scrub.

Most meat is imported but niche markets for home reared grass fed beef and lamb maintain some areas of the grassland. Timber is imported from cheap sources on the world market. Commercial woodland only remains viable on abandoned areas of relatively fertile grassland that are close to transport links (risking disease outbreaks and acidification of water bodies).

Regulations on water quality are weakened in order to reduce public spending. The small rural population increasingly depends on private supplies. Urban communities that can afford it pay for clean water through Payment for Ecosystem Services schemes. Poorer communities rely on buying bottled drinking water as the public water supply is only good for washing ('grey water'). Businesses that depend on clean water (e.g. the Whisky industry) enter into local 'payment for ecosystem services' (PES) schemes with land owners. Downstream urban communities also use rely on PES schemes to protect their livelihoods from flooding.

Consequently there is very little community involvement in land use decision making except where communities can buy into it through PES schemes. Rural communities decline - although there are limited jobs in recreational field sports.

Discussion of the scenarios

After having been presented with the scenarios, participants asked clarifying questions and discussed the contents of the three future scenarios. Most of the discussion concerned the 'World Markets' scenario, which participants felt was not very realistic as they could not imagine that state regulation would ever be relaxed even if subsidies were diminished or removed altogether. In addition, participants commented that even if Scotland adopted a more free market stance, other countries would not be obliged to do so therefore it was unlikely that this scenario would come to pass. However, the scenarios are meant to be 'what if' thought experiments that can encourage thought about what positive and negative consequences different choices or development pathways could have rather than being predictions about the future.

Evaluation of the scenarios

In order to evaluate the potential consequences of the three scenarios, the workshop participants were asked to employ a method known as 'Multi-Criteria Decision Making Analysis' (MCDA). MCDA is a technique that can be used to guide complex decision making. It sets out to evaluate how well alternative options fulfil a range of criteria that reflect the values and objectives of different people. The process helps to define the issues and determine their relative priorities among different stakeholders in a transparent manner. MCDA is therefore a structured and transparent method of breaking down complex problems and prompting discussion among relevant people with differing interests and experiences.

MCDAs may help us to account for a broad range of objectives in land use decision making. These include both private objectives relating to livelihoods and lifestyles as well as policy objectives relating to the public goods the environment provides such as reducing carbon emissions, reducing flood risk, and providing recreation opportunities.

The first step in a MCDA is to identify which criteria should be used to judge the future scenarios. Prior to the workshop, the James Hutton team had gone through the information from the first two workshops to compile a list of criteria that workshop participants had raised as being important in the two local areas. These had been divided into economic, social and environmental criteria and five of each had been chosen as criteria that could be used to judge the impacts of the future scenarios (Table 2).

Table 2. Criteria for the evaluation of future scenarios.

Economic criteria	Social criteria	Environmental criteria
Infrastructure provision	Health & well-being	Carbon capture
Availability of labour and skills	Landscape beauty	Sediment retention on land (prevent export into water courses)
Income generation (land or tourism based)	Access to recreational opportunities	Nutrient retention on land
Control of pests & diseases	Environmental awareness	Protected species conservation
Local energy security	Local community cohesion	Protected habitat conservation

In addition to these criteria, participants were asked to suggest additional criteria which they thought should be used to evaluate the scenarios. Participants came up with the following additional criteria:

- Affordable housing (access to affordable housing where jobs are within easy travel distance)
- Demand for Cheap Food
- Availability of different funding streams
- Land reform & land ownership
- Financial security
- Methane emissions
- Balance (in nature)
- Low carbon transport
- Biodiversity richness
- Importance of family farms

In addition, it was pointed out that the criterion ‘landscape beauty’ would always be subjective. These additional criteria were discussed amongst the participants. In order to keep the task of evaluating the scenarios manageable only six of the suggested criteria were added to the existing list:

- Additional economic criteria: NE niche products; Provision of apprenticeship & training
- Additional social criteria: Affordability of rural life/housing; Land ownership
- Additional environmental criteria: Natural balance; Biodiversity richness

As the next step in the MCDA, participants were asked to think about the importance of each of these criteria to them personally or to their organisation, and to assign a weight (from 1 to 100) to each criterion reflecting its importance with 100 indicating the most important criterion. The same score could be assigned to several criteria. In addition, participants were asked to indicate whether they thought the achievement of each criterion was a negative or a positive thing. For example, someone may consider infrastructure provision as something positive (e.g. enabling businesses and vibrant communities) or as something negative (leading to more traffic, more urban sprawl, more new-comers in the community, etc.). In either case it may be of high, low or medium importance to a person.

Finally, participants were asked to look at the three scenarios and the current situation and evaluate to what degree each scenario would deliver the evaluation criteria (regardless of how important they thought the criteria were). To make it easier, the main contents of each scenario had been summarised in tables which were handed out to participants to aid them in the evaluation of the scenarios. These tables and the sheet used for the evaluation of the criteria can be found in Appendix 3 and Appendix 4, respectively.

During and after the evaluation of the criteria and scenarios participants discussed the process as well as the particular criteria and scenarios. These discussions brought up a number of interesting and important points. The evaluation criteria as well as the scenarios were open to different interpretations and this influenced how people evaluated them. Such differences in interpretation could have been reduced by making the criteria and scenarios more specific or narrow. However, this would have meant that they captured less of what had been raised as being important in the area. Another way to avoid ambiguities or differing interpretations could have been to have a more in-depth discussion in the group on the meaning of each of the criteria and scenarios before the actual scoring. Due to the limited time available, there was some discussion but we did not go through all 21 systematically. Participants also raised the point that evaluations could differ depending on whether they did the exercise from their own point of view or from the point of view of an organisation or business they were part of (although they were asked to evaluate the criteria and scenarios from the point of view of the organisations or sector they were representing). Linked to this was the point that it is important to clarify who benefits from particular criteria or developments and that this may differ amongst different people. This had been discussed in relation to the criteria of 'affordable housing' which would be very different for people looking for a second home, commuters working in the oil industry, or local people working in the area. The same point came up later when participants discussed the likely impact of the 'World Market' scenarios on farming. Participants thought that the farmers who had the option to intensify would profit, while other farmers on more marginal soils would lose out.

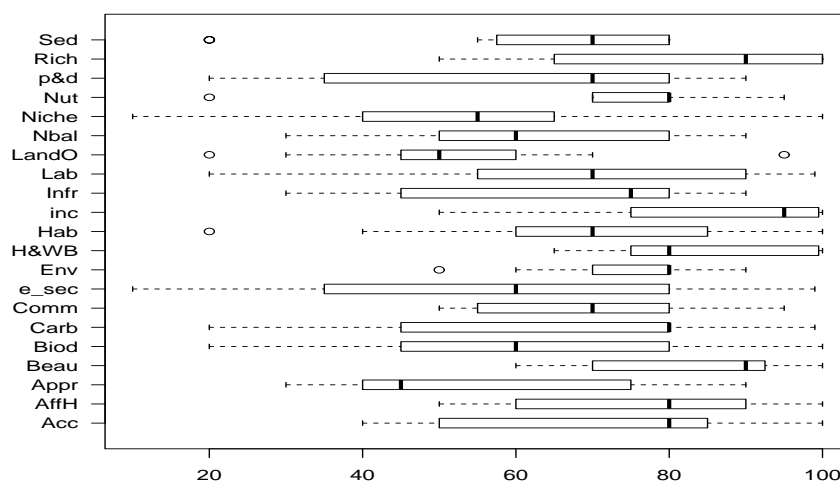
The group discussion raised some useful points about the tension between being systematic and taking a more holistic and connected approach. For example, the division of evaluation criteria into economic, social and environmental did not seem to make much sense as they were overlapping and interlinked. The example given was that of forestry roads which are infrastructure which enable economic activities (felling and transport of timber) but which are also important in promoting recreation. A similar point was raised in relation to the actual scoring of the scenarios where interactions between the different criteria are not taken into account in this kind of systematic evaluation of scenarios in relation to one criterion at a time.

With regard to the time frame of the scenarios, it was pointed out that it was difficult evaluating something for a period in the future (2050) when participants would not necessarily expect still to be alive. Also, participants felt that there were many unknowns, such as technological innovations which made it difficult to evaluate the impacts of the scenarios. Also, participants felt that it was necessary to think not only about the local area or Scotland but more globally. Even if Scotland went down a route of focussing more on the environment this might just result in exporting environmental problems to other countries. Likewise, international developments such as the current political tensions over Ukraine could have large impacts on Scotland and the local area. However, the MCDA exercise did generate useful discussion about the complex and integrated land use issues, despite the limitations identified above.

Results from the evaluation of the criteria and scenarios

Out of the 21 evaluation criteria, 'income generation', 'biodiversity richness' and 'landscape beauty' were on average ranked as the most important ones (>90 on a scale from 0 to 100), while 'provision of apprenticeship & training', 'community land ownership' and 'Northeast niche products' were on average ranked lowest though still above 40 on a scale from 0 to 100. However, in most cases these average values cover a wide range of values. 'Local energy security' and 'control of pests & diseases' showed the biggest variation with regard to how important the participants felt these were with some participants feeling they were very important and others thinking that they were not very important. There was least variation in relation to the criteria 'environmental awareness' which all participants had rated as having relatively high importance (average score was 80 out of 100).

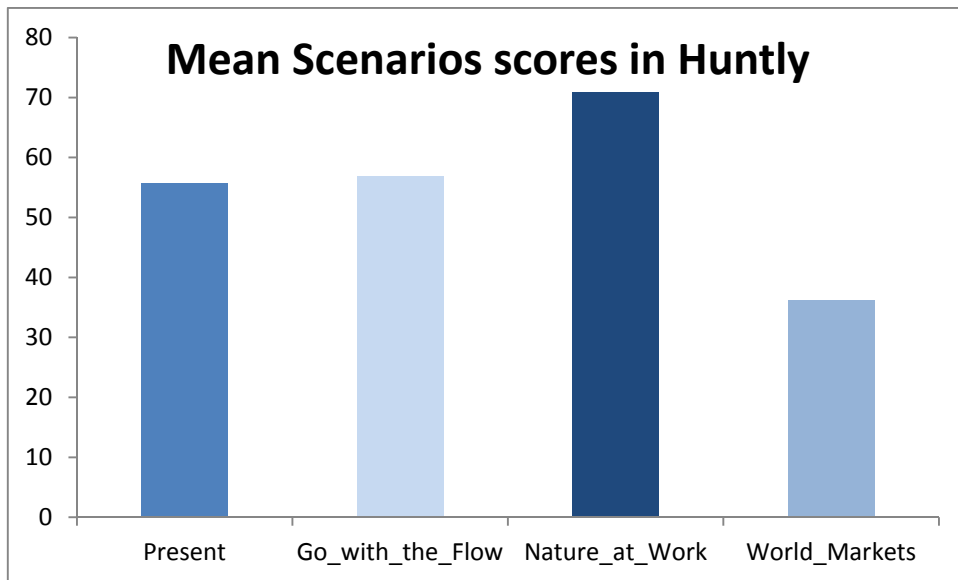
Figure 3: Weightings for the criteria from Huntly workshop participants. The black lines illustrate the median score; whilst the boxes illustrate the scores for the majority and the 'whiskers' indicate the more extreme scores



Legend: **Sed:** sediment retention; **Rich:** biodiversity richness; **P&d:** pest & disease control; **Nut:** nutrient retention; **Niche:** NE niche products; **Nbal:** Natural Balance; **LandO:** land ownership; **Lab:** Availability of labour & skills; **Infr:** infrastructure provision; **Inc:** Income generation; **Hab:** protected habitat conservation; **H &WB:** Health & well-being; **Env:** Environmental awareness; **e_sec:** local energy security; **Comm:** Local community cohesion; **Carb:** carbon capture; **Biod:** protected species conservation; **Beau:** landscape beauty; **Appr:** apprenticeships and training; **affH:** affordability for local residents; **Acc:** access to recreational opportunities

Out of the three scenarios, 'Nature@Work' received the highest average score based on the degree to which participants thought it would be able to meet the 21 criteria and how important these were to each individual (Figure 3). 'Go with the Flow' was evaluated as being very similar to the present, while 'World markets' was evaluated as doing worse than the present in relation to the 21 criteria.

Figure 4. The average scores of the three scenarios and the present based on how well participants thought they did in meeting each of the 21 evaluation criteria and how important these criteria were for each person.



After the presentation of the initial results from the MCDA exercise, participants expressed surprise that the Nature@Work scenario had been relatively uniformly scored by everybody. They thought that the larger spread in the scoring of the World Market scenario probably reflected that there was more uncertainty in the interpretation of this scenario and that it was regarded as less realistic. A world market scenario could for example be interpreted to imply that farmers would minimise inputs (to save money) and thereby reduce environmental impacts rather than leading to increase in the use of inputs where they were cost effective which would increase environmental impacts. Participants also discussed that the economic criteria had been easier to apply compared to the social and environmental ones. It was also re-iterated that change in an area like this is often linked to succession. Change may occur in a situation when for example, young people decide to leave farming altogether and land is sold to e.g. the Forestry Commission or a land bank, whereas the tradition of family farming that dominates this area may mean that changes are quite slow.

Part 3: Model predictions for future scenarios

After participants had evaluated the three future scenarios they were presented with the predictions that the BBN model made for each of the three scenarios. For all three scenarios, the model predicts that the likelihood of land managers changing their land use is quite low. The highest probability of land use change was predicted for the 'World Market' scenario (43.7% of land managers predicted to change land use) while the lowest probability of land use change was predicted for the 'Nature@Work' scenario (26.5% of land managers predicted to change land use) with the 'Go with the Flow' being intermediate (31.5% of land managers predicted to change land use).

The prediction for the way these changes would pan out also differed for the three scenarios. For 'World Markets' the predicted change was mainly an increase in arable land, a small increase in improved grassland, a small decline in woodland and declines in semi-natural grassland and rough grazing. In contrast, for 'Nature@Work' the model predicted a small decline in arable, improved grassland, semi-natural grassland and rough grazing, and a small increase in woodland. For 'Go with the Flow' the model predicted a small increase in arable, improved grazing and woodland while semi-natural grassland and rough grazing were predicted to decrease.

In turn, the model predicted different impacts on nutrient and sediment export and carbon emissions¹ for the three scenarios. Regarding sediment export, all three scenarios were predicted to lead to an increase in sediment export for most areas around Huntly. In the case of nutrient exports and carbon emissions, there was also an increase in all three scenarios, but this was predicted to be highest for the World Market scenario and lowest for the 'Nature@Work' scenario.

Following the presentation of the model predictions participants raised several points. Some of the predictions in the model were not regarded as very realistic. For example, participants did not think that climate change was likely to lead to much increase in agricultural prime land as agriculture in the area is mainly limited by the steepness of slopes, which will not change. These discrepancies in predictions may be due to the coarser resolution of the model and land use maps which currently do not take into account variations in slope at the field scale although the model of land capability does take this into account at a coarser scale (1km²). Also discussed was how changes in technology and future demand may influence land use. For example, new materials could make use of wood obsolete while a rising global middle class could lead to a large increase in demand for niche products such as whisky.

Participants seemed generally surprised that the model predicted relative little change, even though earlier participants had discussed the slow rate of change in land use in the area. They pointed out that it was important to remember that people's attitudes do change and that this will also influence behaviour. Examples given were that people were more environmentally conscious nowadays and how people's perceptions of smoking had changed drastically in a relative short time. Therefore, they

¹ These were predicted using the same process as the predicted maps in the second workshop. They are based on predictions from the InVEST models which uses the proportion of the different land uses in a catchment to predict ecosystem services such as nutrient retention, sediment export and carbon stocks.

thought that even under de-regulation (as in the World Market scenario) environmental standards would not necessarily decrease. However, it was also pointed out that there might be a difference between environmental impacts that people could feel directly and less visible impacts. Another point raised was that a scenario such as the World Market one could also lead to a segregation of areas, where some would become intensive agro-industrial regions and others would become 'rural nature' regions. All in all, participants hence suggested that the likely impact of any scenario was going to be more messy and complex than the model suggested.

After presenting and discussing the model predictions for the three scenarios, the workshop participants were given the opportunity to change the initial scores they had assigned to the three scenarios in the MCDA process taking the model's predictions into account. None of the participants wished to make any changes to their initial evaluation of the scenarios. Reasons given included that the model did not add much new information, that they did not have enough confidence in the predictions to want to use them to re-evaluate their initial scoring or that they could not remember the initial scores and hence might 'accidentally' change their scores without intending to do so (the initial scoring sheets had been collected so that the data could be entered into a computer and the initial results shown to the participants before the end of the workshop).

Next Steps

The workshop held on the 30th October was the last workshop in a series of three. Hence, there are currently no plans for further workshops as part of this work. The information from this and the previous two workshops will be analysed by researchers from the James Hutton Institute and results will be passed on to the Aberdeenshire Council and to Scottish Government. The workshops have formed part of the Aberdeenshire Regional Land Use Pilot which is ending in spring 2015. The results from the Regional Land Use Pilots (Aberdeenshire and Scottish Borders) will feed into the revision of the Scottish Land Use Strategy due to be completed by March 2016.

Results from the workshops will also be written up in the form of academic papers and will thereby become available to other researchers and policy makers in the rest of the UK as well as internationally. In addition, the results will be used by the researchers from the James Hutton Institute to inform further research questions and projects.

Participants' views on the workshop and what they have learnt from the series of workshops can be found in Appendix Five. Overall, the workshops have been relatively useful to participants and were extremely valuable to the researchers in helping identify the main messages from those living and working in the Local Focus Areas.

Appendix 1: List of workshop participants

Aberdeenshire Council	James Davidson
Balloch Riders Access Group	Liz Jones
Farmer/Aberdeenshire Local Outdoor Access Forum	Gordon McKilligan
Farmer	Angus Smith
Farmer/Huntly Development Trust	Sandy Scott
Huntly Development Trust	Mary Scott
Huntly and District Tourism Action Group	Fiona Manson
Forestry Commission Scotland	Iain Anderson
Royal Society for the Protection of Birds	Karen Cunningham
Scottish Natural Heritage	Gillian Forbes
James Hutton Institute	Inge Aalders
James Hutton Institute	Alessandro Gimona
James Hutton Institute	Kirsty Blackstock (facilitator)
James Hutton Institute	Anja Byg (facilitator)
James Hutton Institute	Justin Irvine (facilitator)
James Hutton Institute	Carol Kyle (facilitator)

Appendix 2: Suggested modifications to the model from workshop 2 and how this information has been used.

Suggestion	What we have done
Expertise and interests of land managers	Part of Land Management Objectives (LMO) typology
Distinction between land manager overall values and philosophy and shorter term business objectives	Final objectives for land management reflect a combination of the land manager's values and philosophy and the needs of the business/Non-Govn Organisation/owner ²
Influence of land capability on Land Manager Objectives (LMO); Land capability influenced by/influences drivers	Indirectly represented but direct link became too complex, something to think about in future
Flexibility/reversibility important factor in decision making	Implicit within LMO intersection with policy objectives – woodland harder to 'reverse' than arable or grassland
Business characteristics feed directly into decision to change box not via LMO	We have kept business characteristics as part of the LMO typology (tenancy, profitability etc) but something to think about in the future
Who sets business objectives? And are they principle led or just maintaining tradition?	Covered to some extent in the LMO which includes motivations and attitude to tradition
Issues to include in business or actor characteristics: Age; Attitude to diversification; Short term (ST) or long term (LT) thinking; Attitude/use of technology; Succession; Identity; Response to peer pressure	Diversification, identity and short term (ST) or long term (LT) thinking are included in the LMO but we were unable to include the rest at this stage. They are things we should try to address in future.
Disease is an important influence on decision making	Pests and diseases are part of the criteria we will look at in the upcoming workshop
Housing affects availability of labour	Labour and skills are part of the criteria we will look at in the upcoming workshop
Current profitability affects labour/skills and whether can access information/advice	Income generation is part of the criteria we will look at in the upcoming workshop; so are labour and skills (but not their inter-relationship); information and advice is not currently included and is something we should address in future.
Price of land and impacts on new entrants	This is not currently included and is something we should address in future.
Input prices would include the price of energy and fertilisers; regulations should include the tax regime and the additional	Included in these drivers

² Not all land is managed as a 'business'

bureaucracy	
Consumer demand is linked to population growth (global) and wish for home grown food	We removed consumer demand from BBN as we focussed on 4 drivers, but it is part of the scenarios we will look at in the upcoming workshop
Perceptions of climate change are important driver; affects ability/willingness to diversify	This is not currently included and is something we should address in future.
Public opinions – what do people want/expect from LU; also public opinion about Ecosystem Services impacts on policy; citizen or consumer wants/needs	Included in the scenarios we will look at in the upcoming workshop
Housing/infrastructure/buildings should be included	Now part of the Land Use categories (development)
Confusion over what cultural landscapes means – should include archaeology	Cultural landscapes are represented on the BBN but work is ongoing to refine how to define and measure these.
Designations should be part of land capability	This is not currently included and is something we should address in future.
Should include water quality	Represented by sediment and nutrient ecosystem services
Nature conservation is wider than habitat connectivity	Protected habitats and species are now part of the criteria we will look at in the upcoming workshop
Separate field sports and fishing from food provision – it is both recreation and economic activity	Field sports and fishing is not named as such. Food provision is within the BBN and access to recreational opportunities is part of the criteria we will look at in the upcoming workshop .
Tourism is business as well as recreation - business is needed; overall economic development impacts on provision of labour and skills	Income generation business opportunities and labour/skills are part of the criteria we will look at in the upcoming workshop
Health (physical and mental)	Health and wellbeing are part of the criteria we will look at in the upcoming workshop
Genetic diversity	This is not currently included and is something we should address in future.
Flood alleviation	This is not currently included and is something we should address in future.
Housing and shelter provided by landscape/topography	Development is a category of land use in the BBN
Connection to the land	Environmental awareness is part of the criteria we will look at in the upcoming workshop
Environmental education	Environmental awareness is part of the criteria we will look at in the upcoming workshop
Reintroduction of lost species	This is not currently included and is something we should address in future.

Protecting/restoring soil quality	This is not currently included and is something we should address in future.
Impacts on designated sites	Part of the criteria we will look at in the upcoming workshop
Pollination is an intermediate service leading to the final benefit of food provision	We have both in the BBN at present.
Links between ecosystem services	This is not currently included and is something we should address in future.
Links between ecosystem services and drivers	This is not currently included and is something we should address in future.
Time lags in changes in benefits; and in changing behaviours	This is not currently included and is something we should address in future.
Feedback loops from land managers to drivers; and the role of trusted intermediaries to make these links	This is not currently included and is something we should address in future.
Accessing/influencing those without grants or who are 'hard to reach'	Partly addressed in the within LMO intersection with policy objectives – Community stewards, ecological stewards and Other include those who do not access grants and/or don't participate in land management networks

Appendix 3. Summaries of the three future scenarios

Aspects	Go With The Flow
Policy Direction	Sustainable intensification – balancing increasingly productive land use with environmental minimum standards for water and protected areas, slow transition to low carbon economy
Incentives	Slowly moving away from production subsidies to incentivising environmental outcomes but still large proportion on sustaining viable working farms
Regulations	Maintain environmental, food health and biosecurity standards in line with European Directives
Input Prices	As now – fluctuating – with increased fuel costs slightly offset by renewables
Commodity Prices	Low prices paid to land manager but value added in the supply chain off-farm, low prices off-set by SFP (see incentives above)
Population (remains stable)	Slightly decreased from peak in 2020's as per strategic development plan with similar distribution across the shire
Local employment	Although the number of jobs in land based industries remains low, there is also a shortage of skilled labour for this sector because the majority are employed in urban centres. Oil and gas remain important, despite declining yields in North Sea, due to decommissioning investment
Urban population (influence of)	Political influence reflects balance between land owners and their rights and pressure from urban population where majority of voters live
Community engagement	Where active and charismatic individuals coincide with a tradition of community engagement, there are valuable inputs into regional and national planning processes
Land ownership patterns	Varied pattern continues and includes large long-term land owners; some estates being acquired by corporations for investment; large owner occupier farms , tenant farming and small scale community run small holdings
Technological advances	Ongoing development and up-take of precision farming methods; incremental improvements in renewable technologies; limited to no GM allowed
Food security	Majority of everyday food is imported from Europe but important niche areas of locally produced vegetables, fruit, meat and dairy products
Tourism demand	Domestic (UK) and European tourism remains stable.

Aspects	Nature@Work
Policy Direction(s)	Strong push to maximise delivery of multiple benefits whilst protecting natural capital; and a strong commitment to a low carbon economy
Incentives	Focused on supporting bundles of services and benefits - sustaining food production only where it also produces other benefits – overall environmental incentives increase
Regulations	Extended. Fines for land managers if other services, e.g. carbon sequestration, habitat condition, fall below targets
Input Prices	Those based on oil increase markedly due to low carbon economy measures (e.g. diesel, fertiliser)
Commodity Prices	Premium prices are paid for locally produced food, timber and energy with a provenance that illustrates how it has sustained wider benefits for society
Population (remains stable)	Outward migration from cities and towns into villages and small-holdings
Local employment	A much higher proportion of paid work is associated with land/water/nature based industries with local skilled labour living close to their workplaces
Urban population (influence of)	Distributed population with much closer links to, and interest in, rural and environmental issues, with strong Green lobby.
Community engagement	Strong community engagement with delivery of multiple benefits from the land, with volunteering becoming normal as part of daily routine
Land ownership patterns	An increase in community owned assets and also an increase in non-productive small holdings as people move out of urban centres. Family farms and estates continue. Investment firms target areas with high incentive payments
Technological advances	Substantial improvements in renewables technology; and investment in other technologies to assist with delivering multiple benefits e.g. low impact timber harvesting; low input/nature friendly farming techniques etc
Food security	Imports continue, but much higher proportion grown in Scotland. Home-grown and wild food common
Tourism demand	Domestic (Scotland) and recreational demand is strong; but international tourism is no longer seen as desirable due to negative environmental impacts of travel

Aspects	World Markets
Policy Direction(s)	Belief in global market forces - policies focus on removing market failures and policing fraud and presumption that the most efficient practices will persist etc
Incentives	Removal of all environmental or production incentives – the market rewards high value commodities; local payment for ecosystem services schemes start up to ensure clean water, flood protection etc
Regulations	Removal of all environmental , food and biosecurity regulations – the market rewards ‘clean’ producers
Input Prices	Overall lowering of input prices due to fierce competition and cheap biofuels replacing oil
Commodity Prices	Bifurcated market – large units producing quantities of low value products for major retailers; premium products associated with Scottish brands e.g. single malts, organic aged beef, organic cheese, virgin oils etc
Population (remains stable)	Most people live and work in large cities/towns with low population density in the rest of the shire
Local employment	Very low land-based employment (most producers are large-scale and mechanised with imported labour living onsite); service sector employs most people in Aberdeen & major towns
Urban population (influence of)	The majority urban population is more interested in urban jobs and keeping the cost of living as low as possible.
Community engagement	Very limited community engagement, partly as there is no planning or policy cycle to engage in, and partly as people protest or engage through their consumption choices
Land ownership patterns	Economies of scale leading to fewer land managers running large production units; with marginal land abandoned, or only used for field sports or nature tourism for the wealthy minority.
Technological advances	Investment in fuel and input efficiencies for large scale commercial food & timber production; GM is widely accepted
Food security	Most food is imported, and the locally grown food is grown for export as a world commodity (e.g. Scotch Beef, Scotch Whisky) so little available for home consumption except for the elite
Tourism demand	Increased demand from international visitors from emerging nations (e.g. China, Africa, Middle East) to visit honey-pot areas, little local recreational opportunities – local/UK visitors prefer city breaks

Appendix 4. Evaluation sheet for the Multi-criteria Decision Making Analysis (MCDA)

Name:				Present day	Scenario 1: Go With the Flow	Scenario 2: Nature at Work	Scenario 3: World Markets
	Criteria	Importance of criteria (0-100)	Are criteria positive? (Y/N)	Impact on criteria (0-100)	Impact on criteria (0-100)	Impact on criteria (0-100)	Impact on criteria (0-100)
Economic criteria	Infrastructure provision						
	Availability of labour and skills						
	Income generation (land based or tourism based)						
	Control of pests & diseases						
	Local energy security						
	NE niche products;						
	Provision of apprenticeship & training						
Social criteria	Health & well-being						
	Landscape beauty						
	Access to recreational opportunities						
	Environmental awareness						
	Local community cohesion						
	Affordability of rural life/housing						
	Land ownership						
Environmental criteria	Carbon capture						
	Sediment retention on land (prevent export into water courses)						
	Nutrient retention on land						
	Protected species conservation						
	Protected habitat conservation						
	Natural balance						
	Biodiversity richness						

Appendix 5: Huntly workshop 30th October 2014 evaluation forms:

Most people returned the evaluation forms giving an 80% response rate. Those responding were from the public sector (n=3); the NGO sector (n=3) or represented their own farming businesses (n=2). Not everyone answered every question.

Nearly everyone found the workshop useful (mean score 3.2, between useful and very useful). From the general comments, the reasons for it being useful included finding out more about current land use and the Land Use Strategy; the focus on impacts of potential future changes; and being able to discuss the implications of these changes from a range of perspectives. This is borne out by the fact that participants scored the quality of interaction on the day as between good and very good (mean score 3.75) with many praising the degree of open and informed discussion generated. "It was also very useful/interesting to hear the views of all the other participants over the course of the 3 sessions" (quote from one participant); particularly as it brought out the complexities associated with future land use change; but also some unexpected points of agreement between different stakeholders. The workshop seemed to be relevant to all those attending.

Participants agreed most strongly with the statements relating to whether their inputs had been incorporated (mean 3.4, between agree and strongly agree) and that they had increased their ability to think about multiple issues associated with land use (also mean of 3.4). Most agreed that they had new knowledge about future land use change (mean = 3) but there was a lower score (mean 2.8) regarding whether they had new knowledge about how future land use change might affect ecosystem services.

There was a mixed response in terms of evaluating which 'tools' were most useful in increasing their knowledge and understanding. The scenario and MCDA process was most popular in terms of frequency of being picked (five participants ticked this option) but no one selected it as the most useful. It was selected more often than the BBN and INVEST models used at the same workshop. The next most popular tools were the systems diagram and policy goal discussions as well as the BBN. The following were selected as **most useful**: Participatory mapping; decision making maps; systems diagram; policy goal discussion; policy goal maps and BBN - in other words participants varied greatly in how they related to, and valued, these tools. However, it should be remembered that some participants had not attended earlier workshops or could not really remember them, so the scores must be interpreted with caution.

Additional feedback related to interest in how the results would be used and developed in future and areas that require more attention – namely urban attitudes to rural issues and the importance of access and recreation in land use change planning. A participant noted that it would have been good to have a larger number of attendees with an even greater range of opinions and perspectives.

Participants were complimentary about the workshop facilitation (mean score 3.75, or between good and very good) and the materials provided (mean score 3.65).