



“Farmers as Water managers in a Changing Climate”

Tarland Baseline Report

December 2009

European Union



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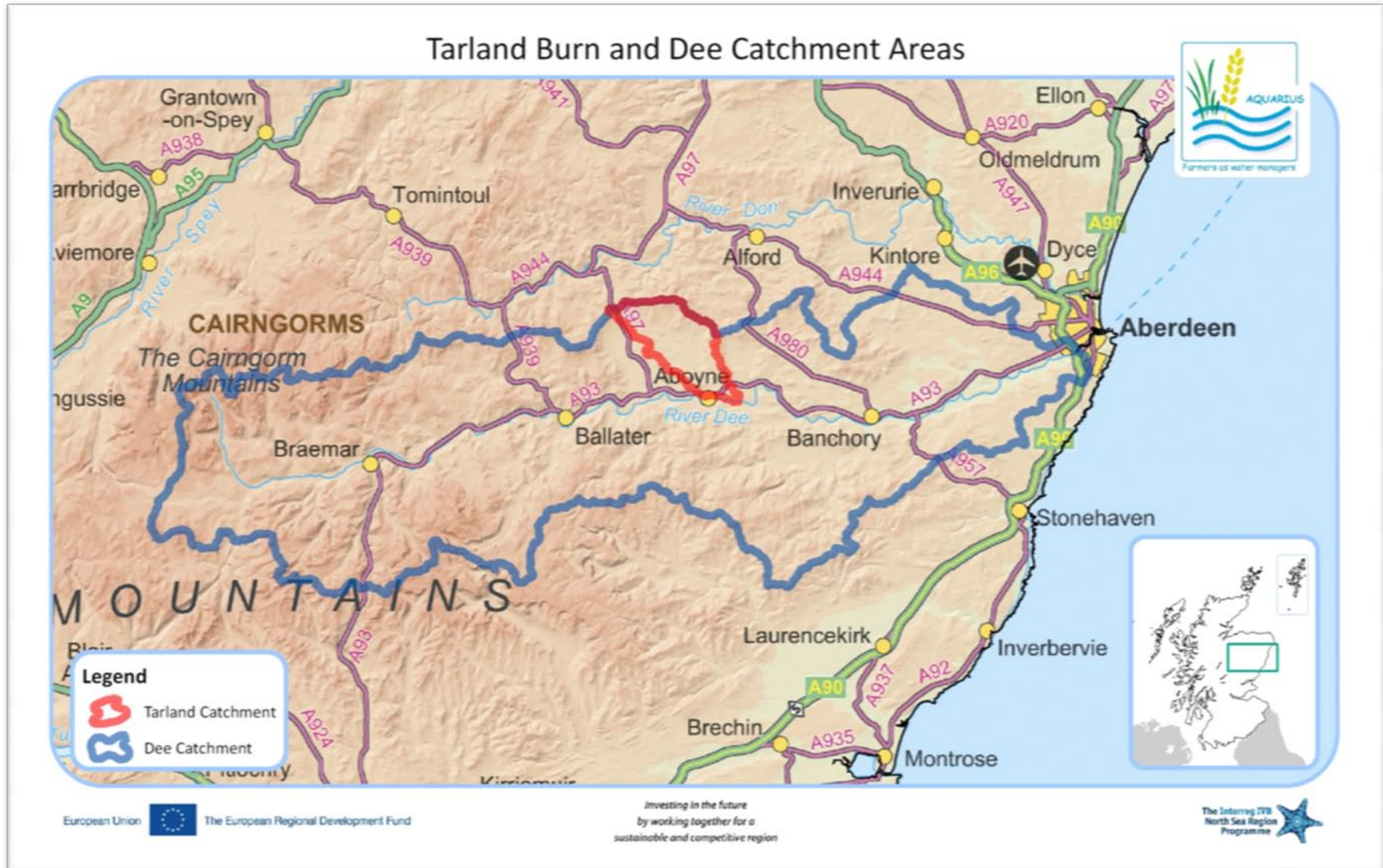
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1 Welcome to the North East Scotland Aquarius Pilot – Tarland Basin

1.1 Catchment – River Dee

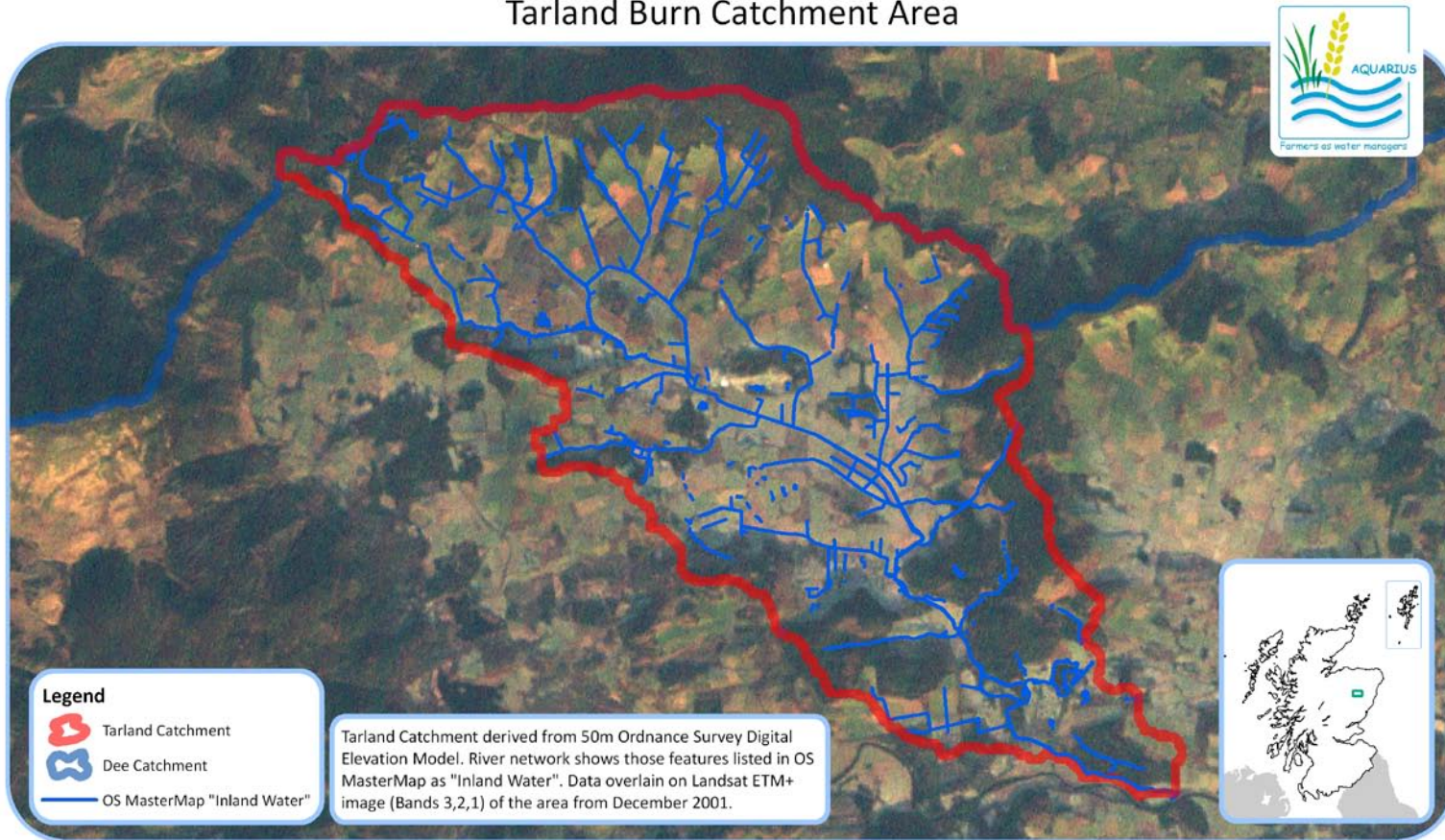
Area: 2,083 km², Max Elevation = 1304m' Mean Elevation = 410m



1.2 Pilot Area – Tarland Burn

Area = 73 km², Max Elevation = 620m, Mean Elevation = 227m, Elevation at which Tarland Burn enters the Dee = 109m

Tarland Burn Catchment Area



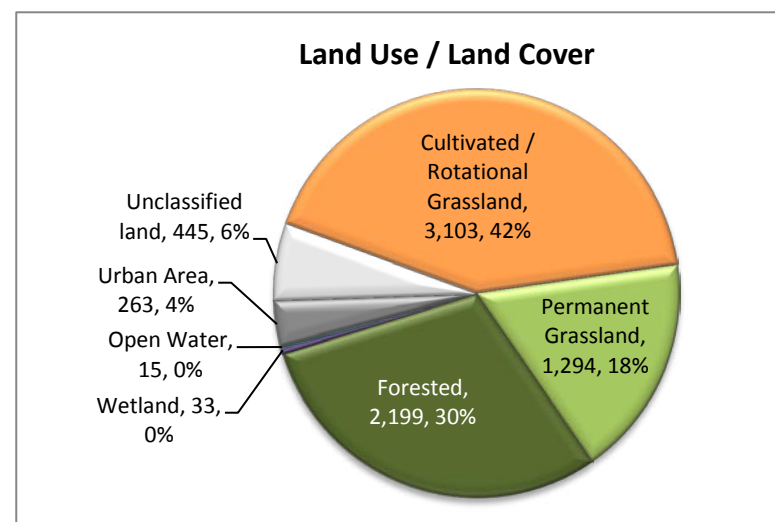
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1.3 Land Cover & Land Use in catchment area

Land Use / Land Cover	Ha	%
Cultivated / Rotational Grassland	3,103	42.2%
Permanent Grassland	1,294	17.6%
Forested	2,199	29.9%
Wetland	33	0.4%
Open Water	15	0.2%
Urban Area	263	3.6%
Unclassified land	445	6.1%
Total	7,352	100%



1.4 Number and tenure of holdings in the catchment

54 Holdings

51 with Agricultural Census Records 2007

41 Major >1ha

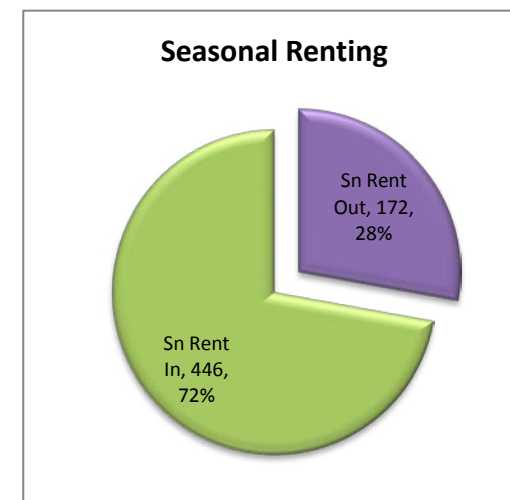
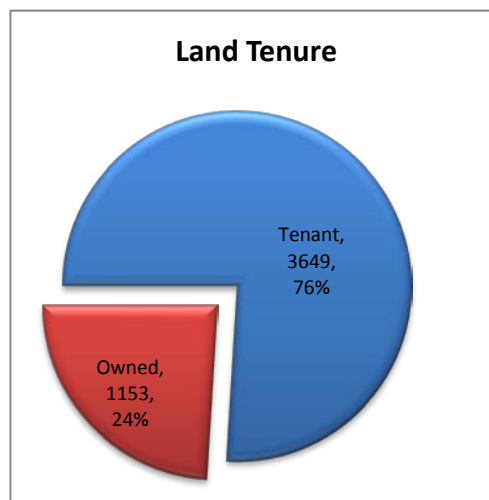
10 Minor <1ha

36 Wholly within catchment

18 Partially within

47 Businesses (max 2 holdings per business)

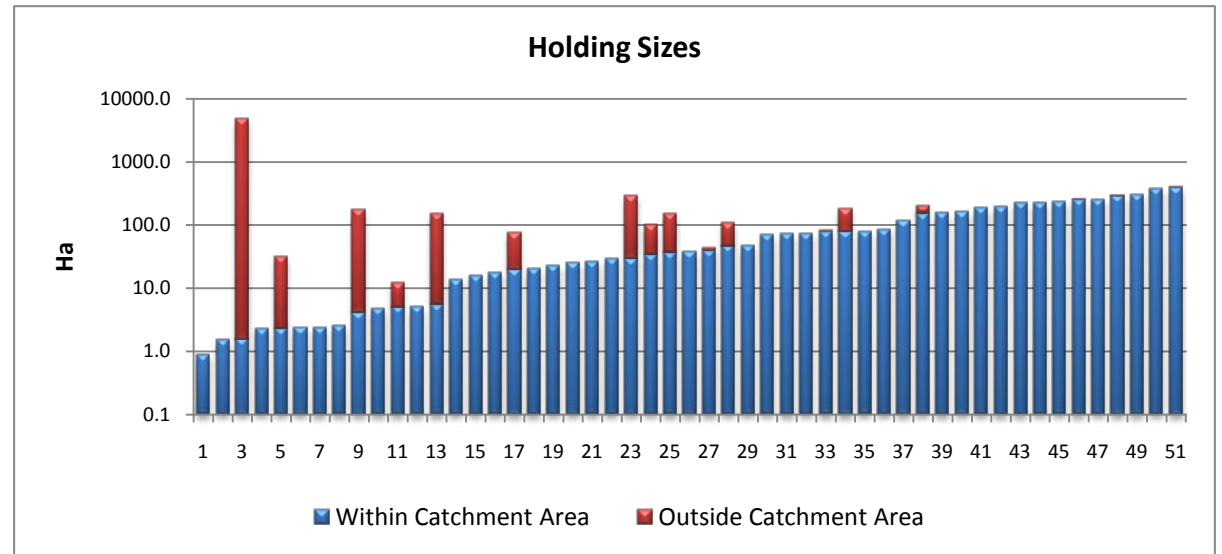
Tenure	Area(Ha)	%	% Reg. Avg.
Owned	1153	24	85
Tenanted	3649	76	15
Seasonal Renting	Area(Ha)		
Seasonal rent (out)	172		
Seasonal rent (in)	446		



1.5 Typical holding sizes

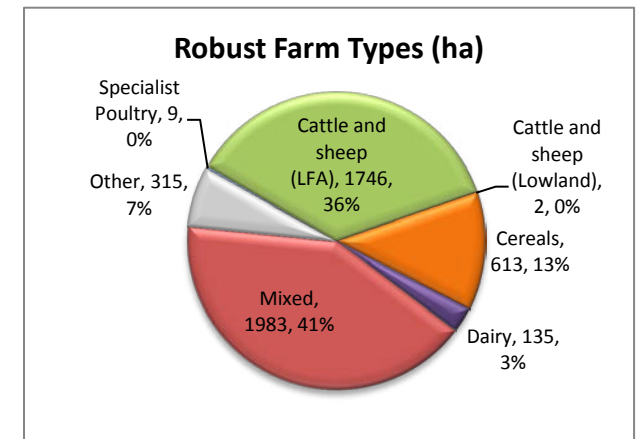
All Quartile	Size (ha)
Q1 (min)	0.90
Q2 (25%)	21.72
Q3 (50%) Median	81.12
Q4 (75%)	194.61
Q5 (max)	4785.85
Average	206.27

Inside Quartile	Size (ha)
Q1 (min)	0.90
Q2 (25%)	9.49
Q3 (50%) Median	38.15
Q4 (75%)	155.83
Q5 (max)	394.03
Average	90.59



1.6 Farm types (robust)

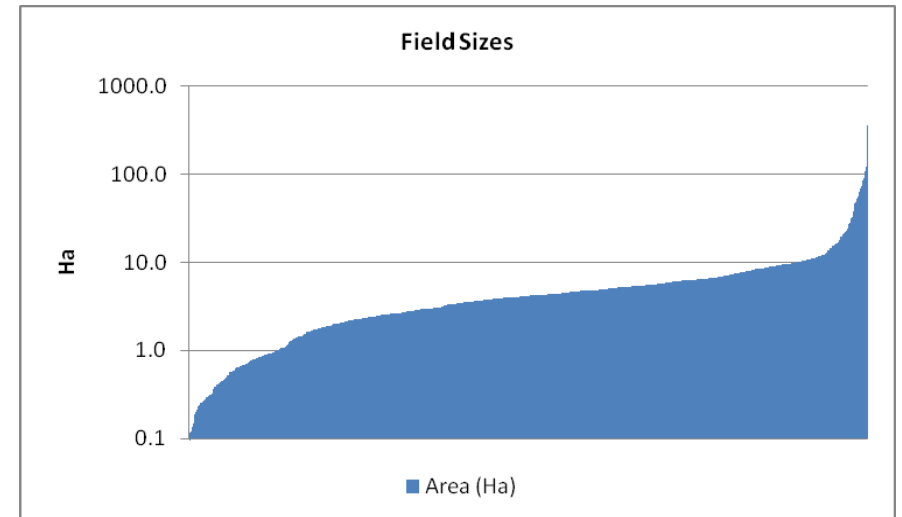
Robust Farm Types	No Holdings	Area (ha)	%
Cattle and sheep (LFA)	18	1746	36.35%
Cattle and sheep (Lowland)	1	2	0.04%
Cereals	6	613	12.77%
Dairy	1	135	2.80%
Mixed	11	1983	41.29%
Other	13	315	6.56%
Specialist Poultry	1	9	0.19%
Grand Total	51	4802	100.00%



1.7 Field sizes

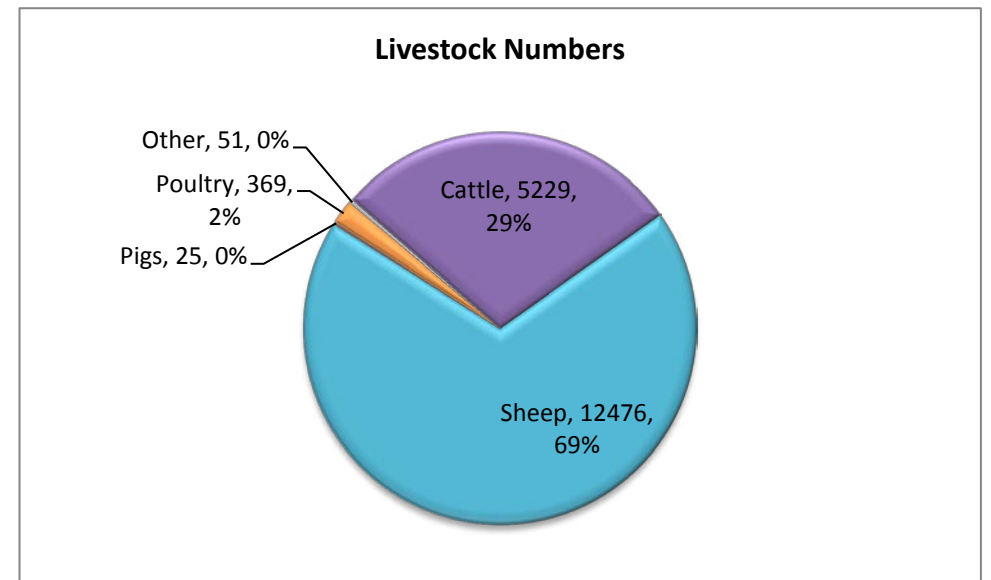
Quartile	Area (Ha)
Median	4.16
Q1 (min)	0.09
Q2 (25%)	2.27
Q3 (50%) median	4.16
Q4 (75%)	6.42
Q5 (max)	362.28
Average	6.81

Field Shape – see supplementary data



1.8 Stock Density

Type	Count
Cattle	5229
Sheep	12476
Pigs	25
Poultry	369
Other	51
LSU	3957
Ha (field area all crops)	4620
LSU/Ha	0.86



1.9 Employment

Local Employment (Marr)

Sector	'000s	%
Agriculture and fishing	0.3	2.7%
Banking/Finance/Insurance	1.6	14.2%
Construction	1.0	8.8%
Distribution and Hotels	2.9	25.7%
Manufacturing	0.7	6.2%
Other services	0.8	7.1%
Public Admin/Education/Health	3.3	29.2%
Transport and Communications	0.4	3.5%
All Sectors	11.3	100%

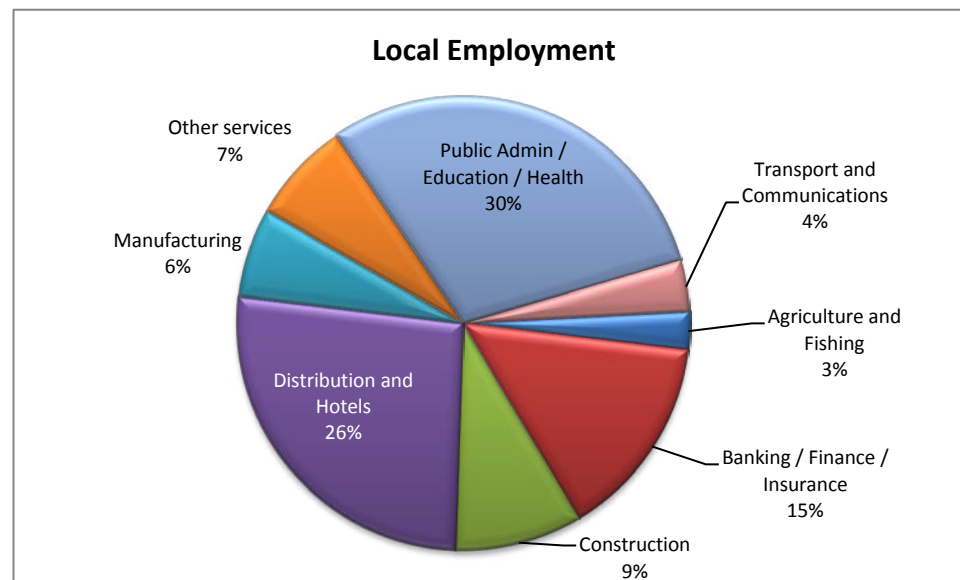
Farm Type	FTE ¹	SLR ²
Cattle and sheep (LFA)	40.49	34.16
Cattle and sheep (Lowland)	0.75	0.03
Cereals	5.82	2.91
Dairy	4.07	3.62
Mixed	29.05	27.51
Other	8.67	0.40
Specialist Poultry	0.25	0.05
Grand Total	89.11	68.67

1.10 Population density in the catchment area

Population	
2001 Census	2,679
Total Area of Census Units (km ²)	77.94
Population Density (people/km²)	34.37

1.11 Land and water issues

Tarland Burn is degraded due to diffuse pollution and morphological alterations. The morphological alterations, and the nature of urban development, lead to flooding of low lying houses in Tarland and Aboyne. This is likely to be worse with increased storm events. Over abstraction and low flows is also a potential problem in the future. Tarland Burn is typical of an East Coast tributary running through mixed farming country.



¹FTE – Full Time Equivalent (Estimated from June Annual Census – uncertainty on part-time and casual employees. Importance of contractor hours – how to include?)

²SLR – Standard Labour Requirement (statistical estimate of labour requirements based on enterprises present)

2 Ecological Baseline

2.1 Water Quality

Tarland Burn was classified at moderate status under the 2007 WFD classification system.

The 'failing' elements of the classification system are:

- Morphology is moderate – principally due to low impact channel realignment but also due to changes to riparian vegetation and embankments.
- Soluble reactive phosphorus (sampled at Aboyne) is just the wrong side of the good /moderate boundary, with a mean of 39ug/L.

Phytobenthos is also just achieving good status. The overall status is still moderate though due to the changes to the morphology.

Unlikely to be resolved by 2015 but hopefully by 2027. Remediation will involve:

1. Raising awareness of issue through Aquarius, Dee CMP
2. Intervention and improved land management through buffer strips and wetlands installation incrementally placed on tributary by tributary approach.
3. Agriculture is a major influence (see previous section of baseline report) and impacts both on water quality and morphology.

Other influences are private water treatment systems on water quality.

2.2 Water Quantity

The villages of Tarland and Aboyne have been impacted by flooding on a number of occasions in the last 7 years. In addition farmers express concern about prevalence of surface water on their fields at certain periods. A number of outlying remote houses and farms have lost their private water supplies due to summer droughts.

2.3 Water quality (beyond WFD parameters)

Indicative Flood Map – see Section 6.2

2.4 Bio-diversity (Habitats Directive)

1. The Tarland burn is part of the wider River Dee Special Area of Conservation identified as part of Natura and the Habitats Directive. The main channel and major tributaries are identified for their internationally significant populations of salmonids (*salmo salar*), otter (*luttra luttra*) and freshwater pearl mussels (*margaritifera margaritifera*). Site condition monitoring by Scottish Natural Heritage results in Tarland being classified as in satisfactory condition for salmon and otter but unsatisfactory for freshwater pearl mussels.

2. In addition to this statutory ecological monitoring a range of further studies have been undertaken investigating the impacts of restoration in terms of both water quality, habitat and ecology. Specifically the impact of riparian restoration on salmon and aquatic invertebrates, riparian terrestrial habitats on birds, bees and butterflies and physical in stream habitat restoration on salmon habitat. The RSPB an international NGO for bird protection has also monitored the utilisation of a wetland by wader birds created to deal with waste water from the sewage treatment plant.

Indicators could be derived from annual electrofishing for salmonids, local interested residents are involved in undertaking Wader bird surveys. Other possible indicators may be the number and location/capacity of wetlands, the length of riparian habitat that is restored through reducing the intensity of management.

2.5 Bio-diversity (beyond Habitats Directive)

See also Annex I for a full listing of the priority, conservation concern and locally important species from the NE Scotland Local Biodiversity Action Plan, and their presence in Tarland. www.macaulay.ac.uk/aquarius

Note the species presence data is coded as Y (Yes definitely present), L (likely), M (maybe), U (unlikely), N (definitely not present) or ? for no data. Listed is the sum of all species in the class.

Priority Level	Higher-Group	Group	Species Present?						Listed
			Y	L	M	U	N	?	
UK PRIORITY SPECIES	Invertebrates	Ant	1					2	3
		Bee				1			1
		Beetle						2	2
		Butterfly			2				2
		Fly			1			5	6
		Mollusc		1				2	3
		Moth				2		5	7
		Stonefly						1	1
	Invertebrates Total			2	5	1		17	25
	Plants	Fungi						1	1
Lichen					3	1	4	8	
Liverwort							1	1	
Moss					2	1	5	8	
Vascular Plant			1	1	6	4	4	16	
Plants Total			1	1	11	6	15	34	
Vertebrates	Amphibian						1	1	
	Bird	9		1	3			13	
	Mammal	5				2		7	
Vertebrates Total			14	1	3	3	3	21	

Priority Level	Higher-Group	Group	Species Present?						
			Y	L	M	U	N	?	Listed
UK SPECIES of CONSERVATION CONCERN	Invertebrates	Butterfly	2			1			3
		Damsel/Dragonfly			1				1
		Fly						1	1
		Moth			1		1		2
		Spider Group						1	1
	Invertebrates Total			2	2	1	1	2	8
	Plants	Lichen					2	2	4
		Liverwort						1	1
		Vascular Plant			1		8		9
	Plants Total				1		10	3	14
	Vertebrates	Amphibian	2						2
		Bird	9	2	4	7	5		27
		Fish	2				1	2	5
		Mammal		1				1	2
Reptile		2						2	
Vertebrates Total		15	3	4	7	6	3	38	
<hr/>									
Priority Level	Higher-Group	Group	Y	L	M	U	N	?	Listed
LOCALLY IMPORTANT SPECIES	Invertebrates	Beetle						3	3
		Butterfly/Moth					1	1	2
		Mollusc						2	2
		Spider						1	1
	Invertebrates Total						1	7	8
	Plants	Algae						1	1
		Fungi						3	3
		Lichen				2		22	24
		Liverworts/Mosses						2	2
		Vascular plants	1		2	1	12		16
	Plants Total		1		2	3	12	28	46
Vertebrates	Bird					1		1	
Vertebrates Total						1		1	
ALL			32	6	16	26	40	75	195

UK PRIORITY SPECIES		Present					
Main Habitat Grouping	Y	L	M	U	N	?	Listed
Farmland and Grassland	4		1	1	1	2	9
Farmland, Grassland, Montane, Heath and Bog					1		1
Freshwater and Wetland, Woodland				1			1
Montane, Heath and Bog			2	2	3	4	11
Montane, Heath and Bog, Coastal and Marine		1					1
Montane, Heath and Bog, Woodland			1				1
Wetland and Freshwater	2	1			2	7	12
Wetland and Freshwater, Montane, Heath and Bog	1						1
Woodland	7	1	2	4		5	19
Woodland, Freshwater and Wetland						1	1
(blank)			1	2	1	8	12

UK SPECIES of CONSERVATION CONCERN		Present					
Main Habitat Grouping	Y	L	M	U	N	?	Listed
Coastal and Marine, Montane, Heath and Bog					1		1
Farmland and Grassland	4			1			5
Farmland and Grassland, Coastal and Marine				1			1
Freshwater and Wetland	3	1	2	2	1	2	11
Montane, Heath and Bog	3		4	2	6		15
Rock, Coastal and Marine					1		1
Wetland and Freshwater	1					1	2
Wetland and Freshwater/ Marine	1						1
Woodland	2	1	1	1		1	6
Woodland/Freshwater/Farmland and Grassland		1					1
(blank)	1				1	3	5

LOCALLY IMPORTANT SPECIES		Present					
Main Habitat Grouping	Y	L	M	U	N	?	Listed
Farmland and Grassland, Coastal					1		1
Freshwater and Wetland				1	1		2
Freshwater and Wetland, Woodland, Coastal and Marine			1				1
Montane, Heath and Bog					9	2	11
Woodland						6	6
Woodland, Farmland and Grassland	1						1
(blank)				1		22	23

2.6 Land and water issues for ecology

Tarland Burn is degraded due to diffuse pollution and morphological alterations. The morphological alterations, and the nature of urban development, lead to flooding of low lying houses in Tarland and Aboyne. This is likely to be worse with increased storm events. Over abstraction and low flows is also a potential problem in the future.

3 Economic Baseline

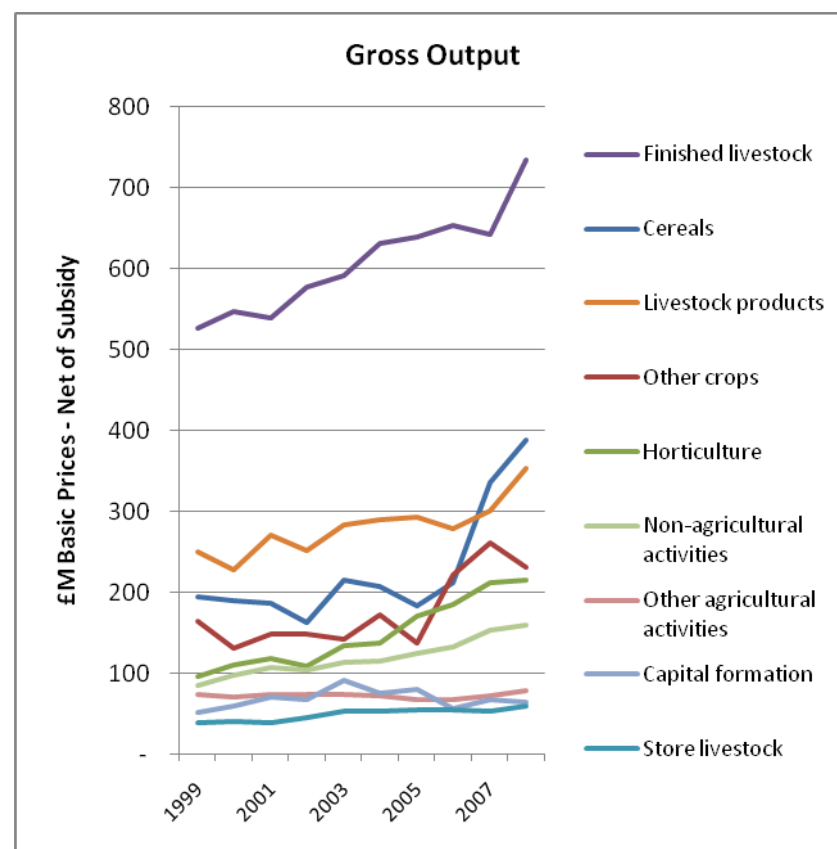
3.1 Gross Output and Gross Value Added

No local figures – national level grss outputs and value added.

Gross Outputs (Scotland - £M)	2004	2005	2006	2007	2008	Avg
Finished l'stock	631	639	653	641	734	660
Cereals	208	182	212	335	387	265
L'stock prods	289	292	278	301	352	302
Other crops	172	137	221	261	231	204
Horticulture	136	170	185	211	215	184
Non-agric	115	125	133	154	160	137
Other agric	73	68	67	71	78	71
Capital form	75	80	56	67	64	68
Store l'stock	53	55	54	53	59	55
Gross output	1,752	1,749	1,860	2,094	2,281	1,947

Gross Value Added (£M)			% of GVA	
Region/Sector	2005	2006	2005	2006
Scotland	88,085	93,361		
AFF	1,160	1,271	1.32%	1.36%
Abdn City & Shire	10,300	10,879		
AFF	187	205	1.82%	1.88%

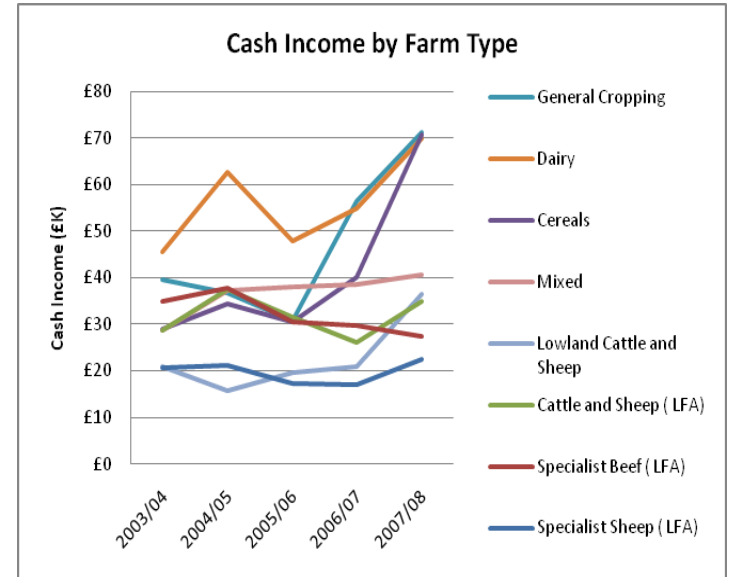
AFF – Agriculture Forestry and Fisheries



3.2 Farm Incomes

No local income data – national level income data by farm type.

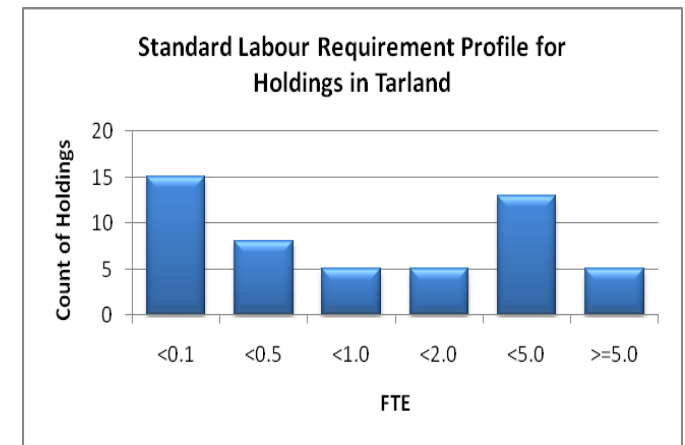
Income (£k)	Years					
Type of Farms	2003/04	2004/05	2005/06	2006/07	2007/08	Avg
Specialist Sheep (LFA)	£20.7	£21.2	£17.4	£16.9	£22.5	£19.7
Specialist Beef (LFA)	£34.8	£37.6	£30.5	£29.7	£27.5	£32.0
Cattle and Sheep (LFA)	£28.8	£37.6	£31.4	£26.1	£34.9	£31.7
Cereals	£28.8	£34.4	£30.5	£40.1	£70.7	£40.9
General Cropping	£39.5	£36.8	£30.7	£56.5	£71.2	£46.9
Dairy	£45.7	£62.8	£47.8	£54.8	£70.0	£56.2
Lowland Cattle and Sheep						
Cattle and Sheep	£21.0	£15.8	£19.7	£21.0	£36.5	£22.8
Mixed	£28.6	£37.1	£38.1	£38.5	£40.5	£36.6
All Farm Types	£31.9	£36.8	£31.3	£35.5	£44.8	£36.0



3.3 Full-time and Part-time Farming

Tarland 2008	Count	Area (Ha)
Main Farms >=3.0 ha	46 (90.2%)	10510.2 (99.9%)
Minor Farms <3.0 ha	5 (9.8%)	9.7 (0.1%)

Scotland 2008	Count	Area (Ha)
Main Farms >=3.0 ha	37,350 (73%)	5,629,645 (99.6%)
Minor Farms <3.0 ha	14,139 (23%)	22,618 (0.4%)



3.4 Agricultural Assets

Value of the holding including land, buildings, equipment and stock, but not financial assets

Scotland

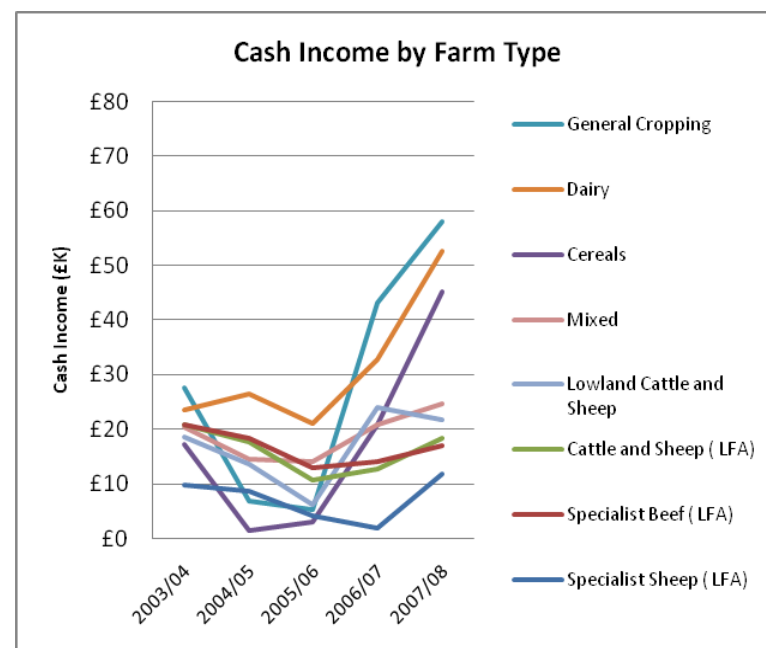
	2004	2005	2006	2007	2008	Avg
Assets* (£M)	13,530	13,550	13,765	14,055	14,360	13,852

*Excluding Financial

3.5 Net Farm Income

Scotland* Net Farm Income (£k)		Years				
Type of Farms	2003/04	2004/05	2005/06	2006/07	2007/08	Avg
Spec Sheep (LFA)	£9.9	£8.6	£4.1	£1.9	£11.9	£7.3
Spec Beef (LFA)	£20.9	£18.4	£12.9	£14.1	£17.1	£16.7
Cattle and Sheep (LFA)	£20.9	£17.8	£10.6	£12.7	£18.4	£16.1
Cereals	£17.3	£1.5	£3.1	£20.8	£45.2	£17.6
General Cropping	£27.6	£6.9	£5.4	£43.1	£58.0	£28.2
Dairy	£23.5	£26.4	£21.1	£32.7	£52.7	£31.3
L'land Cattle and Sheep	£18.5	£13.6	£6.2	£24.0	£21.8	£16.9
Mixed	£20.3	£14.6	£14.0	£20.8	£24.6	£18.8
All Farm Types	£19.8	£13.8	£10.1	£19.8	£29.8	£18.7

*No local profitability figures available.



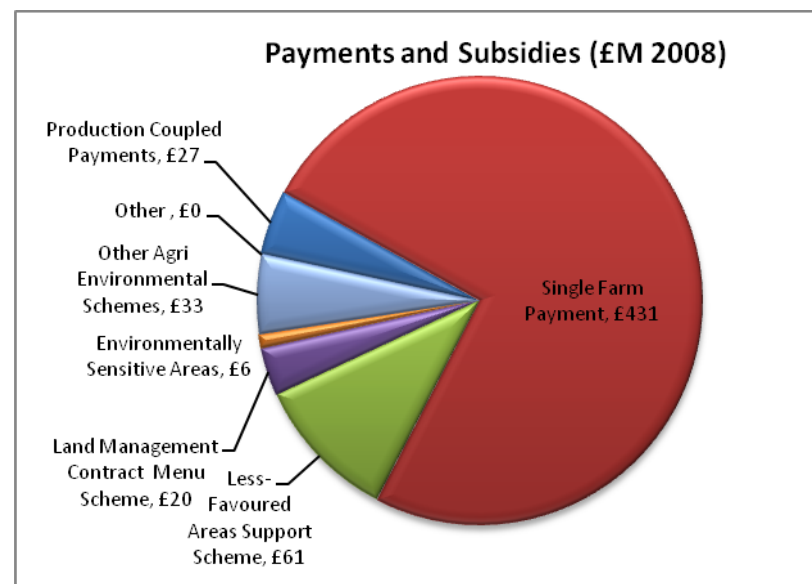
3.6 Range of Incomes per Farm Type

Net Farm Income (£K)		2003/4	2004/5	2005/6	2006/7	2007/8	Avg
Specialist Cereals	Lower 25%	-5.60	-19.77	-29.32	-3.29	10.74	-9.45
	Upper 25%	40.91	19.54	29.39	47.18	87.68	44.94
	All	17.27	1.38	3.10	22.28	45.22	17.85
General Cropping	Lower 25%	-6.41	-33.70	28.55	-4.53	6.21	-1.98
	Upper 25%	53.41	45.28	36.44	72.21	116.24	64.71
	All	27.57	4.09	5.36	36.76	57.97	26.35
Dairy	Lower 25%	-2.98	-5.42	-17.44	-1.52	-11.48	-7.77
	Upper 25%	64.70	64.33	63.70	103.36	144.88	88.19
	All	25.88	24.57	21.06	40.33	52.70	32.91
LFA:Special Sheep	Lower 25%	-0.72	-6.64	-15.95	-15.55	-16.05	-10.98
	Upper 25%	27.04	25.21	23.58	19.61	48.74	28.84
	All	11.94	8.36	4.05	1.48	11.86	7.54
LFA:Specialist Beef	Lower 25%	-3.59	-8.36	-10.79	-10.22	-10.15	-8.62
	Upper 25%	42.73	42.94	33.89	37.64	42.49	39.94
	All	20.86	19.47	12.92	14.42	17.08	16.95
LFA:Cattle and Sheep	Lower 25%	-4.22	-8.43	-11.72	-12.27	-12.37	-9.80
	Upper 25%	48.02	44.02	37.10	41.68	57.97	45.76
	All	20.91	14.58	10.61	11.35	18.40	15.17
Lowground Cattle and Sheep	Lower 25%	-	-	-	-	-	-
	Upper 25%	-	-	-	-	-	-
	All	20.15	22.06	6.24	21.22	21.84	18.30
Mixed	Lower 25%	-7.33	15.63	-22.54	-9.59	-17.42	-8.25
	Upper 25%	46.52	59.97	43.59	55.31	65.21	54.12
	All	21.26	35.92	13.97	20.52	24.63	23.26

3.7 Payments and Subsidies

Type	2004	2005	2006	2007	2008	04-08
PCP	426.4	48.2	29.8	26.2	26.9	112
SFP		387.3	388.4	393.7	431.4	400
LFASS	60.7	61.0	100.3	61.0	61.0	69
LMCMS		14.5	22.0	19.8	20.0	19
Set Aside	15.4					15
ESA	9.7	8.2	6.3	5.1	5.9	7
Other AES	25.4	24.8	34.3	40.7	32.9	32
Other	0.1	0.0	0.1	20.6	0.1	4

PCP – Production Coupled Payments, SFP – Single Farm Payment, LFASS – Less Favoured Areas Support Scheme, LMCMS – Land Management Contract Menu Scheme, ESA – Environmentally Sensitive Areas, Other AES – Other Agri-Environmental Schemes



3.8 Part of income based on EU or national agri-environmental schemes

Scotland

	2004	2005	2006	2007	2008	04-08
Agri-Env (£M)	50.6	47.5	62.7	86.2	58.9	61.2
As % of TIFF	11%	11%	11%	13%	9%	11%

TIFF – Total Income from Farming

3.9 Liabilities

Scotland

	2004	2005	2006	2007	2008	Avg
Liabilities as % of Assets	13.2%	14.8%	14.6%	13.1%	12.9%	13.7%

3.10 Conditions for financing investments

The agricultural sector is generally regarded as relatively risk free, less susceptible to some adverse conditions although suffering from periodic economic shocks. It is traditionally well supported (by government) and this is seen as positive by bankers since it represented a relatively guaranteed source of income. Historic values tied up in assets have the potential to create significant hidden reserves on balance sheets. Scottish farmers were traditionally less highly borrowed compared to England (see above). The sector has commanded finer interest rates for size of business than other industry sectors.

Commercial Mortgages (typical)	
Availability	70% LTV (loan to value)
Amount	£25K+ - no upper limit
Interest	Fixed or Variable: 1.5%/2.5% + base rate or linked to LIBOR
Arrangement	1%/1.5% and 0.5% at renewal
Security	60%/70% - can create anomaly with LTV (above) – depends on wide range of factors
Term	25/30 years max, typically 10/15 years

3.11 Special economic conditions from banks and/or mortgage institutions

Not known beyond the conditions and commentary provided above.

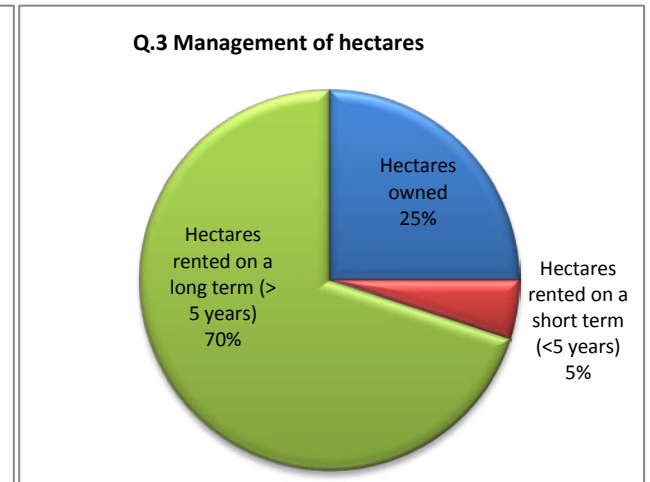
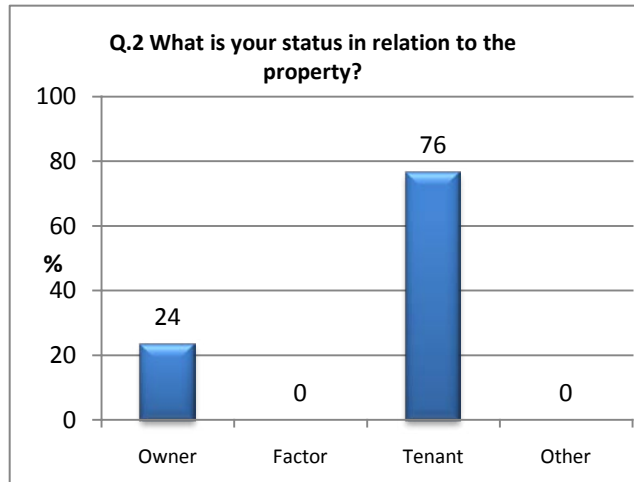
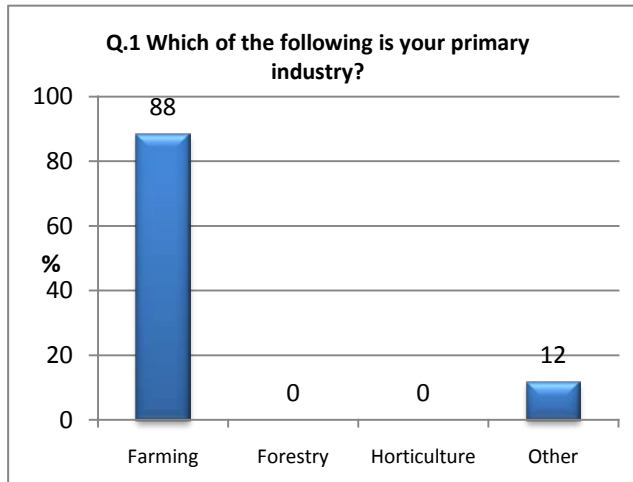
3.12 Medium Term Profitability Outlook

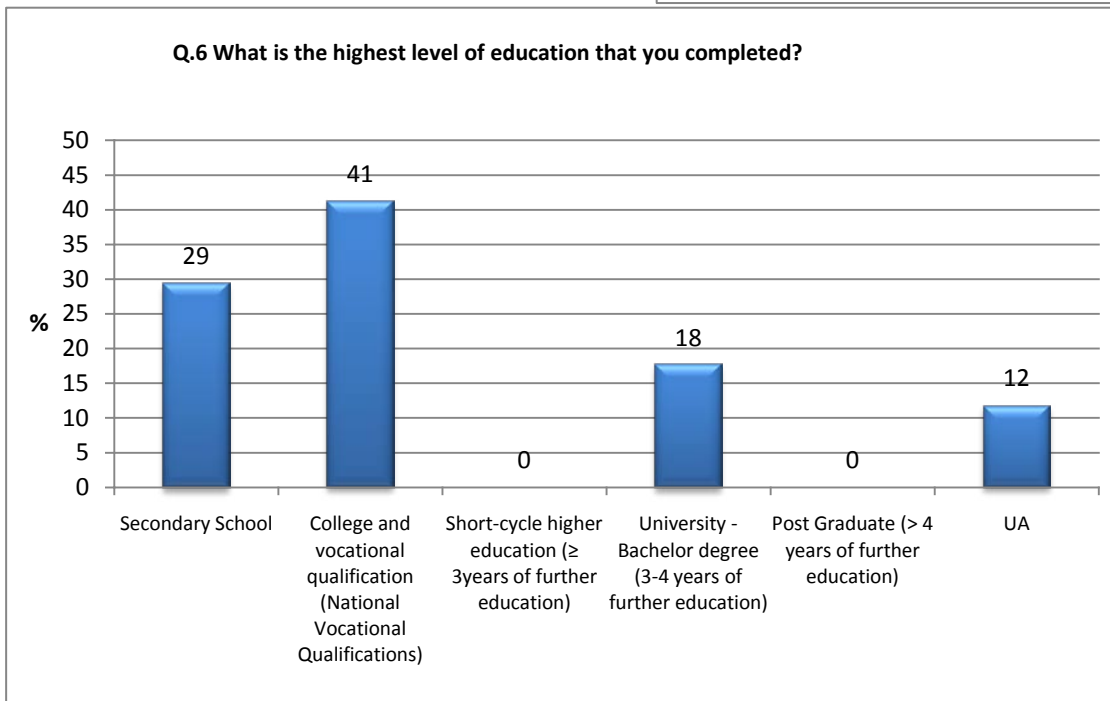
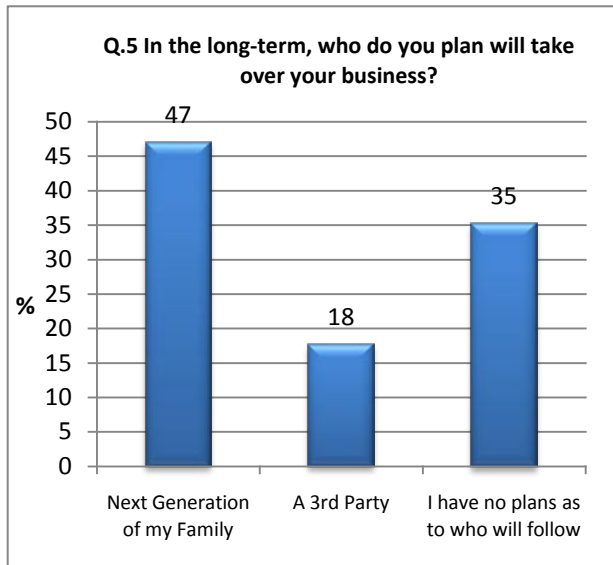
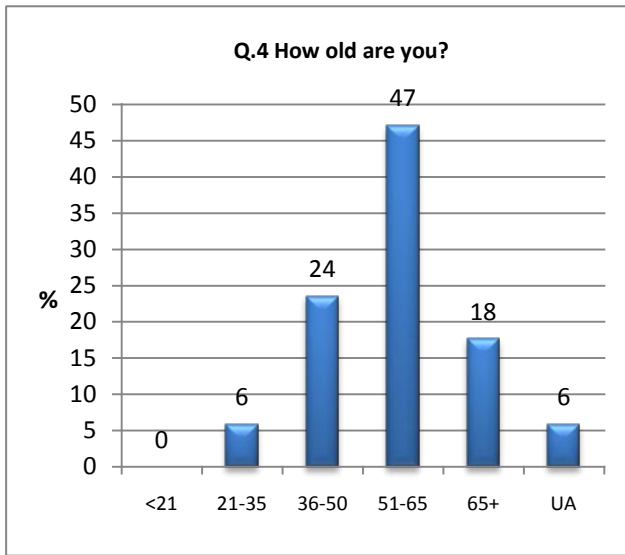
Budgets for models based on real Aberdeenshire farms suggest that for most farm businesses 2007 and 2008 should have been years of improved profitability. However, the sharp input cost rises, and downward movement in feed grain prices expected as of summer 2008, result in estimated 2009 profits returning to pre-2007 levels (Table 2). The recent boom in crop prices may be short lived, but there will still be opportunities for systems which allow input reductions. The figures also tell us that we are in a new era of volatility and higher risk, which has implications for the entire food chain. (Agriculture in Aberdeenshire – Looking to the Future – NESAG 2008)

4 Sociological Baseline

4.1 Land Users as Water Managers Questionnaire

There are 54 land based holdings within the Tarland catchment, managed by 48 people. We approached 24 people (five holdings fall mainly outside the catchment; and 19 are very small patches of land that are not really 'farms'). We received 17 responses giving a response rate of 61% - the data below is all based on N=17 unless otherwise stated. Most of the questionnaires were done face to face; but three were mailed out and returned by phone at the request of the farmer.





Q1&2 - Other is contractor for other farmers; local shop owner.

n = 14 for Q4.

n = 15 for Q6.

No option of short-cycle higher education

Q.7 - Which of the following environmental measures have you applied to the property?

Q.7 (% in brackets)	N=15	No	Yes	UA
Environmentally friendly management of run-off and drainage water		10 (59)	5 (29)	2 (12)
Establishment of buffer strips, field margins, fences or edges?		7 (41)	8 (47)	2 (12)
Change in the management of arable land and woodlands		15 (88)	0 (0)	2 (12)
Extensification of cultivated land		13 (76)	2 (12)	2 (12)
Working out green accounts or environmentally targeted management plans		11 (65)	4 (24)	2 (12)
Other		14 (82)	1 (6)	2 (35)
None		9 (53)	6 (35)	2 (12)

- Other:**
- through 3-Dee Vision, installed improved design in-stream watering and diverted runoff from overland/road into ditch & main watercourse

Q.8 - To what extent have the following parties influenced decision-making on uptake of environmental measures on the property?

Q.8 (% in brackets)	None	Minor	Medium	Major	NA	UA	
Family relative	9 (53)	2 (12)	4 (24)	1 (6)	0 (0)	1 (6)	N=16
Production/farm business advisor	11 (65)	1 (6)	2 (12)	1 (6)	0 (0)	2 (12)	N=15
Environmental advisor	8 (47)	0 (0)	1 (6)	6 (35)	0 (0)	2 (12)	N=15
Colleagues in your profession	12 (71)	3 (18)	0 (0)	0 (0)	0 (0)	2 (12)	N=15
Estate management	13 (76)	2 (12)	0 (0)	0 (0)	0 (0)	2 (12)	N=15
Members of the local community	7 (41)	1 (6)	4 (24)	2 (12)	1 (6)	2 (12)	N=15
Farmers unions	12 (71)	1 (6)	2 (12)	0 (0)	0 (0)	2 (12)	N=15
NGO's other than farmers' unions	13 (76)	0 (0)	1 (6)	0 (0)	0 (0)	3 (18)	N=14
Local authority representatives	11 (65)	4 (24)	0 (0)	0 (0)	0 (0)	2 (12)	N=15
Knowledge-based institutions	10 (59)	5 (29)	1 (6)	0 (0)	0 (0)	1 (6)	N=16

Q.9 - On average, approximately how many hours of external advice do you receive per annum?

Q.9	Hours	NA	UA	
Private production		12	5	N=12
Private environmental	8h*	12	4	N=13
Public production		12	5	N=12
Public environmental		12	5	N=12

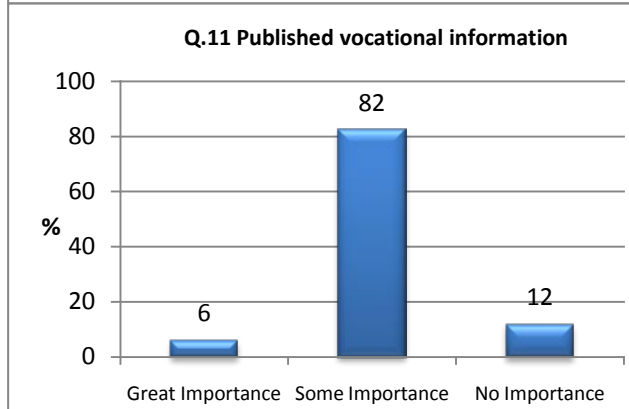
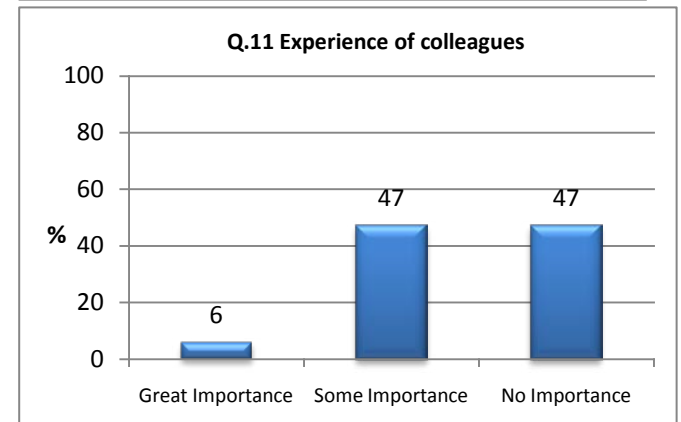
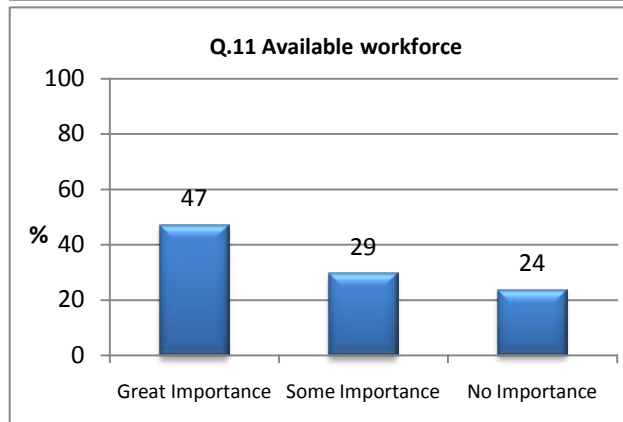
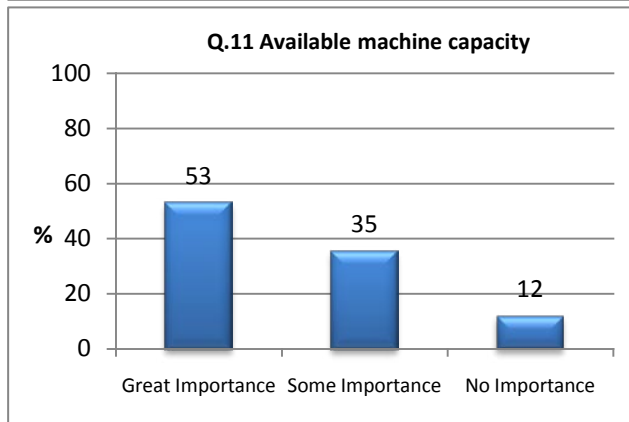
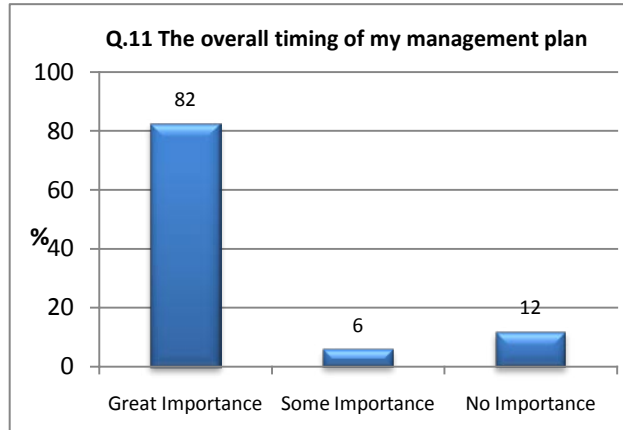
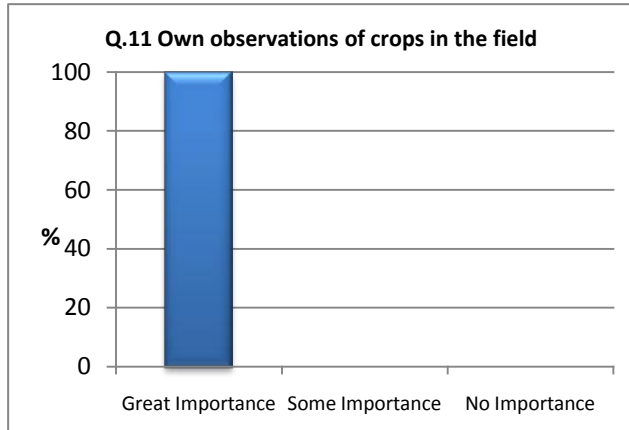
* Only one response

Q.10 – On average, approximately how much do you spend on advising per annum?

Q.10	Average	Range	
Private production	£1217pa	£2850 - £400 pa	N=12
Private environmental	£500pa*	£500pa*	N=13
Public production	NA	NA	N=12
Public environmental	NA	NA	N=12

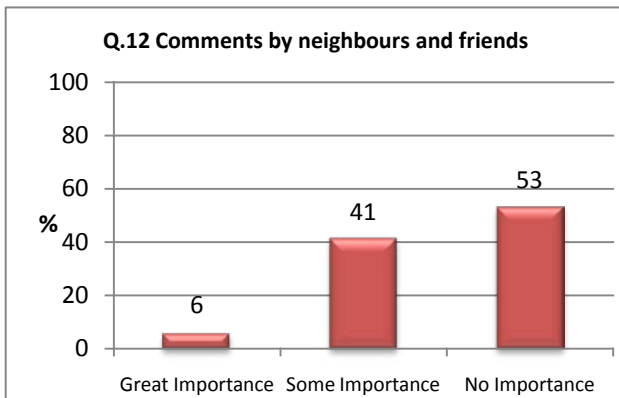
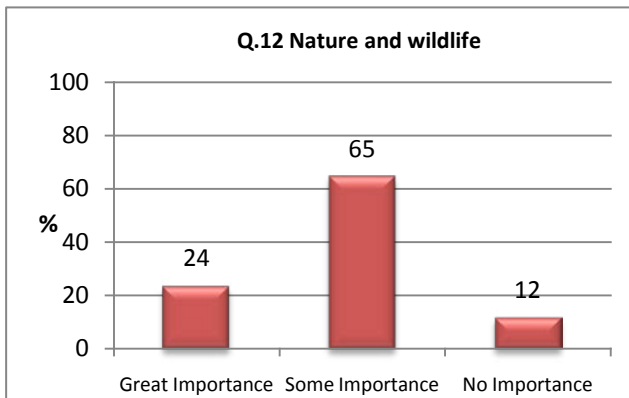
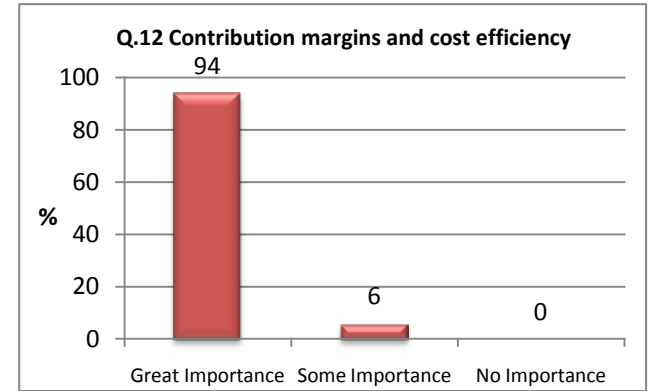
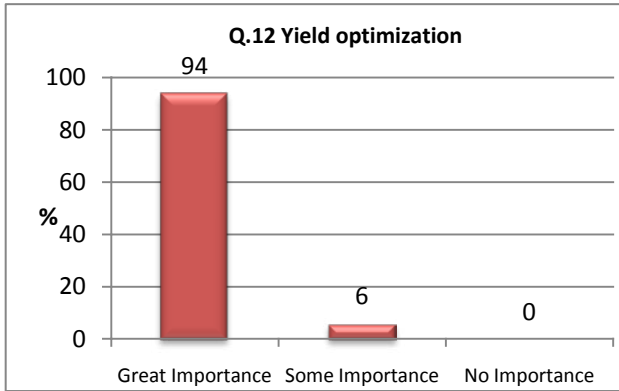
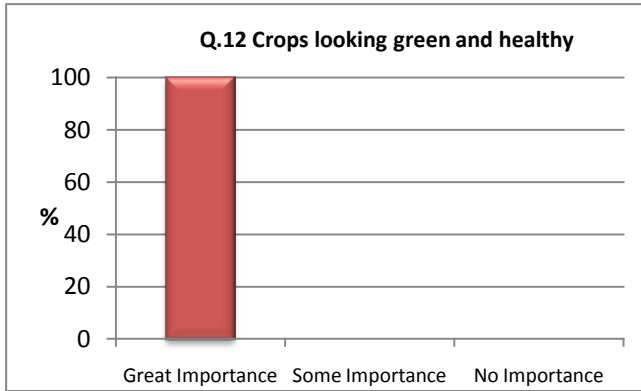
* Only one response

Q 11: How important are the following when you make choices about how to manage your land?



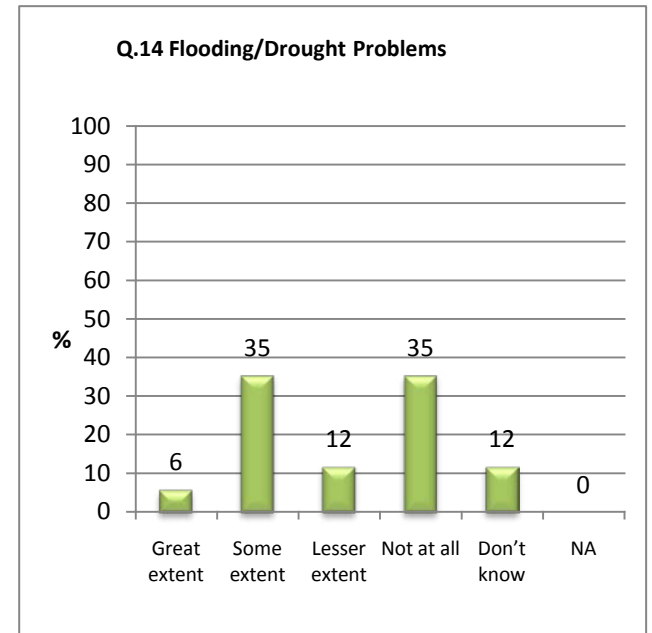
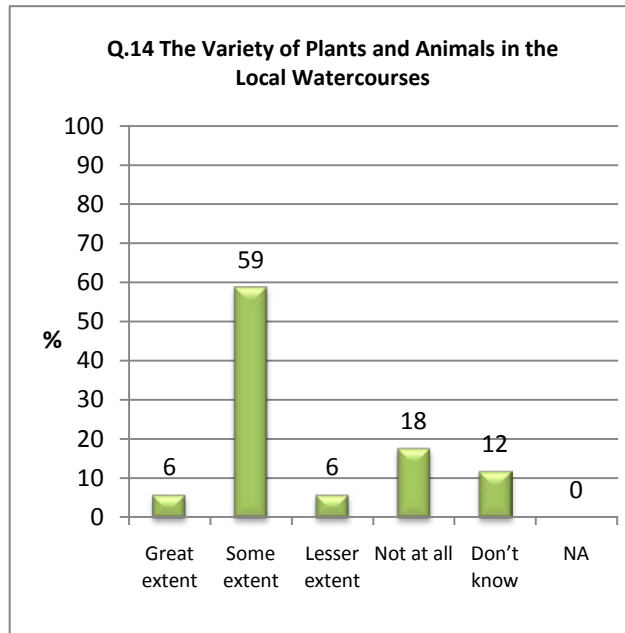
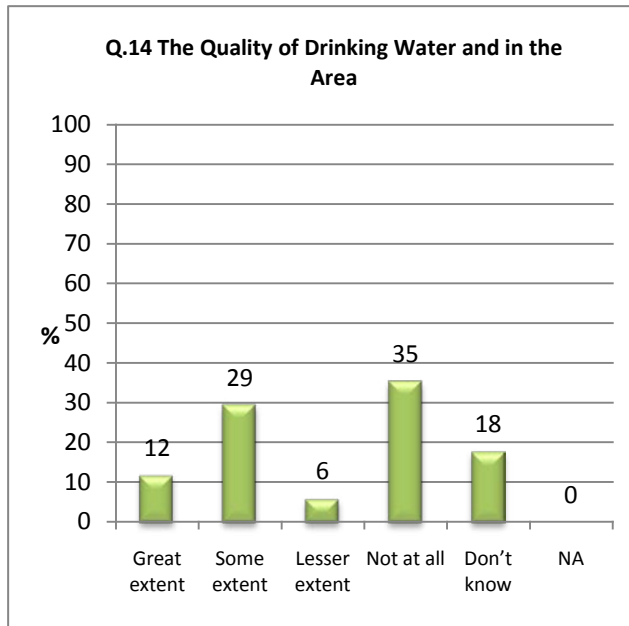
n=17

Q12: How important are the following when deciding if you have achieved land management objectives?

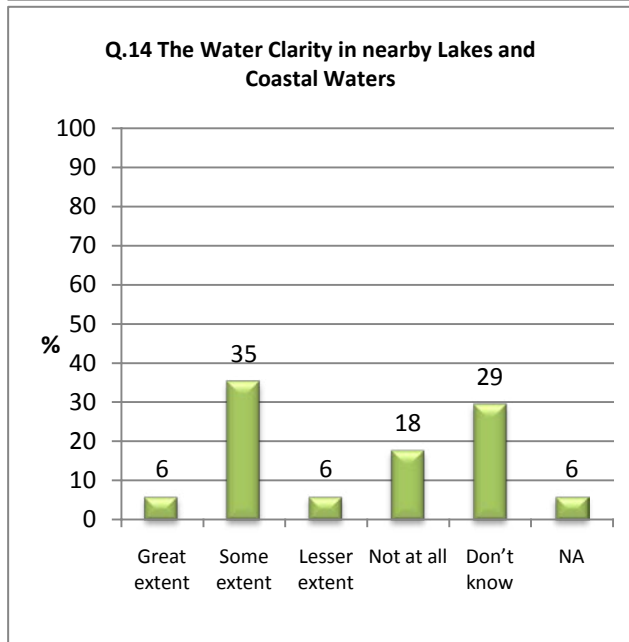


n=17
 NB. We have combined the nature categories & added the new category 'comments by neighbours and friends'

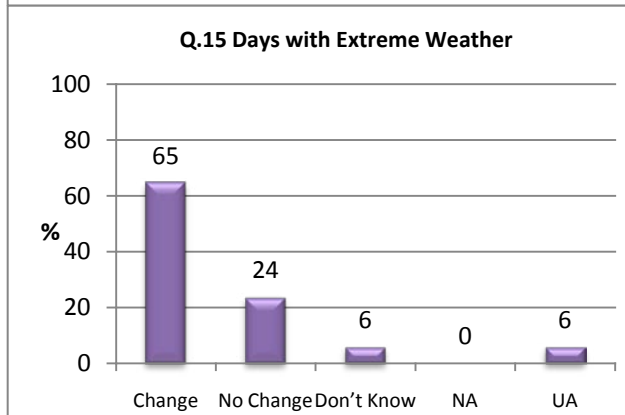
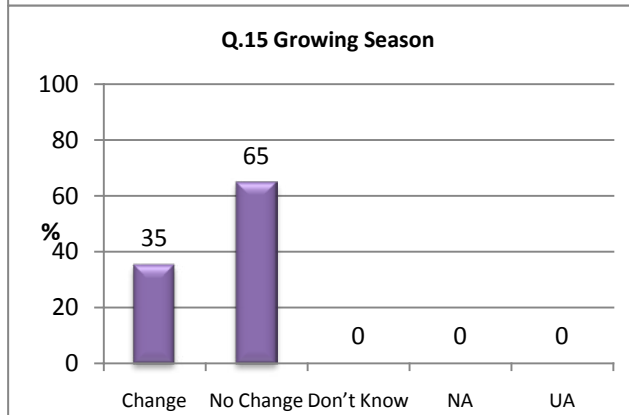
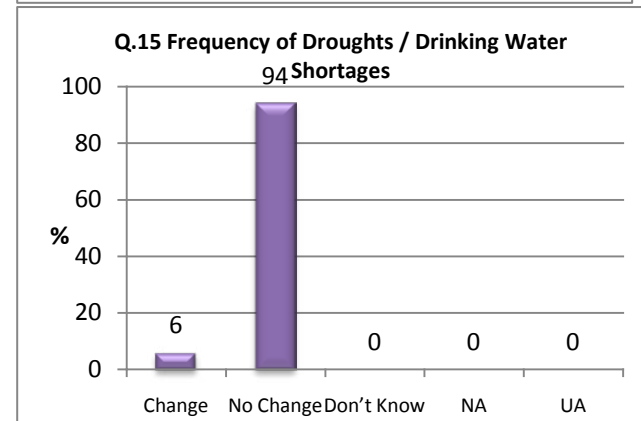
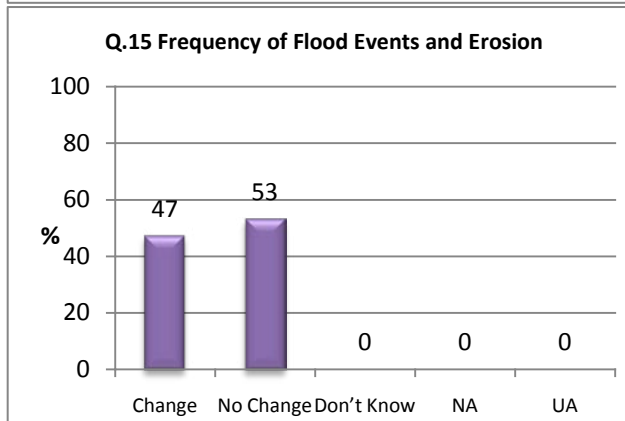
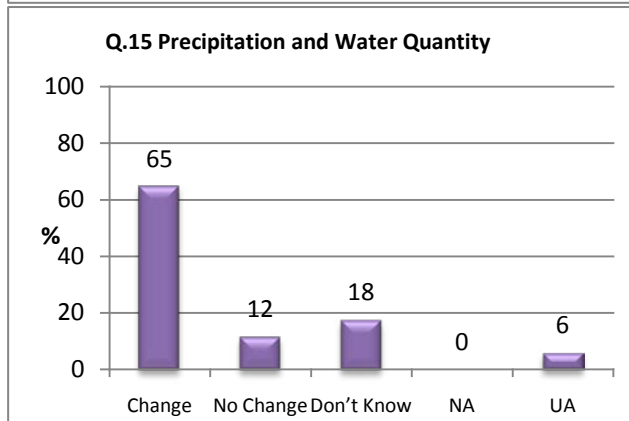
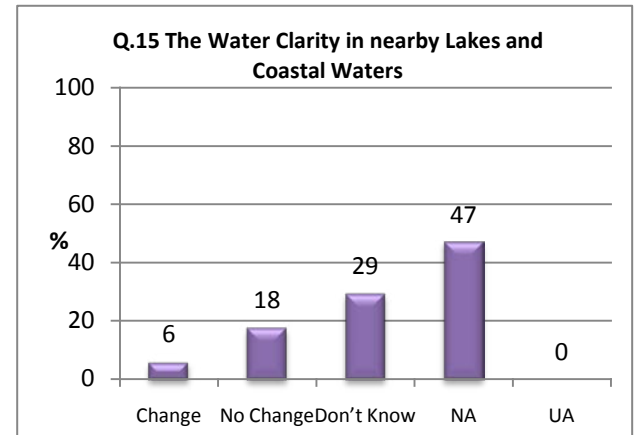
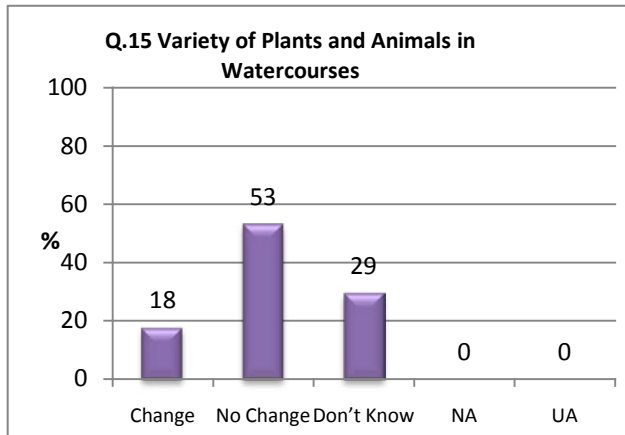
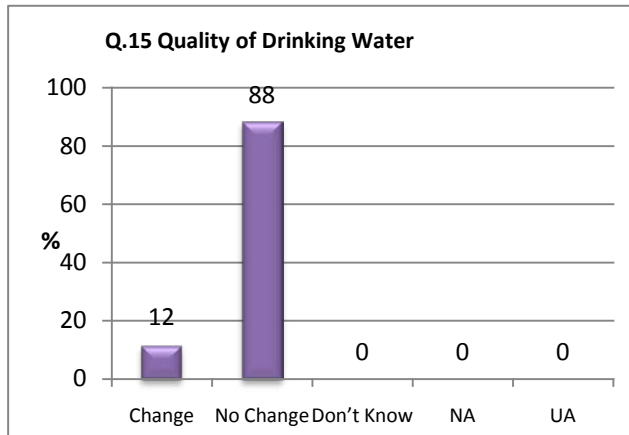
Q.14 - To what extent do you assess land management in your area is connected with:



n=17



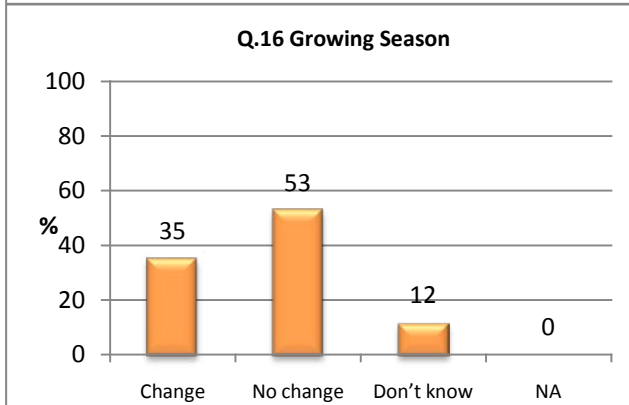
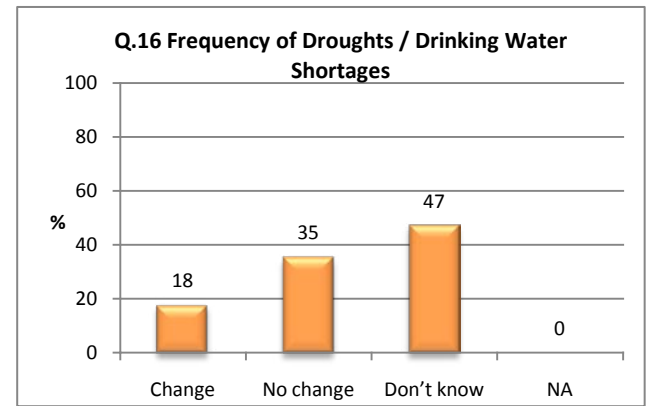
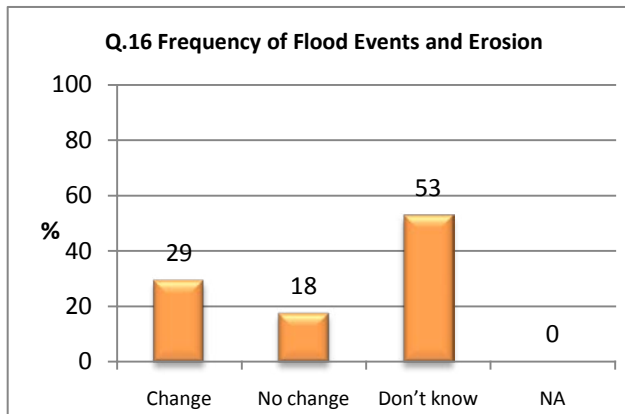
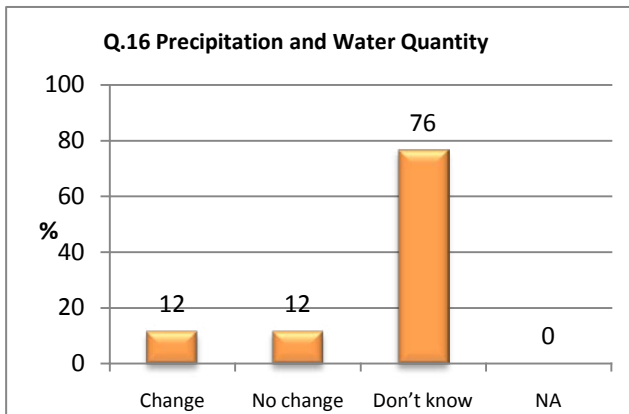
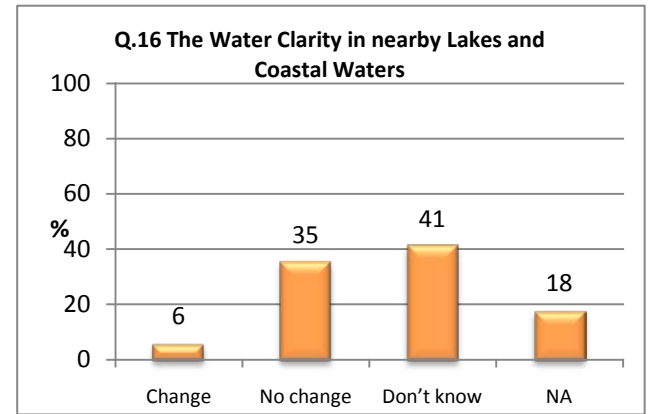
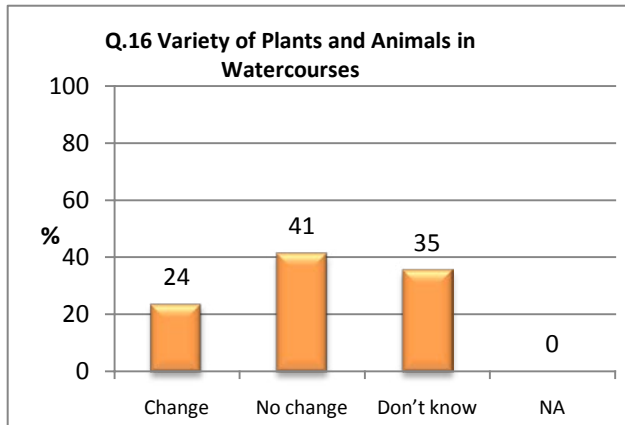
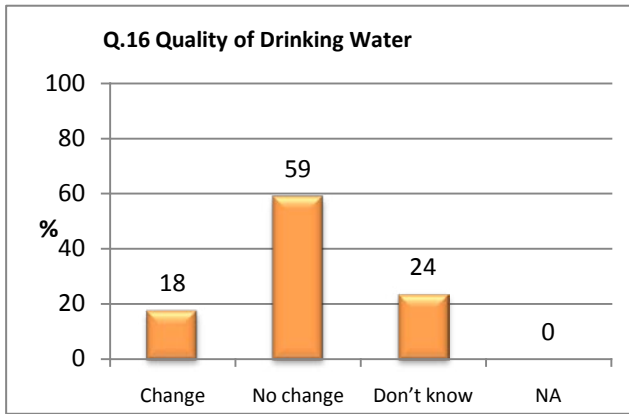
Q.15 - During the past 10 years, how much have the following changed in your area?



n=16

NB. We have combined the categories 'improve' and 'worsen' to 'change' as the categories didn't make sense to the farmers

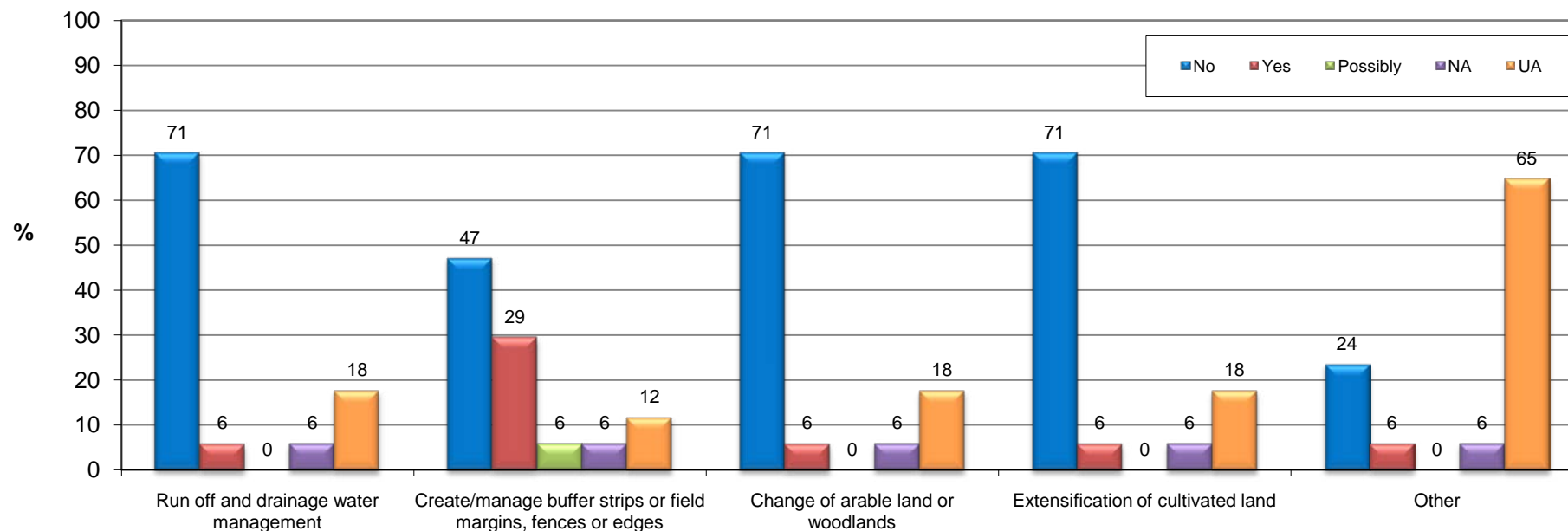
Q.16 - Over the next 10 years, how much do you predict the following will change in your area?



NB. We have combined the categories 'improve' and 'worsen' to 'change' as the categories didn't make sense to the farmers

Q.17 Within the next couple of years do you plan to apply any of the following environmental measures?

Q.17 Within the next couple of years do you plan to apply any of the following environmental measures?



Run off and drainage water management	N=14
Create/manage buffer strips or field margins, fences or edges	N=15
Change of arable land or woodlands	N=14
Extensification of cultivated land	N=14
Other (rush management & wild bird cover)	N=6

Additional Question: In your opinion, how important are farmers as water managers in the future?

Answer	Number (%)
Very	5 (29)
Quite	9 (53)
Not Very	2 (12)
Don't Know	1 (6)

4.2 Results of Advisor and Authority Perspectives Workshop

11 people then took part in the transnational baseline activity to answer questions about how advisors and authorities work with farmers. 4 people answered the Authority Questions and 8 (making 7 post it notes as one worked as a pair) answered the Advisor Questions. The individual post it notes have been summarized under each question.

4.2.1 Authorities

Q1. What is the main aim of your organization? There were four different aims: to achieve the Scottish Government 5 objectives (Smarter, Greener, Safer, Fairer, Wealthier); Statutory Nature Conservation; to deliver quality of life and environment protection to local communities via planning and to protect properties through flood prevention.

Q2. What are your remits and responsibilities with respect to land use and water management? To implement regulations (e.g. Natura 2000; environmental health); to administer grant schemes; to provide planning permission; and to work with land owners to protect properties from flooding.

Q3. What measures do you use to affect land managers' behaviour? (e.g.: statutory planning; licenses, grants, inspections etc) Applying regulations; inspections; statutory consultee for planning; provision of grants; environmental impact assessments for planning and regulatory regimes.

Q4. Do you work with other sections within your organisation? If so which one(s) (e.g. economic development; building control; inspectors; advisors)? Regulators work with advisors within organisations; within the Local Authority work with other departments e.g. roads, environment, education, economic development; planning; and most Scottish Agencies coordinate with each other within the SEARS family (Scottish Environment and Rural Services).

Q5. What are the most common academic subjects represented within your organisation? (E.g. agronomy, biology, engineering?) Biology; Botany; Zoology; Geology; Ecology; Agriculture; Planning; Geography; Countryside management; engineering.

Q6. In your organisation, what experience do you have working with farmers to resolve environmental problems? A variety from very little to extensive experience. Experience from regulating farmer practices, administering grants and pilot projects (e.g. replanting vegetation, diffuse pollution measures and access projects).

Q7. How is climate change taken into account when working with farmers? Some do not take it into account; others do but it is secondary to other pressures; some have a rule of thumb (add 20%) when advising and others see climate change as something being increasingly addressed in grant applications.

Q8. Thinking of the current state of the water environment in Tarland - What are the main opportunities for farming/forestry/estate management to improve the water environment in the Tarland catchment? Do the same opportunities apply to the whole Dee catchment area? Riparian management (buffer strips and wetlands); riparian planting; avoiding hard engineering; attenuate runoff; restoration of natural water courses. The measures would work for both the Tarland and the Dee, although the Dee provides opportunity to try a range of options.

Q9. Thinking about the uptake of various agri-environmental schemes in the Tarland catchment, how effective do you think these schemes are in achieving their aims? One felt biodiversity was increasing; pollution was decreasing; land management was improving but there has been little change in flood prevention. Another agreed there had been continual improvement and this showed that farmers and land owners are interested their environment. Two could not comment.

Q10. When, as an authority, you make decisions concerning water quality, water quantity and climate change – who are your statutory consultees? How do you work with them? [Please note if climate change is not an issue for you] The following consult one another for the delivery WFD, Natura and Floods Directive: RPID¹, SNH, SEPA, Aberdeenshire Council and DDSFB [the last one was seen as a statutory consultee by one person but put in the group below by others]

Q12. Who else do you discuss issues with, regarding decisions concerning water quality, water quantity and climate change (i.e. non-statutory bodies that provide advice – can be very informal) Advisors and land agents; land owners and occupants; other agencies (CNPA, FCS); partnerships e.g. Grampian LBAP, Dee Partnership; NGOs e.g. RSPB, WWF; other local authorities; researchers (e.g. Macaulay Institute).

Q13. I'd like you to describe your cooperation with other authorities in matters concerning the Tarland catchment. Who do you cooperate with? (E.g. council, Government, agencies) How do you cooperate? (use a specific example) Consult agencies e.g. FCS, SEPA, SNH for information for grant applications e.g. RPAC assessment of agri-environmental schemes in Tarland; Consult as part of statutory implementation of WFD and Floods but also work on demonstration projects; Consult SEPA for license conditions and flood storage options; Scottish water on existing infrastructure capacity; work with land managers and DDSFB to discuss license applications.

Q14. In what ways might politicians and political agendas have an impact on your day-to-day activities? National and European politicians change regulatory and grant regimes; create the context for actions on the ground; local and national politicians give things priority but can also make other things take priority ahead of climate change and water management.

4.2.2 Advisors

Q1. What is the main aim of the advisory organization that you belong to? A variety of answers: 3 advisors aimed to combine economic development with environmental advice to ensure a sustainable land based industry; one sought to improve economic development in the area; and 2 aimed to protect, enhance and restore the aquatic and terrestrial environment. (This question was not relevant for one attendee).

Q2. Are you a private, not for profit or state funded advisory service? 3 were privately funded; 2 were state funded and 2 were not for profit partnerships.

¹ RPID = Rural Payments and Inspection Directorate; SNH = Scottish Natural Heritage; SEPA = Scottish Environmental Protection Agency; DDSFB = Dee District Salmon Fishery Board; CNPA = Cairngorms National Park Authority, FCS = Forestry Commission Scotland; RSPB = Royal Society for Protection of Birds; WWF = World Wildlife Fund for Nature; AHB = Aberdeen Harbour Board; SRDP – Scottish Rural Development Programme.

- Q3. What kind of advice is provided by your organization? (E.g. production advice, environmental advice, business advice? For agriculture? Forestry? Estates? Households? Industry? For individual businesses or community groups?)** Most gave advice to individuals and businesses rather than groups. Two gave environmental advice for land based industries, households and businesses. Three advisors integrated production, business and environmental advice to the land based sector; and one provide business advice to all economic sectors.
- Q4. What kind of advice do you provide within the Tarland catchment?** Most of the Q3 answers were relevant; although one has not worked in Tarland (yet) and another felt there would be more focus on water quality and diffuse pollution in Tarland.
- Q5. Does your organization integrate different forms of advice? (E.g. combination of production – environmental – business advice)** Three linked environmental, production and business advice; two linked environmental and funding advice and one noted that tended to put farmers in touch with people who could give complementary advice.
- Q6. What are the most common academic subjects represented within your organisation? (E.g. agronomy, biology, engineering?)** Agronomy, Biology, Business Studies; Ecology, Engineering, Environmental Management; Food Technology; Geography; Pollution Management; Silviculture.
- Q7. In your opinion, what is the role of advice in getting farmers to act as water managers?** Awareness raising and empowering farmers to be part of a solution to societal problems; provide information on how to fund projects; provide information on how they can link water management to improved business; how their farm is part of a wider catchment or ecosystem.
- Q8. In your opinion what do farmers/foresters/estate managers in Tarland want from your advisory service? Have you had to change as a result of these expectations?** Farmers want to know acting on advice will improve their business and/or environment; what are their choices and how might their actions be funded; what is the evidence base for the need to manage differently; what are the long term implications of changing management. Farmers want things in their language and measures that are financially neutral and low in bureaucracy. This is getting more difficult to deliver!
- Q9. In your opinion, what are the most important issues for your advisory service to communicate to farmers/foresters/estate managers?** Environmental awareness & relationship between biodiversity/diffuse pollution/flooding and land management; Sustainability; Impact on their management systems – costs and benefits; profits; Need for action; what is their role; why they should help; Information about the whole ecosystem/catchment.
- Q10. In your opinion, what measures, with respect to farmers'/foresters'/estate managers' water management, would be most beneficial within the Tarland catchment?** Measures to slow down run off; reduce artificial drainage; Conversion from arable to grass; Riparian management (buffer strips, wetlands, trees); Placement of gates and tracks; Restoration of natural water courses; Septic tank care; Evidence base for flood storage and wetlands; Beneficial to whom (environment, land manager, community?).
- Q11. How is climate change taken into account in the present advisory service?** Advisors try to take account of climate change but it is not easy – if funding allows or encourages a climate change focus then advice is more likely to focus on this but both farmers and grant schemes tend to be more focused on the short

to medium term, and climate change is a long term variable. The best way to factor in climate change is to encourage flexibility in management and to protect vulnerable species or habitats.

Q12. How has WFD, the Floods Directive and/or Habitats Directive influenced your advice? WFD has influenced a focus on diffuse pollution; Habitats on management of habitats and species and the flood directive may influence management and funding availability. Statutory mechanisms influence funding priorities for land management grants and projects. There seems to be more influence on environmental than holistic or rural development advisors.

Q13. How have funding mechanisms influenced your advice? Please name the funding sources. Three advisors nominated SRDP as the main influence. One noted a range of funding sources (landfill tax, LEADER, SNH, Trusts and private sources of funding although SRDP most dominant now). Two noted that the objectives were set and then funding sought to implement them.

Q14. Thinking about the uptake of various agri-environmental schemes in the Tarland catchment, how effective do you think these schemes are in achieving their aims? Three advisors did not know or have enough information to say. One thought biodiversity had improved. One thought uptake of these schemes had helped achieve their organisation's aims. Two advisors felt the uptake was patchy; the competition and bureaucracy was off-putting and these would limit the ability to achieve the scheme objectives.

Q15. Which authorities (organisations with statutory powers) complement the advice that your organisation provides? SEPA, RPID, Local Authorities (e.g. Aberdeenshire Council); SNH; CNPA; FCS; AHB; DDSFB.

4.2.3 Further comments made during the group discussion:

- Advisors need to listen to farmers and focus on what farmers need to know – although sometimes they need reminding that long term care for their environment is needed as much as immediate profit
- Advisors know why measures work and have an evidence base – the evidence can come from other areas.
- Farmers define themselves as producers of food and feel it is crime to lose good land if it means they can't feed the nation
- Measures tend to be driven by grant funding options and other, more innovative measures, might be given lower priority
- Most measures are implemented on more marginal land; so options at top of catchment
- Easy to give advice on climate change but is it acted on? - some farmers do not see climate change as an issue
- Need to look at the implications of measures .e.g. wet grasslands may increase liver fluke infestations
- Further measures - separating clean and dirty water.
- Important to get a baseline and measure change to illustrate why farmers should put in new measures.

5 Current legal framework

5.1 Policies that apply in Tarland

Name of Act	Objective	Lead Agency	Scale	Implementation
Water Environment and Water Services (Scotland) Act 2003	To get all water bodies to Good Ecological Status by 2015 (or lower objective or later time – 2021, 2027 if ness)	Scottish Environment Protection Agency (SEPA)	Scottish Act for Water Framework Directive Covers all water in Scotland	Scotland River Basin Plan supported by North-East Area Management Plan (due Dec 2009) – includes Controlled Activity Regulations covering river engineering & diffuse pollution
The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2007	To maintain biodiversity through an European ecological network known as 'Natura 2000' that comprises special areas of conservation (SACs), and special protection areas (SPAs).	No competent Authority – delivered by Scottish Natural Heritage (SNH) & SEPA alongside JNCC (Joint Nature Conservation Council)	Scottish Act for Habitat's Directive Applies to all SACs and SPAs	SNH have responsibility for developing management plans for SACs and monitoring condition of the sites. River Dee and Tarland SAC for otter, freshwater pearl mussel & Atlantic Salmon.
Flood Risk Management (Scotland) Act 2009	To provide a more sustainable approach to flood risk management, suited to the impact of climate change and a more joined up and coordinated process to manage flood risk at a national and local level.	SEPA with local Authorities and Scottish Water	Scottish Act for the Floods Directive Applies to all of Scotland	Scottish Advisory and Implementation Forum on Flooding (SAIFF) has been set up. Includes a Natural Flood Management working group.
Climate Change (Scotland) Act 2009	Provides targets to reduce greenhouse gas emissions by at least 80 per cent by 2050, and will drive new thinking, new solutions, and new technologies putting Scotland at the forefront of building a sustainable low carbon economy.	Duty on all public bodies – no designated lead authority	Scottish Act for whole of Scotland	The Climate Change Delivery Plan sets out the high level measures required in each sector to meet Scotland's statutory climate change targets, to 2020 and in the long term.

Name of Act	Objective	Lead Agency	Scale	Implementation
Scottish Government's Forestry Strategy	Improved health and Forestry's role in achieving the wellbeing of people and their communities; Competitive and innovative businesses contributing to the growth of the Scottish economy and a high quality, robust and adaptable environment	Forestry Commission Scotland	Scotland for all forested areas (and potentially forested areas)	2008-2011 Implementation Plan for Scotland Grampian Forest Initiative for the area that includes Tarland. Forest & Water Guidelines - Statutory instrument – foresters must comply to get grants and licences to fell or plant.
The Surface Waters (Fishlife) (Classification) (Scotland) Amendment Regulations 2007	Statutory protection for economically significant freshwater fish species	SEPA Dee District Salmon Fishery Board is the statutory body tasked with protecting and enhancing stocks of salmon and sea trout across the district.	Scottish version of European Freshwater Fisheries Directive. Whole Dee catchment are designated as 'salmonid'	Freshwater Fisheries Directive Improvement Plans Don, Dee and Bervie Plan covers Aboyne and Tarland. 5 ongoing projects with DDSFB
National Scenic Area	Designation to protect those areas of land considered of national significance on the basis of their outstanding scenic interest which must be conserved as part of the country's natural heritage.	SNH	Scottish	No formal statutory designation but considered when making planning consultation submissions. Tarland part of Deeside and Lochnagar NSA
Common Agricultural Policy Reform	The aim is to promote a market-focussed, sustainable agricultural system throughout Europe.	Scottish Government via SG Rural Payment and Inspectorate Division	Scottish options were to fully decouple all the existing direct payments from production; to calculate the SFP on an 'historic payments' basis and to make use of a 'beef national envelope' (Scottish Beef Calf Scheme)	Implemented via cross-compliance to maintain Single Farm Payment; and application to Scottish Rural Development Programme (see below) Farmers and crofters must maintain their land in Good Agricultural and Environmental Condition (GAEC) and respect regulations relating to public, animal and plant health, environmental protection and animal welfare. Less Favoured Area Scheme payments also apply in Scotland but not to pilot area.

Name of Act	Objective	Lead Agency	Scale	Implementation
Nature Conservation (Scotland) Act	Requires public bodies to conserve biodiversity, protects Sites of Special Scientific Interest (SSSI)	All public bodies	Scottish only	no SSSI in the pilot but general requirement for public bodies to protect biodiversity
Planning etc (Scotland) Act; National Planning Framework 2	Proposed National Planning Framework builds on 1st NPF, and identifies key issues and drivers, sets out a vision to 2030, and identifies priorities.	Local Authorities	Scottish Act that influences the development of the Stucture Plan for Aberdeen City region; and the local (building) development plans	Tarland in the East Coast area; The primary aim for Aberdeen and Aberdeenshire is to grow and diversify the economy, making sure the region has enough people, homes, jobs and facilities. In addition to energy; develop tourism, the rural economy and food and drink sector

5.2 Policies that do not apply in Tarland

Nitrates Directive			Not in Tarland
The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2007	Identifies surface water and groundwater used for the abstraction of drinking water (either provide more than 10 cubic metres of drinking water per day, or serve more than 50 persons).		Not in Tarland (applies to some parts of the Lower Dee)
National Park (Scotland) Act			Border to West of catchment

5.3 Financial support schemes directly relevant to farmers as Water mangers

Name	Aim	Funder	Eligibility	Details
Single Farm Payment	See CAP reform	Scottish Government	All Farmers and crofters are eligible for the Single Farm Payment Scheme if they received payments in any of the calendar years 2000, 2001 and/or 2002.	Eligible hectares must be used for arable land or permanent pasture (including common and shared grazings); and The land must have been at the claimant's disposal for at least 10 months.
Scottish Rural Development Programme: Land Management Contracts	The aims of the SRDP are to increase competitiveness in agriculture and forestry, improve the environment and the countryside and enhance the quality of life in rural areas	Scottish Government	LMO are non competitive and open to all land managers with land in Scotland. You must be registered with the Integrated Administration and Control System (IACS) and have a Business Reference Number (BRN).	Relevant LMCs Option 3 - Nutrient Management Plan Option 10 - Improvement of Rush Pasture for Wildlife Option 18 - Small-scale woodland creation Option 20 - Improving access
Scottish Rural	The aims of the SRDP are	Scottish Government	RDCs are competitive and open to all land	Set out by regional priorities – Grampian Area is relevant for Tarland.

Name	Aim	Funder	Eligibility	Details
Development Programme: Rural Development Contracts	to increase competitiveness in agriculture and forestry, improve the environment and the countryside and enhance the quality of life in rural areas		managers with land in Scotland. You must be registered with the Integrated Administration and Control System (IACS) and have a Business Reference Number (BRN).	Main themes for this project GRA19: Sustainable flood management and reduced flood risk (including adaptation to climate change), through appropriate land management, Other themes are: Biodiversity Priorities GRA08; 09; 12 Water and Soils Priorities GRA 16, 18, 20 Adaptations to Mitigate Climate Change Priorities GRA 21 Public Access Priorities GRA 25 Diversification of Rural Enterprise Priorities GRA30
Scottish Rural Development Programme LEADER	LEADER is part of the Scottish Rural Development Programme (SRDP), aimed at promoting economic and community development within rural areas.	Scottish Government	Must be a group – either properly constituted organisations and social enterprises; private individuals where sponsored by public bodies, clubs and societies; business partnerships and capital companies; public agencies; collaborations between groups and individuals listed above in an appropriately legally constituted form	Access is through Rural Aberdeenshire LAG that has 2 priorities: Revitalising Communities & Progressive Rural Economy
Water environment restoration fund	To restore the condition of Scotland's water environment and to support partnership projects with third parties	SEPA	Unclear	Focus on: restoring natural processes in rivers or lochs; engineering degraded rivers to restore natural profiles by recreating meanders; removal or modification of man-made barriers to improve fish passage and sediment transport; restoration of flood plains, coastal intertidal zones and wetlands; scoping studies to assess costed options for restoration works.
SNH Grants	Water for Life covers natural flood management and restoring wetlands Supporting Biodiversity covers priority habitats (wet grasslands) Rural land use – today for tomorrow covers demonstration sites	SNH	Community groups or voluntary organisations; businesses where public benefits clearly shown Rural Land Use targeted at individual land managers Pay 50% eligible costs; unclear maximum funding available	

Name	Aim	Funder	Eligibility	Details
Local Authority Support for Aberdeenshire Business (SAB) Grants	The scheme aims to strengthen the economy of Aberdeenshire by assisting in the development of new businesses and encouraging the expansion of existing ones.	A'shire Council	Businesses applying for assistance will be asked to complete an application form demonstrating compliance with the following criteria <ul style="list-style-type: none"> • The proposal will have to bring additional economic benefit to Aberdeenshire • The proposal must demonstrate viability • The proposal must have the potential to increase employment in the Aberdeenshire area • The proposal must prove there is a need for top-up finance over and above what is available on the open market or within the business • The proposal must not have a detrimental effect on existing Aberdeenshire businesses 	SAB offers practical business advice and financial assistance, in the form of loans and grants, to businesses throughout the region http://www.aberdeenshire.gov.uk/support/finance/sab.asp

5.4 Legally binding area plans (national, regional, local)

Structure Plan – the area is not within the Growth Corridors but in the Local Growth and Diversification Area which covers most of Aberdeenshire and has no specific allocation for housing or industrial development land. What will be allowed will be sufficient to meet local needs which will be expanded in the Local Development Plan.

The Tarland catchment is, however, part of the River Dee Special Area of Conservation and the River Dee is a main source of drinking water. This resource is under pressure from development in the Growth Corridors and so protecting and managing this will be important.

Local Development Plan – New Plan to support current Structure Plan is still under development. Current Plan classes the village of Tarland as a rural service centre and it has limited development allocation. Aboyne at the bottom of the Tarland Burn catchment is classed as a main settlement and although there is provision for development there are also a number of protected sites within the settlement where flooding is considered an issue.

General Policy 8 Flooding restricts development of the floodplain and there are a number of Environmental Policies that influence land use and activity in and around watercourses including Env. Policy 4 – Biodiversity, Env. Policy 11 – Agricultural Land, Env. Policy 15 - Aquatic Environmental; Works and Env. Policy 16 – Water Catchments.

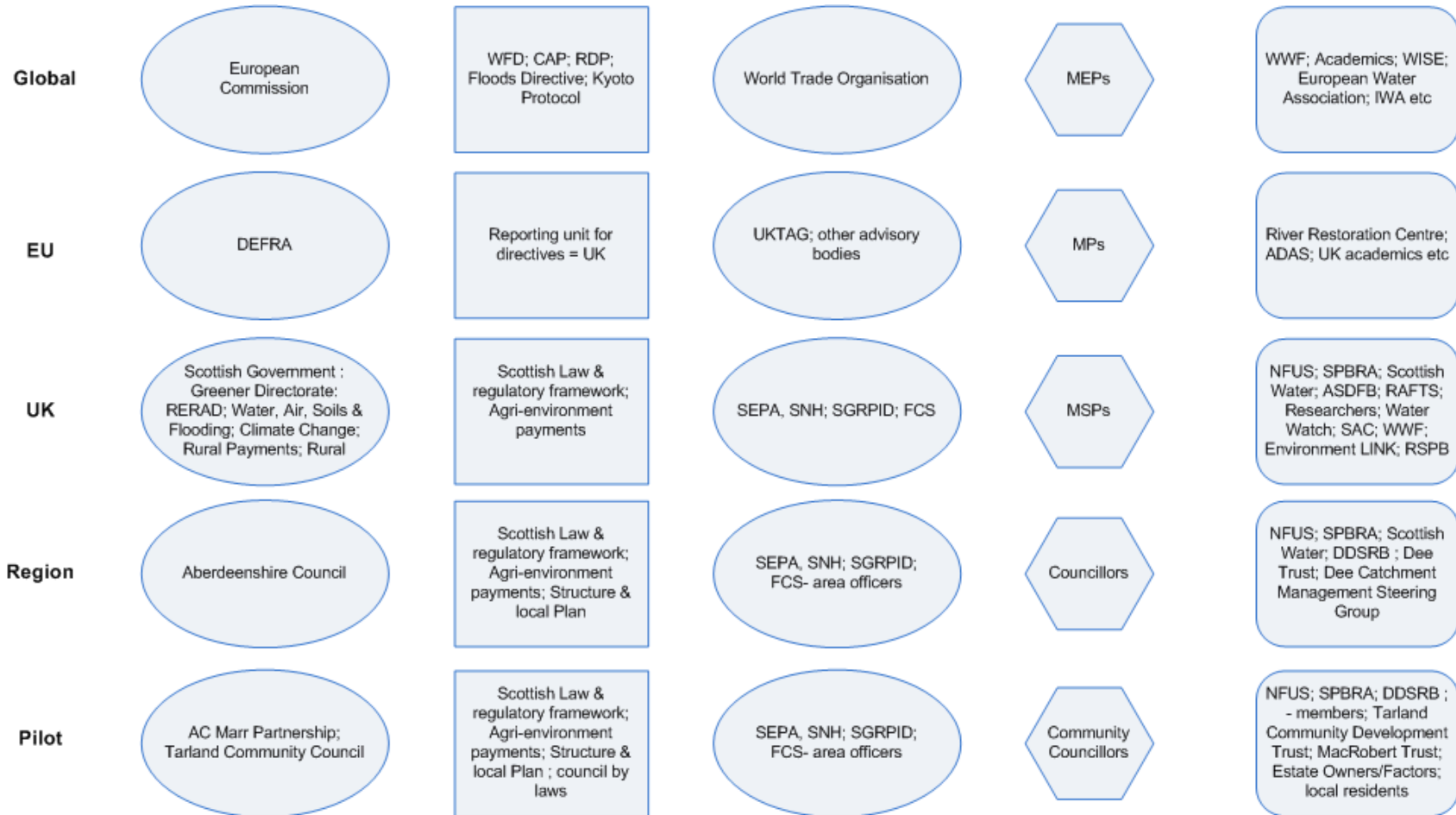
The Scotland River Basin Management Plan - North East Scotland Area Management Plan This plan is currently under development and main issues for North East Scotland are as follows:-

- Nutrient enrichment
- Impacts on areas for natural heritage
- Barriers to fish passage
- Water abstraction

All of which will have implications to farming practice in the Tarland catchment.

5.5 Governance Map

The influences on land and water decision making in Tarland



WFD – Water framework Directive; **CAP** – Common Agricultural Policy; **RDP** – Rural Development Programme; **WWF** – World Wildlife Fund for Nature; **WISE** – Water information system & exchange; **IWA** – International Water Association; **DEFRA** – Department for Environment, Food & Rural Affairs; **UKTAG** – UK technical advisory group; **SEPA** – Scottish Environment Protection Agency; **SNH** – Scottish Natural Heritage; **SGRPID** – Scottish Government Rural Payments and Inspectorate Division; **FCS** – Forestry Commission Scotland; **NFUS** – National Farmers Union Scotland; **SRPBA** – Scottish Rural Property and Business Association; **ASDFB** – Association of salmon district fishery boards; **SAC** – Scottish Agricultural College; **RSPB** – Royal Society for Protection of Birds; **DDSF** – Dee District Salmon Fishery Boards

6 Scenarios for future climate

Also see a wider range of agro-meteorological indicators in Annex II - www.macauley.ac.uk/aquarius

6.1 Climate changes from past to today

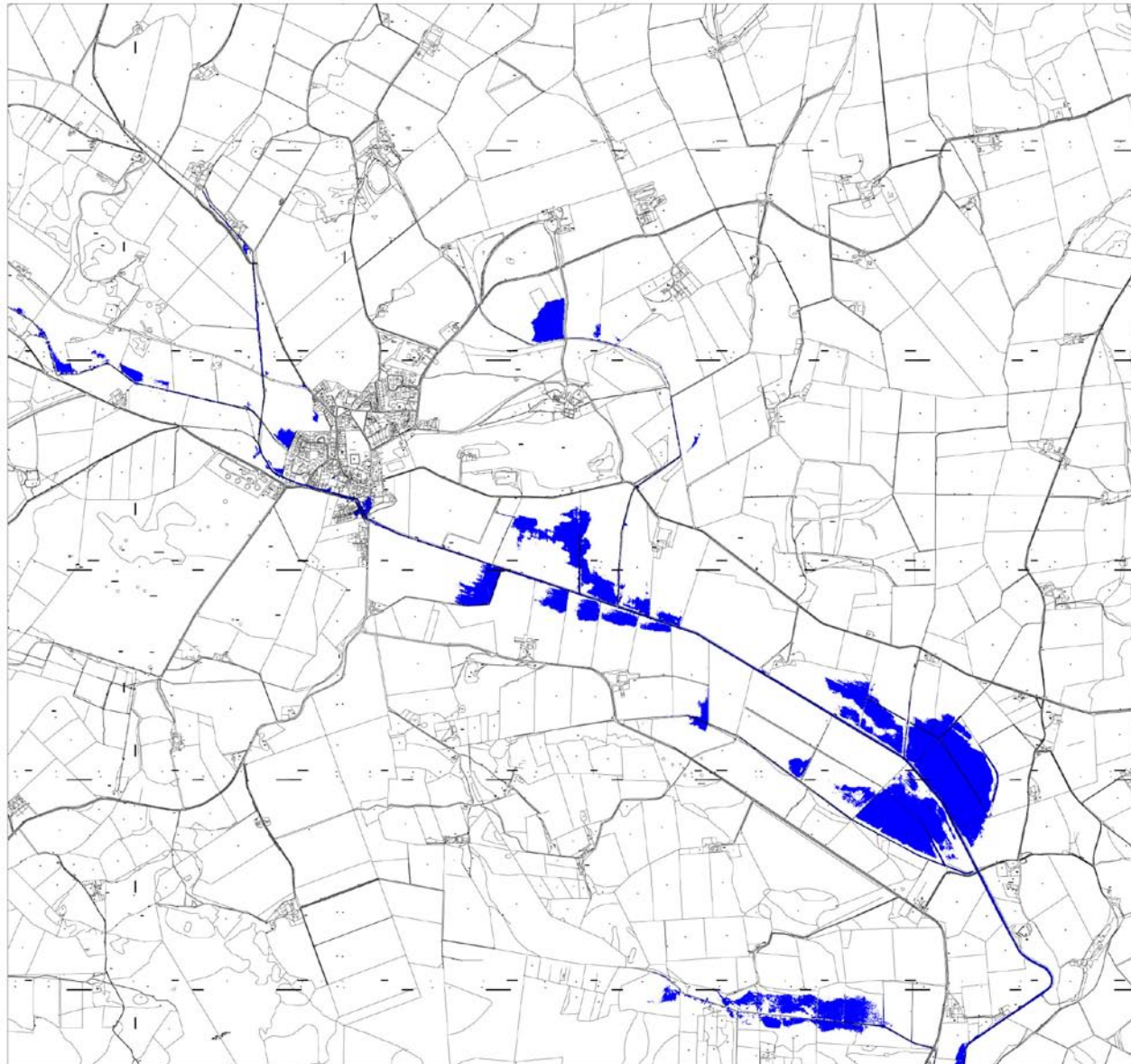
Temperature (regional average 1961-2004)		
Spring	rising	1.23 °C
Summer	rising	1.12 °C
Autumn	rising	0.68 °C
Winter	rising	1.39 °C

Precipitation (regional total 1961-2004)		
Spring	not significant	9.4%
Summer	not significant	0.2%
Autumn	not significant	22.2%
Winter	rising	36.5%

6.2 Current flooding regime

drought in summer - *not important*, drought in winter - *not important*

flooding in summer – *important*, flooding in winter – *important*



Legend:



1 in 200 Flood Outline

SCALE: Not to Scale

Project Title:

Tarland Burn Catchment Study

Figure Title:

1 in 200 year Flood Outline:
Tarland Burn & Small Burn

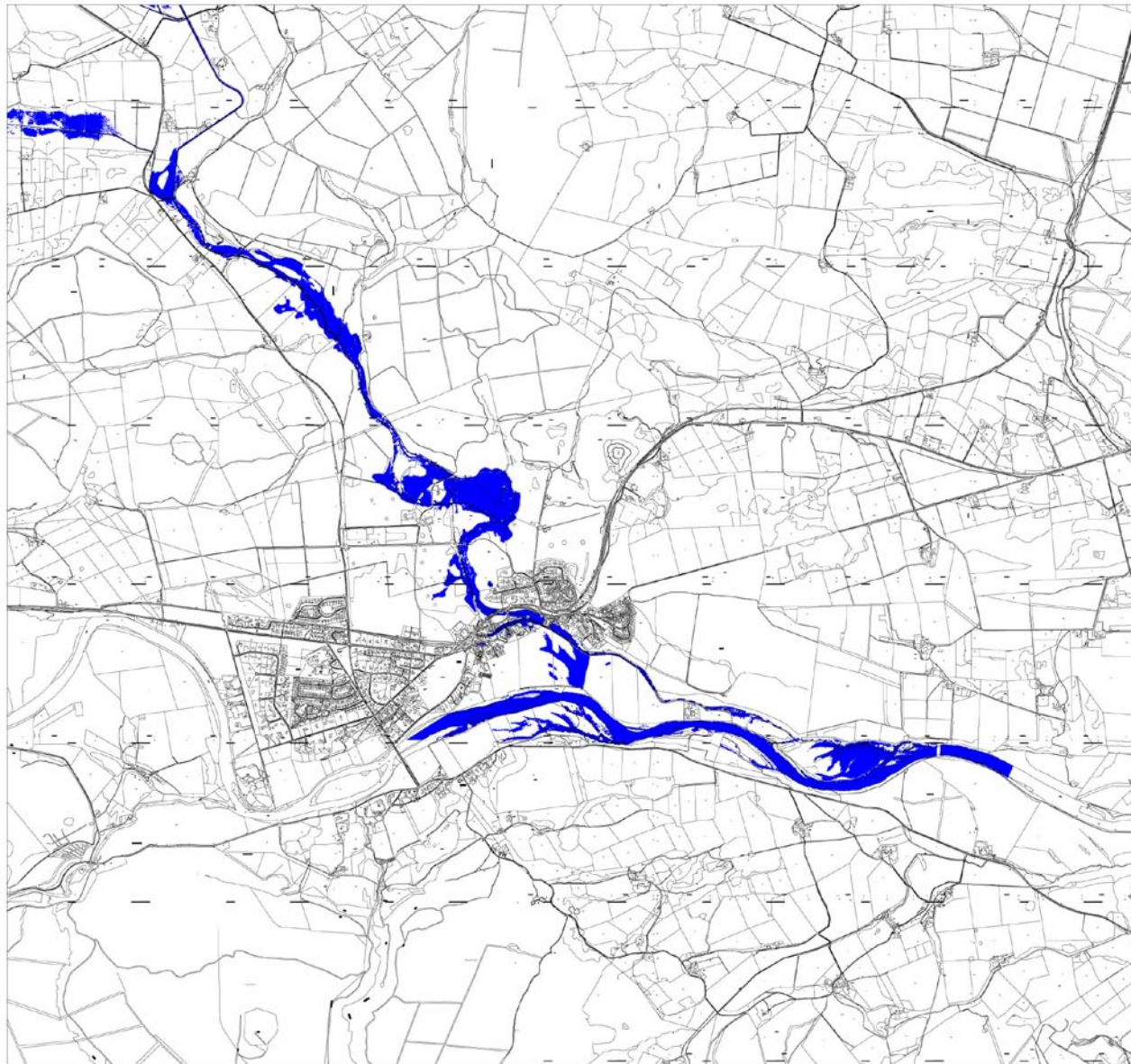
Document Reference:

5075338/62/DG/21

Figure Number:

21

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Glasgow
G1 4RU



Legend:



1 in 200 Flood Outline

SCALE: Not to Scale

Project Title:

Tarland Burn Catchment Study

Figure Title:

**1 in 200 year Flood Outline:
Aboyne and River Dee**

Document Reference:

5075338/62/DG/23

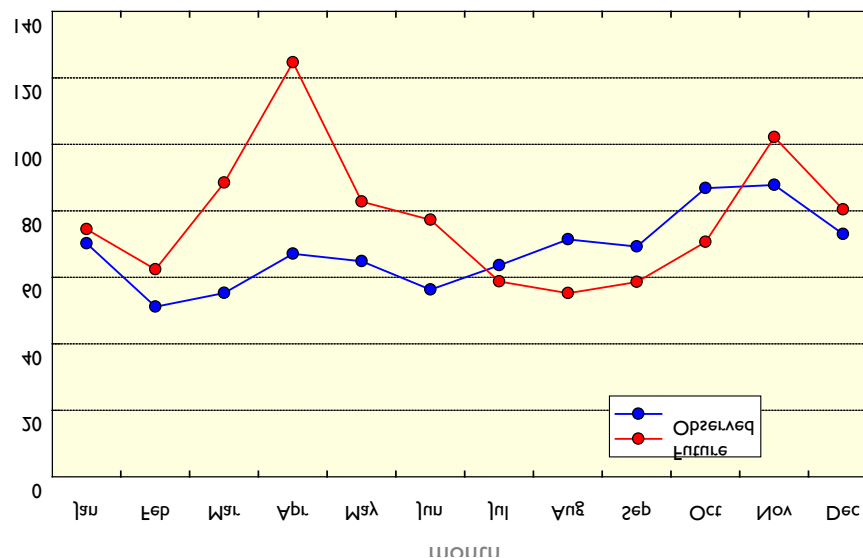
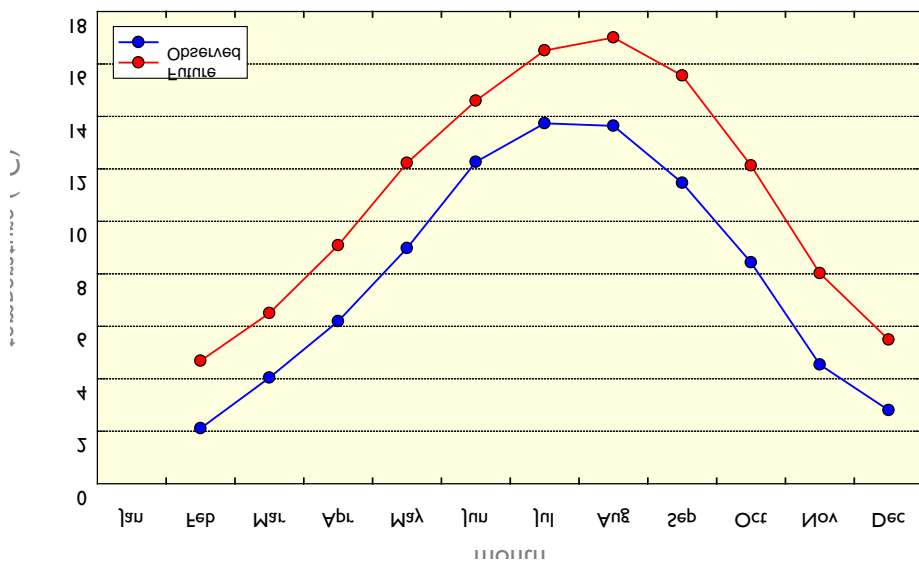
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6.3 Current and future (2100) conditions

Future climate data from Hadley Centre Regional Climate Model 3 (HadRM3) using the A2 (medium-high) emissions scenario. The HadRM3 cells are 50km square – the data from these have been downscaled to better represent local conditions. See <http://www.macaulay.ac.uk/LADSS/agromet>



6.4 Scenarios for land and water change (2100)

Issue	Nature of the change	Magnitude of change
drought in summer	days without:	Driest year Wettest year
	plant easily available water	+13 days +0 days
	plant available water	+14 days +0 days
drought in winter	n/a	n/a
flooding in summer	more often, more severe	not quantified
flooding in winter	more often, more severe	not quantified
high temperature in summer	more often	not quantified

6.5 Scenarios for climatic differences

Climate Change Summary 2070-2100		
Temperature		
Spring	warmer	2.8 °C
Summer	warmer	2.7 °C
Autumn	much warmer	3.5 °C
Winter	warmer	2.3 °C
Precipitation		
Spring	much more	+86mm (54%)
Summer	less	-25mm (4%)
Autumn	not significant	-10mm (5%)
Winter	not significant	-14m (7%)
Evapotranspiration (grass)		
Spring	not significant	+13mm
Summer	not significant	+4mm
Autumn	not significant	+6mm
Winter	not significant	+5mm

6.6 Consequences for land management

Tsum200		
Yearly	earlier	27 days
Last Air Frost		
Spring	earlier	45 days
Growing Season		
Start	earlier	45 days
End	later	22 days
Length	longer	63 days
Access		
Spring	not significant	+2 days
Autumn	more	+8 days
Access in Growing Season		
Yearly	longer	18 days

6.7 Consequences for water management

Climate change has both a direct and indirect potential impact within the catchment. As if predicted we move to an arena of more extreme events these will impact through drought and flood. Extended drought periods will have a potentially direct impact on many of the remote dwellings and farmhouses that have private water supplies. There is a greater risk that these shallow well supplies will dry up for extended periods during the summer. Droughts will also increase the need for farmers to irrigate heavy water demand crops such as potatoes. With less water in the streams the concentration of pollutants will rise due to less dilution. Septic tank discharges are a good example of this. All of these will have an knock on, indirect impact on habitat availability and therefore biodiversity. One contribution to the adaptation is to increase wetlands to maintain higher river base flow.

Conversely during periods of high flow in addition to the immediate problem of inundation of private property there is an increased risk of damage to infrastructure (roads, waste water treatment plant). Where flooding is associated with intense periods of rainfall this may lead to damage to agricultural land with the loss of soil to streams. This soil is an effective transport mechanism for the nutrient phosphorus which can contribute to eutrophication issues. The soil itself is a pollutant and can smother fish redds and adversely impact on other aquatic ecology. In the past one solution to the issue was to dredge and increase channel capacity to evacuate water faster. However under increasingly unpredictable and possibly larger flows and the negative impact on river functioning this is not a sustainable solution. We would propose that it is more appropriate to attain multiple benefits from increasing buffer strips, wetlands and increasing awareness amongst land managers and the wider community.

7 Conclusions: Main drivers and barriers for farmers as Water Manager

The baseline process has greatly improved our knowledge about land use and farming in the catchment, providing more rigorous evidence to back up our experiential knowledge. We have been able to link technical data on flood prevention with existing land use patterns and also the attitudes and preferences of land managers. The process has reinforced the need to continue a dialogue with land managers and land owners in the catchment, however it has proved challenging to find the 'right' time to engage when the team itself is still learning about possible options and alternatives. We have identified that the next stage will have to have three themes:

- communicating with land owners and managers about what, where and how measures could be implemented
- identifying the technical aspects of potential temporary flood storage (where, what size, what profile, how to move water in and out, how to get multiple objectives)
- the institutional changes required to provide suitable incentives for land owners and managers.

We are planning farmers meeting in January to start this process.