

**BiGGAR Economics**

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# **Economic Impact of IBERS**

A report to  
**Aberystwyth University**

APRIL 2014



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**Aberystwyth University**



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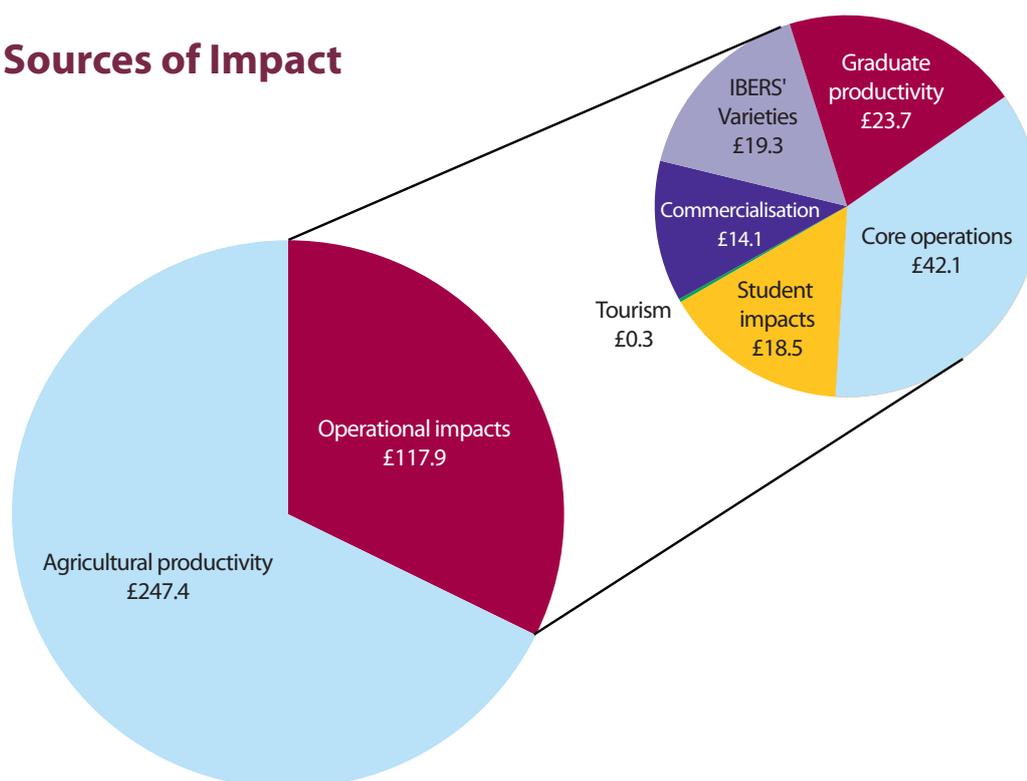


# 1 EXECUTIVE SUMMARY

## Economic Impact of IBERS

1,551 students	£31.3 million income	358 staff
In 2012/13 IBERS generated a total economic benefit of £365 million GVA for the UK economy and supported almost 2,450 jobs.		
<b>Each £1 of public funding invested in IBERS generated £12.18 of benefit for the UK economy.</b>		

## Sources of Impact



## IBERS also...

- Makes a substantial local economic contribution
- Supports the competitiveness of the UK agri-food sector
- Improves food security both within the UK and overseas
- Generates benefits for human health in the UK and internationally
- Enables international development
- Helps to reduce the carbon emissions of agriculture in the UK
- Develops ways of adapting to and mitigating against climate change
- Contributes to better public policy

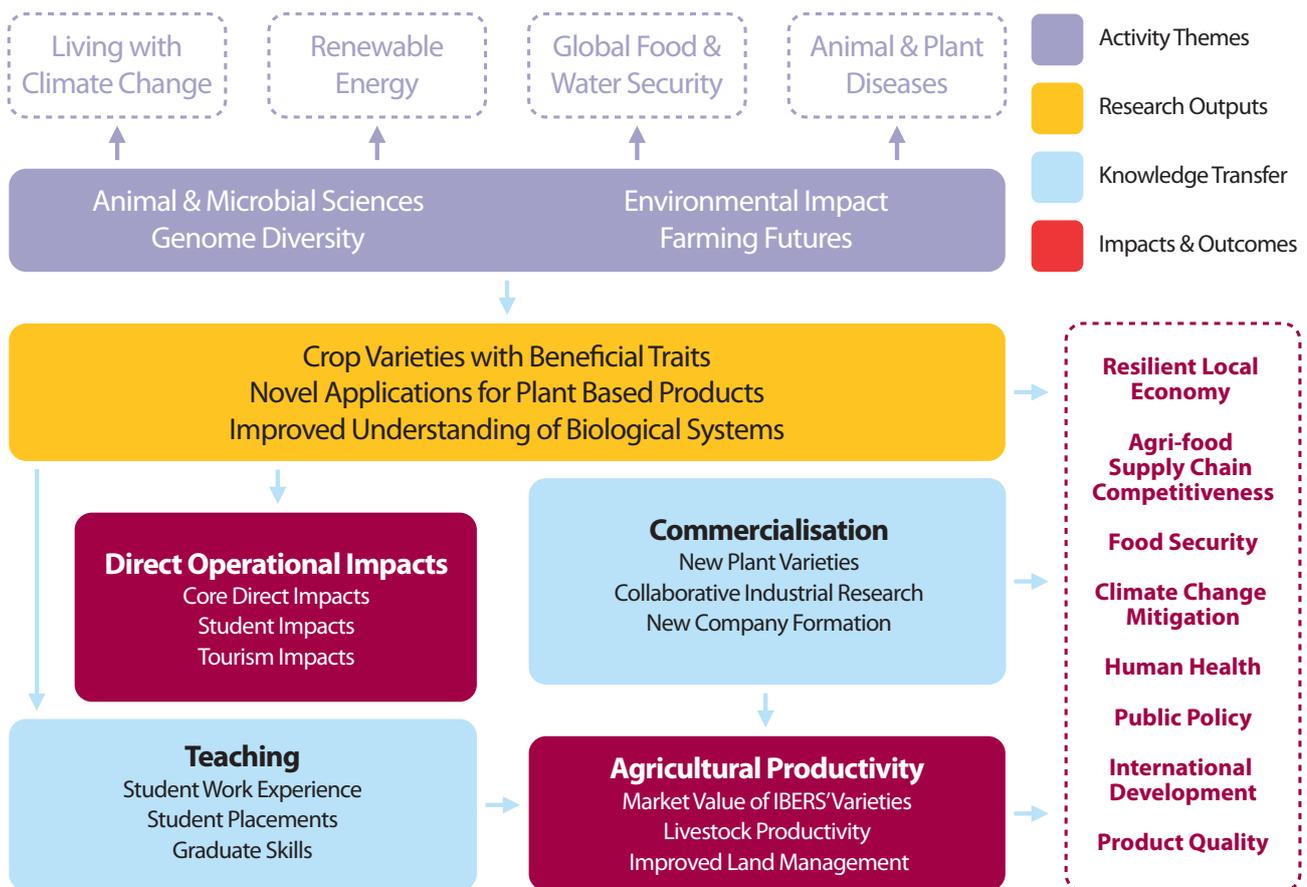
## How IBERS Generates Impact

Scientists at IBERS undertake fundamental and applied biological research designed to tackle some of the most important challenges facing humanity.

This activity has an immediate impact on the UK economy through the day-to-day operational activity of IBERS and its staff and students.

This activity generates a variety of research outputs, the commercialisation of which generates wealth and supports employment throughout the UK. Research outputs are also used to inform teaching activity at IBERS, which contributes to the productivity of IBERS' graduates and the companies that employ them.

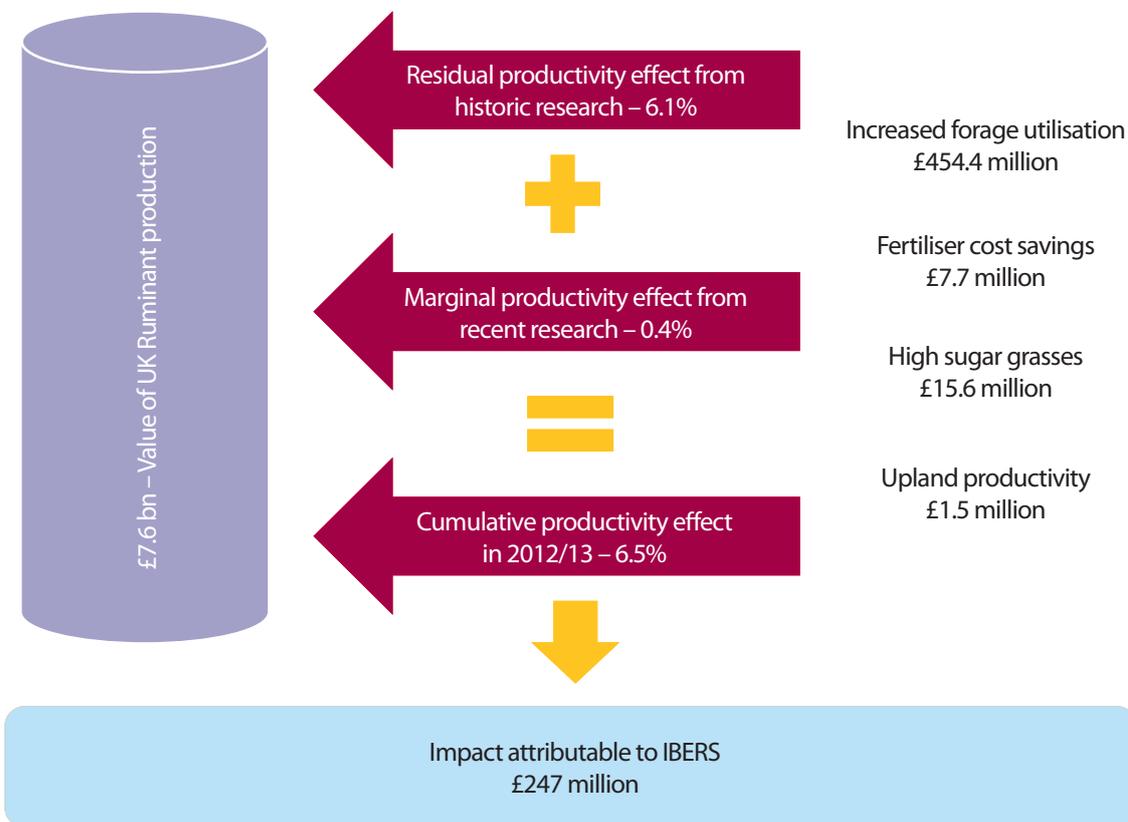
Taken together this activity helps to generate long-term improvements in the productivity of UK agriculture and a variety of wider, unquantifiable benefits both within the UK and overseas.



## Agricultural Productivity

32.6 million cows and sheep	62,000 hectares of grassland	14% of total nutritional input
<p><b>IBERS' varieties provide 14% of the total nutritional input required by the 32.6 million cows and sheep reared in the UK each year.</b></p>		
<p>Global population growth and increasing disposable incomes in the developing world are and will continue to generate unprecedented pressure on global demand for food. Agricultural land is a finite resource so in order to avoid unsustainable food price increases in the future it is vital that the UK becomes more efficient in how it produces and uses food.</p> <p>IBERS plays a fundamental role in helping to achieve this. By combining world-leading expertise in plant breeding with an in-depth understanding of how animals use the food they eat IBERS has been able to develop varieties of forage that improve livestock performance. IBERS' long-standing relationships with commercial seed developers means that these varieties have been widely adopted by grassland farmers across the UK and Ireland, leading to significant and consistent improvements in livestock productivity.</p> <p>IBERS' expertise has also helped to bring about improvements in land management practices, that have generated further productivity benefits.</p> <p>The nature of agricultural productivity improvement is permanent and cumulative. This means that gains realised in one year will be realised again in each subsequent year as each new technological innovation is reapplied to new forage varieties. On-going research means that the number of innovations is continually increasing, causing the total cumulative impact each year to increase.</p>		
<p><b>Residual productivity effect of historic research – 6.1%</b></p>	<p><b>Marginal productivity effect from recent research – 0.4%</b></p>	<p><b>Cumulative productivity effect in 2012/13 – 6.5%</b></p>

## Agricultural Productivity



## Graduate Productivity

253 undergraduates	167 postgraduates
<p>Each year graduates from IBERS take what they have learned while studying into the workplace, helping to improve the productivity of UK industry. This productivity benefit can be measured by the additional income earned by graduates because they have a degree. It was estimated that this productivity improvement contributed more than £23 million GVA to the UK economy in 2012/13.</p>	

## Commercialisation



## IBERS Varieties



## Future Impact of IBERS



## 2 INTRODUCTION & APPROACH

The Institute of Biological, Environmental and Rural Sciences (IBERS) is a world class research and education centre based at Aberystwyth University. It is an internationally recognised research and teaching centre that provides a unique base for research in response to global challenges such as food security, bioenergy, sustainability, and the impacts of climate change. IBERS scientists conduct basic, strategic and applied research from genes and molecules to organisms and the environment.

According to its major funder, BBSRC<sup>1</sup>, a distinctive feature of IBERS' work is the integration of research linking fundamental plant genomics and biology to plant breeding, the animals that consume the plant forages, the microbial populations within the gut that digest them, and the bioreactors that are used to transform plant products into useable fuels.

The objective of this study is to describe, exemplify and quantify the benefits of IBERS' research and capabilities and to deliver a better understanding of its impacts. It examines the importance of IBERS to the UK economy and to its key sectors: agriculture and food; energy and industrial biotechnology; biosecurity and environment.

Section 2.1 describes the framework that has been used to structure this analysis and section 2.2 describes the approach that has been used to quantify the economic impacts described in this report.

### 2.1 Framework for Analysis

The framework used to analyse the impacts of the IBERS is described below and summarised in Figure 2-1.

#### 2.1.1 Challenges and Activities

IBERS aspires to be one of the top three land-based University departments in the World. In order to realise this vision the Institute conducts fundamental and applied biological research to tackle four of the most important challenges facing humanity:

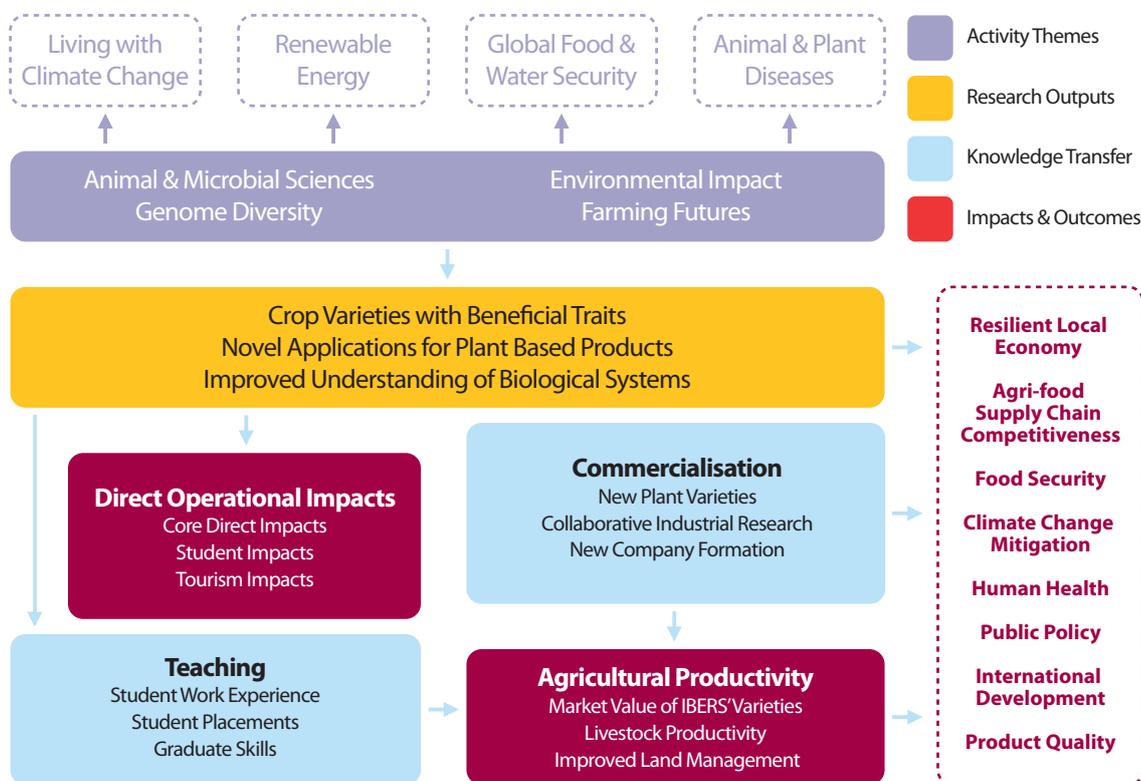
- living with climate change;
- renewable energy;
- global food and water security; and
- animal and plant diseases.

To address these challenges, IBERS focuses on three broad areas of research:

- Genome Diversity;
- Animal and Microbial Sciences; and
- Environmental Impact.

<sup>1</sup> <http://www.bbsrc.ac.uk/organisation/institutes/institutes-of-bbsrc/ibers.aspx>

**Figure 2-1 Framework for Analysis**



In addition to this, IBERS is also one of the two founding partners of Farming Futures (formerly the Centre of Excellence for UK Farming and Food Supply). Farming Futures is a research consortium with very close links with industry that aims to help farmers and the food industry address key challenges and achieve a balance between increased productivity and more efficient use of resources. **The scale of IBERS’ activities and an outline of the main areas of research undertaken at the Institute is provided in chapter 3.**

**2.1.2 Operational Impacts**

In undertaking these activities, IBERS generates substantial operational economic impacts. These impacts include the core operational impacts associated with IBERS’ day-to-day activities and the impact of purchases made by the Institute and its staff, including IBERS’ substantial capital investment programme.

The operational impact of IBERS also includes the activity supported by students in the local economy. This includes the impact of student spending in the local economy and the contribution made to local businesses by students who work part-time during their studies.

IBERS’ operations also generate a significant impact on the local tourism sector. This impact is generated by the personal visitors who come to see students and staff throughout the year and the numerous visiting scientists, public officials and industrial partners who come to the Institute each year.

The operational impacts of IBERS are considered in chapter 5.

### 2.1.3 Knowledge Transfer

The research undertaken at IBERS generates various outputs including new seed varieties, novel applications for plant based products and improved understanding of biological and land-based systems. In order for these research outputs to generate economic impact, the knowledge embedded within them must somehow be transferred from IBERS into industry.

One of the main ways in which IBERS transfers knowledge into industry is through its students. This process can occur either before students graduate, through the completion of work experience placements or participation in knowledge transfer programmes. Substantial knowledge transfer also occurs after students graduate and begin applying what they have learned in the workplace. **The impact of teaching and learning is considered in chapter 6.**

The other main way in which IBERS transfers the outputs of its research into industry is by commercialising intellectual property developed at the Institute. This is achieved in a number of ways including developing seed varieties that are then sold commercially, undertaking collaborative research with industrial partners and supporting the formation of new start-up and spin-out companies. **The impact of commercialisation is considered in chapter 7.**

### 2.1.4 Catalytic Impacts and Outcomes

In addition to the direct commercial returns to IBERS' industrial partners, the research undertaken by IBERS also has an important catalytic impact on the productivity of the agri-food sector in the UK. These catalytic effects include the market value of oats grown using IBERS' seed varieties, **which is considered in chapter 8.**

IBERS' research also has a significant impact on the productivity of the UK livestock production sector. These improvements have been generated either directly through the effects of IBERS forage varieties on livestock productivity or indirectly as a result of IBERS' influence on agricultural policy and land use in the UK. **The quantifiable catalytic impact of IBERS' research on agricultural productivity are considered in chapter 9.**

In addition to the quantifiable impact that IBERS has on agricultural productivity, it also generates substantial wider benefits that cannot be quantified. At the local level, IBERS' operations make an important contribution to the resilience of the local economy by generating high-value local employment and supporting a significant local supply chain.

At the UK level, IBERS' research has had a significant impact on land-management practices. This has not only generated important ecological benefits but has also helped to improve the productivity of some of the most marginal agricultural land in the UK.

IBERS' research is also playing an important role in improving food security, not just in the UK but also overseas and in improving the quality of food products available to consumers. **The wider impacts of IBERS' activity are discussed in section 10.**

The main focus of this report is the economic impact that was realised in 2012/13 as a result of IBERS' activities. It is however important to note that much of the research currently being undertaken at IBERS could generate substantial additional economic impacts in the future. The announcement in July 2013

that Aberystwyth University plans to invest £35 million in the development of a new UK Innovation and Enterprise Campus (AIEC) at Gogerddan means that IBERS is also about to enter an exciting period of expansion, which should further increase future economic impact. **The potential future impacts of IBERS' research are considered in chapter 11.**

The current and potential future economic impact of IBERS are summarised in final chapter of this report, chapter 12.

## 2.2 Approach to Economic Impact

The activities undertaken by all universities and research institutes share much in common. This means that all universities and research institutes generate a set of common “core” economic impacts. These include direct economic impacts from employing staff, impacts as a result of spending money on goods and services, impacts of staff spending and the impacts of capital spending programmes. The starting point for this study was therefore to gather information about IBERS' activities in order to estimate these core impacts.

In other respects universities and research institutes are usually very different from one another, often with strengths that have evolved over a number of years. In order to fully capture the economic impact of an institution it is necessary to identify and where possible quantify these strengths and areas of distinctiveness. In order to do this for IBERS, the data gathering exercise was supplemented by a series of consultations with key members of staff and others outwith the institution.

### 2.2.1 Geographic study areas

The study has considered the economic impacts that IBERS has in the county and national economies. The three study areas that are used in the analysis are:

- Ceredigion;
- Wales; and
- the United Kingdom.

### 2.2.2 Economic measures

This study has quantified the economic impacts of IBERS in terms of Gross Value Added (GVA) and jobs.

GVA is the measure of the value that an organisation, company or industry adds to the economy through its operations. The study used the production approach to measuring this impact, where the GVA is equal to the value of production less the value of the inputs used. Typically this is estimated by subtracting the non-labour costs of the organisation from the organisation's total revenue.

### 2.2.3 Methodology

Both employment and Gross Value Added (GVA) impacts have been assessed and account has been taken of the following concepts:

- **deadweight** – this considers how much of the economic activity would have happened anyway;
- **substitution** – the extent to which any private sector investment and economic activity stimulated by

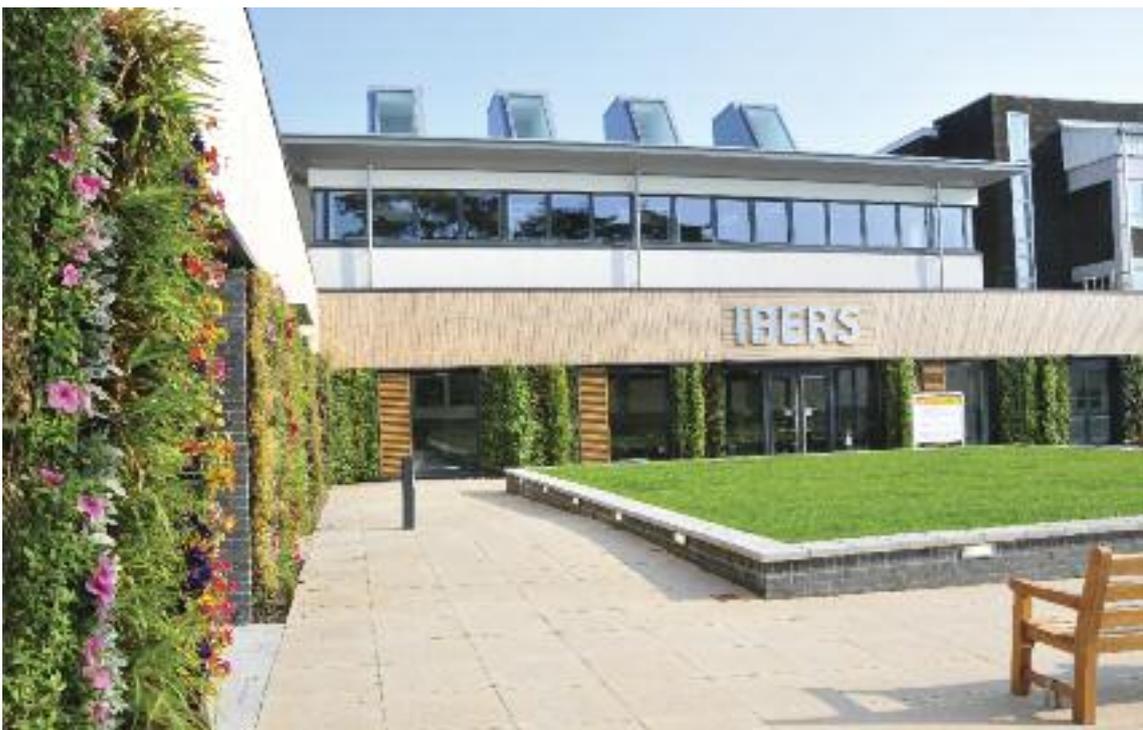
public sector intervention could have been diverted in order to take advantage of the public sector investment. However, investment decisions in the global plant and animal biosciences are based on market opportunities and on the quality of the science base. Substitution is therefore not a concern for IBERS;

- **leakage** – this considers how much of the economic activity occurs in the study area. This study considers the economic impact for Ceredigion, Wales and the UK as a whole. Leakage is taken account of by considering the geographical source of the impact, the location of the impact and adjusting multipliers to the Welsh and UK levels;
- **displacement** – this takes into account whether the activity of IBERS has resulted in the reduction of activity in other organisations and businesses in the area; and
- **supplier multiplier effects** – purchases of supplies and services associated with the direct impact and all the resulting purchases of supplies and services down the supply chain; and
- **income multiplier effects** – the expenditure of employees supported by the direct effect and the supplier effect.

The details of how each impact has been estimated are explained in the subsequent sections of this report.

Each area of impact requires the use of three types of economic assumptions:

- turnover to GVA ratio – this is used to estimate the GVA impact of the spend in an area;
- turnover per employee – this is used to estimate the employment impact of the spend in area; and
- GVA and employment multipliers – this is used to estimate supplier and income impact created by businesses that directly benefit from additional spend in area.



## 3 IBERS

IBERS is a research and teaching centre at Aberystwyth University, created in 2008 when the former BBSRC Institute of Grassland & Environmental Research merged with the Institutes of Rural Sciences and of Biological Sciences with the vision of becoming one of the top three land-based University departments in the world.

It aims to conduct fundamental and applied biological research to tackle global challenges, including human and veterinary diseases, food production and bio-energy in the face of climate change, growing populations, water scarcity and competing demands for land.

### 3.1 Income

In academic year 2012-13 IBERS received total revenue income in excess of £28 million. IBERS' single largest source of revenue income was the Higher Education Funding Council for Wales (HEFCW), which provided just over a quarter of IBERS' income in 2012/13. IBERS received a further 15% of its income from tuition fees.

IBERS is a member of the National Institutes of Bioscience and receives strategic research funding from the BBSRC to support long term mission driven research, of over £3.5 million in 2012-13 (13% of revenue income). It also received an additional £1.8 million from BBSRC. IBERS also benefits from financial support from the Welsh Government (12%), from non teaching income (9%), as well as its own farm (5%) and links with industry (5%). The full range of research councils also contribute to overall income. A breakdown of IBERS' revenue income by source is provided in Table 3-1.

**Table 3-1 IBERS Revenue Income 2012-13**

Source: IBERS

	Value	Proportion
HEFCW Income	£7,439,911	24%
Tuition fees	£4,245,530	14%
BBSRC Institute Strategic Programme Grant	£3,585,947	11%
Central Government	£3,487,182	11%
Other Non-Teaching Income	£2,426,338	8%
BBSRC	£4,816,459	15%
Farm Income (external)	£1,529,362	4%
UK Industry	£1,314,580	3%
BEACON	£1,036,552	3%
EU Government	£858,134	3%
NERC	£249,857	1%
EPSRC	£9,475	<1%
MRC	£79,224	<1%
EU Other Source	£43,249	<1%
Charities	£111,534	<1%
Overseas and other sources	£75,953	<1%
<b>TOTAL REVENUE INCOME</b>	<b>£31,309,287</b>	

## 3.2 Teaching

IBERS is the largest institute within Aberystwyth University, with 360 members of staff and over 1,500 students. IBERS' undergraduate courses include a wide range of life sciences subjects:

- agriculture;
- animal science/zoology;
- biochemistry;
- biology;
- conservation/countryside management;
- environmental biosciences and ecology;
- equine science;
- genetics;
- marine and freshwater biology;
- microbiology and
- plant biology

•  
Taught postgraduate courses cover animal sciences, food and water security, biotechnology and a range of environmental management subjects. The training of research postgraduate students includes the full range of disciplines relevant to the biological and rural sciences within the Institute's research themes, which are listed in section 3.3 below.

Table 3-2 shows the profile of undergraduate and postgraduate students for 2012-13. There were almost 1,300 undergraduates and over 250 postgraduates studying within the institute in 2012-13.

**Table 3-2 Student profile, 2012-13**

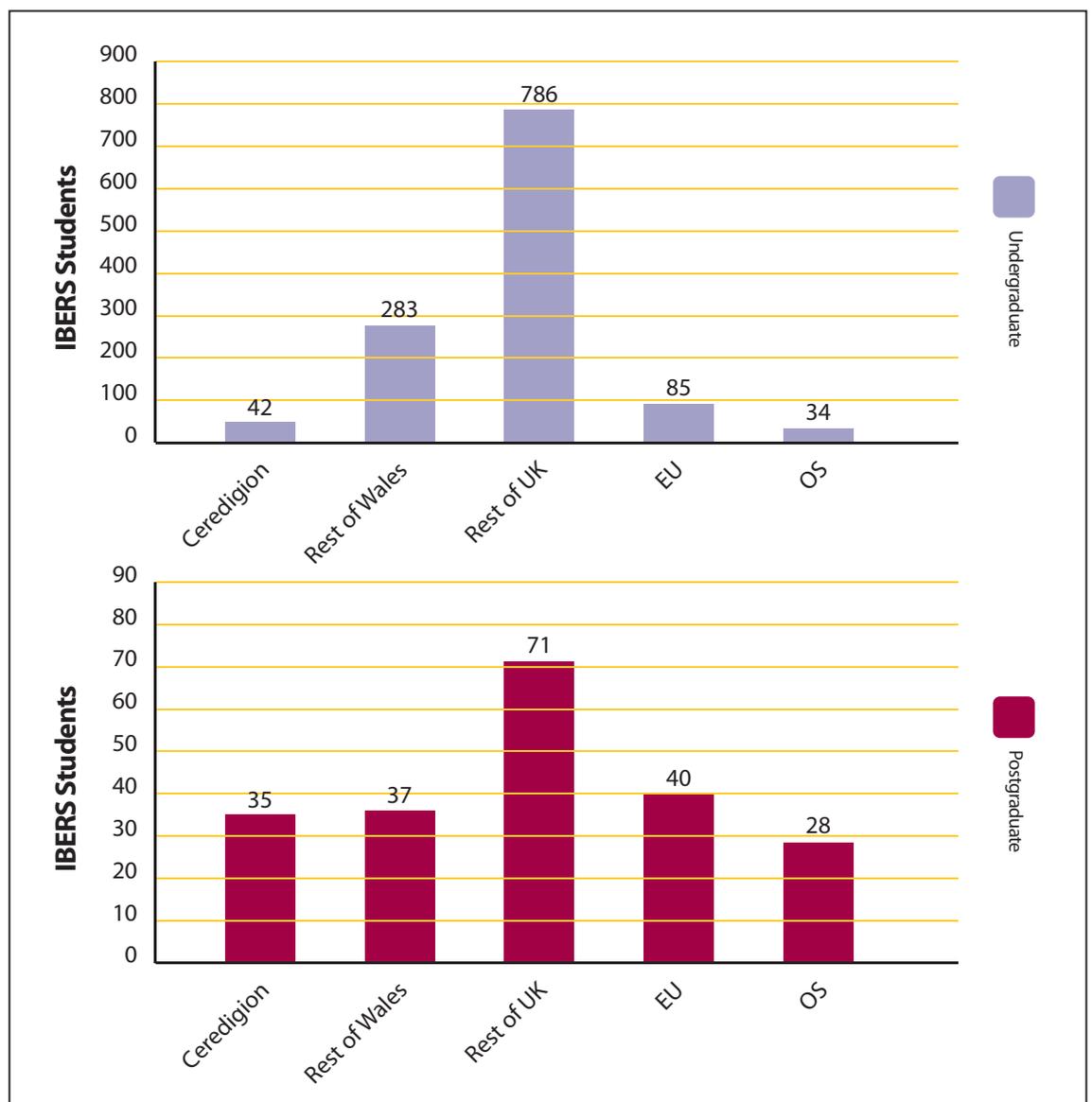
<b>Undergraduate</b>	
Full-time	1,230
Part-time	69
Total	1,299
<b>Postgraduate</b>	
Full-time	165
Part-time	87
Total	252
<b>Total student numbers</b>	<b>1,551</b>

Source: IBERS

Figure 3-1 shows that over 300 IBERS' undergraduates (26%) come from Wales (42 of these from Ceredigion) and the majority (64%) come from the rest of the UK. Almost 120 (10%) come from the EU or the rest of the world (OS).

A higher proportion of postgraduate students come from the EU and overseas (32%, 67 students). 72 postgraduate students (34%) come from Wales, with almost 20% of these (35) from Ceredigion. Figure 3-1 Number of IBERS students from Ceredigion, Wales, UK, EU, World (OS)

**Figure 3-1 Number of IBERS students from Ceredigion, Wales, UK, EU, World (OS)**



Source: IBERS

### 3.3 Research

IBERS' approach to sustainable land-use is based on the interaction between three interrelated core research themes, as follows.

- **Animal and microbial sciences** consists of five research groups, including: animal systems; diet and health; herbivore gut ecosystems; microbiology; and parasitology and epidemiology;
- **Environmental impact** consists of five research groups, including: abiotic stress resistance and nutrient use efficiency; bioconversion and biorefining; ecology; energy crop biology; and energy crop breeding and modelling;
- **Genome diversity** consists of four research groups: public good plant breeding; breeding methodologies; plant genome and chromosome biology; aquatic, behavioural and evolutionary biology.



## 4 LOCAL ECONOMIC CONTEXT

IBERS is based in Aberystwyth, the administrative capital of the Welsh county of Ceredigion. This section describes the local economic context within which IBERS operates.

### 4.1 Economic Activity

The total population of Ceredigion in 2012 was 76,000, 2% of the population of Wales. The table below shows that at 64.3% the economic activity rate for the county is lower than for Wales (73.9%) and Great Britain (77.3%). Economically active people are either in employment or unemployed and available for work. Economically inactive people include, for example, students, those who are looking after a home or retired people. The table shows the very high relative proportion of students in the county, explaining the low economic activity figures.

Reflecting the economic activity profile, the proportion of people in employment (62.3%) is low compared to Wales and Great Britain. Also, Ceredigion is characterised by a higher rate of self employment than the national figures, with 8,000 people (13.6% of the population) working for themselves, compared with 8.9% for Wales.

**Table 4-1 – Economic activity and employment (Jul 2012 – Jun 2013)**

	<b>Ceredigion numbers</b>	<b>Ceredigion (%)</b>	<b>Wales (%)</b>	<b>Great Britain (%)</b>
Economically active	33,800	64.3	73.9	77.3
In employment	32,800	62.3	67.7	71.1
Employees	24,200	47.7	58.1	61
Self employed	8,000	13.6	8.9	9.5
<b>Economically inactive</b>				
- Student	7,900	45.6	26.1	22.7
- Looking after family/home	1,800	10.3	21.5	25.5
- Retired	2,900	16.4	16.4	15.7

Source: ONS annual population survey. Numbers are for those aged 16 and over, % are for those aged 16-64. N.B in employment figure includes employees and self-employed.



Table 4-2 below shows that over 5,500 people in Ceredigion claim working age benefits. This is over 11% of the population of the county and compares relatively well with Wales (17.4%) and Great Britain (13.9%). This is reflected across the range of working age benefits, with claimant rates lower in Ceredigion than nationally for Job Seekers Allowance, ESA and Incapacity Benefits and Key out-of-work benefits. This may reflect the very large proportion of students in the county, shown in the table previously.

**Table 4-2 – Working Age Benefits (May 2013)**

	Ceredigion numbers	Ceredigion (%)	Wales (%)	Great Britain (%)
Total claimants	5,560	11.4	17.4	13.9
Job seekers	800	1.7	3.7	3.5
ESA and incapacity benefits	3,020	6.2	8.4	6.2
Key out-of-work benefits†	4,270	8.8	14	11.2

Source: DWP benefit claimants - working age client group. % is a proportion of resident population of area aged 16-64.

† Key out-of-work benefits includes the groups: job seekers, ESA and incapacity benefits, lone parents and others on income related benefits.

## 4.2 Employment

Although Ceredigion is a rural county, its jobs density compares well with Wales and Great Britain. Jobs density is the level of jobs per resident aged 16-64. For example, a jobs density of 1.0 would mean that there is one job for every resident aged 16-64.

Table 4-3 shows that Ceredigion's jobs density (0.73) is higher than Wales (0.70) and below Great Britain (0.78). The table also shows a comparison with the jobs density of neighbouring counties. Ceredigion compares well with its coastal neighbours, while Powys has a higher jobs density (0.81) than the local or national comparisons.

**Table 4-3 – Jobs density (2011)**

Region	Jobs density
<b>Ceredigion</b>	<b>0.73</b>
Wales	0.70
Great Britain	0.78
Powys	0.81
Carmarthenshire	0.66
Gwynedd	0.79
Pembrokeshire	0.75

*Source: ONS jobs density. The density figures represent the ratio of total jobs to population aged 16-64. Total jobs includes employees, self-employed, government-supported trainees and HM Forces*



Table 4-4 below shows the employment profile for Ceredigion, compared nationally. The largest occupational type in the county is professional occupations, with 6,300 people working in this category this represents 19.1% of the population (compared to 18% in Wales and 19.6% in Great Britain). Ceredigion has a higher proportion of people working in skilled trades and occupations (15.6%) than Wales (12.2%) or Great Britain (10.4%).

Looking at the industrial sectors in which these jobs lie (table 4-5), the proportion in education is considerably higher than the national levels, with almost 5,000 people working in the sector in Ceredigion, 18.3% of employees. This compares to around 10% of employees in Wales and Great Britain.

Except for education, the employee profile in Ceredigion broadly reflects the national picture, with slightly higher proportions working in retail, tourism and administration related jobs, and markedly fewer in business administration. This reflects the service and tourism focus of the remainder (non-education) of the local labour market.

**Table 4-4 – Employment by occupation (Jul 2012-Jun 2013)**

	<b>Ceredigion numbers</b>	<b>Ceredigion (%)</b>	<b>Wales (%)</b>	<b>Great Britain (%)</b>
Managers, directors and senior officials	3,100	9.3	9.4	10.2
Professional occupations	6,300	19.1	18	19.6
Associate professional & technical	3,900	11.9	12.2	14.1
Administrative & secretarial	3,600	10.8	10.9	10.9
Skilled trades occupations	5,100	15.6	12.2	10.4
Caring, leisure and other service occupations	3,100	9.4	10	8.9
Sales and customer service occs	2,700	8.2	8.1	8
Process plant & machine operatives	1,200	3.8	7.2	6.3
Elementary occupations	3,700	11.3	11.1	10.9

*Source: ONS annual population survey. Numbers and % are for those of 16+. % is a proportion of all persons in employment*

**Table 4-5 – Employees by industry (2012)**

<b>Industry</b>	<b>Ceredigion numbers</b>	<b>Ceredigion (%)</b>	<b>Wales (%)</b>	<b>Great Britain (%)</b>
Education	4,683	18.3	10.7	9.5
Health	4,191	16.4	16.5	13.4
Retail	3,444	13.5	11.6	10.2
Accommodation & food services	2,746	10.8	7.5	6.8
Public administration & defence	2,262	8.9	7.6	5.0
Arts, entertainment, recreation & other services	1,487	5.8	4.5	4.4
Manufacturing	1,146	4.5	11.2	8.6
Construction	1,099	4.3	4.4	4.5
Professional, scientific & technical	871	3.4	3.6	7.5
Transport & storage	740	2.9	3.2	4.5
Motor trades	578	2.3	1.9	1.7
Wholesale	540	2.1	2.8	4.1
Property	371	1.5	1.3	1.6
Business administration & support services	369	1.4	6.0	8.3
Information & communication	291	1.1	1.9	3.9
Financial & insurance	275	1.1	2.5	3.9
Agriculture, forestry & fishing *	243	1.0	1.3	0.8
Mining, quarrying & utilities	200	0.8	1.8	1.3
<b>Total</b>	<b>25,536</b>			

Source: ONS business register and employment survey. \*these figures exclude farm agriculture

### 4.3 Earnings

As illustrated by Table 4-6, employees in Ceredigion earn less than the median earnings for Wales and Great Britain. Median weekly pay in the county is £428.80, comparing to £472.30 in Wales and £517.80 in Great Britain.

**Table 4-6 – Gross weekly pay (full time workers 2013)**

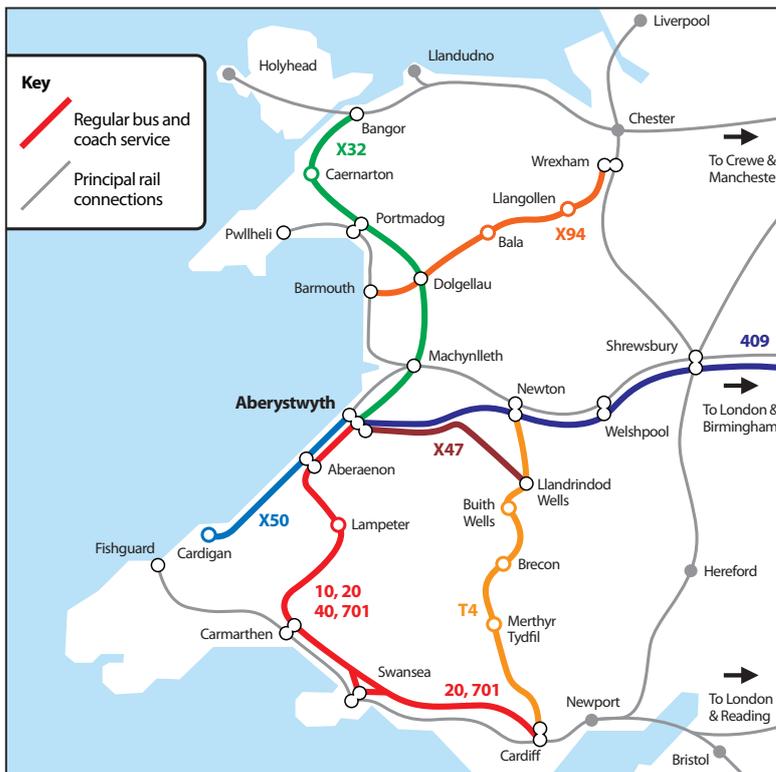
	Ceredigion (£)	Wales (£)	Great Britain (£)
Full-time workers	428.8	472.3	517.8

Source: ONS annual survey of hours and earnings - workplace analysis. Median earnings in pounds for employees living in the area.

### 4.4 Location

Aberystwyth is a relatively isolated location. There are no motorways links between Ceredigion and the rest of Wales and therefore the train lines that run to Aberystwyth from North Wales and Birmingham are vital. Connections to North Wales can be made via Shrewsbury (train) or Bangor (bus). Bus and rail connections are shown in Figure 4-1.

**Figure 4-1 Bus and rail connections to Aberystwyth**



Source: www.aberystwyth.org.uk

## 5 OPERATIONAL IMPACTS

IBERS generates a set of economic impacts which arise from its day to day operation. These include core impacts (direct, supplier, capital and staff spending impacts) as well as student impacts and tourism impacts (visits from friends and family, conferences and other activities that attract visitors to the area). These impacts are discussed in this chapter. The analysis is based on the methods described at section 10.

### 5.1 Core Operational Impacts

The core impacts associated with IBERS are those that occur through the day-to-day operations of the organisation. The core impacts that are covered in this section include:

- direct impacts;
- supplier impacts;
- staff spending impacts; and
- impacts of capital spending.

A summary of the core impacts is provided at the end of the chapter.

#### 5.1.1 Direct Impact

The income of IBERS in 2012/13 was £31.3 million. Of this £3.0 million was capital income from the BBSRC, which is considered later in this chapter. The operational income of IBERS was therefore £28.3 million. In this same period IBERS spent £8.1 million on supplies.

IBERS employed 358 members of staff in 2012/13, equivalent to 342 full time equivalents (ftes). These assumptions are shown in Table 5-1.

**Table 5-1 – Direct Impact – Assumptions**

	Source	Value
Operational Income of IBERS	IBERS	£28.3m
Amount spent on supplies		£8.1m
Employees (jobs)	Aberystwyth University HR	358
Employees (ftes)		342

The direct operational GVA of IBERS is estimated by subtracting expenditure on supplies from the total operational income of IBERS. This means that the direct GVA of the institution at the UK level is £20.2 million.

**Table 5-2 – Direct Impact**

	<b>Ceredigion (£)</b>	<b>Wales (£)</b>	<b>UK (£)</b>
GVA Impact (£m)	20.2	20.2	20.2
Jobs Impact	342	342	342

Source: BiGGAR Economics

### 5.1.2 Supplier Impact

IBERS has an impact on the wider economy as a result of the purchases it makes. In 2012/13 IBERS spent £8.1 million on goods and services. This expenditure represents an increase in turnover in the supply chain companies.

The location of the supplier spend was provided by IBERS. This showed that the majority of the supplies, with a value of £5.3 million came from 'Rest of UK'. Approximately 5% of the supply chain value was procured from the local area of Ceredigion. This expenditure is shown in Table 5-3.

**Table 5-3 – Supply chain expenditure by location**

	<b>Ceredigion</b>	<b>Rest of Wales</b>	<b>Rest of UK</b>
Supply chain value (£m)	0.8	1.4	5.3

Source: IBERS Supplier Data

The breakdown of expenditure on supplies by sector was used to estimate the total GVA. The direct GVA in each study area is shown in Table 5-4.

**Table 5-4 – Supplier Calculations**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
Direct GVA (£m)	0.3	0.9	1.9
Indirect GVA (£m)	0.1	1.0	2.8
Direct Jobs	8	21	41
Indirect Jobs	3	16	47

Source: BiGGAR Economics

In this way it was estimated that the economic impact of IBERS' supply chain expenditure amounts to £0.4 million GVA and 11 jobs in Ceredigion, £1.8 million GVA and 38 jobs in Wales, £4.7 million GVA and 89 jobs in the UK. This impact is broken down in Table 5-5.

**Table 5-5 – Supplier Impact**

	Ceredigion	Rest of Wales	UK
GVA Impact (£m)	0.4	1.8	4.7
Jobs Impact	11	38	89

Source: BiGGAR Economics

### 5.1.3 Staff Spending Impact

The staff who are employed at IBERS have an impact on the economy by spending their salaries. In the period 2012/13 IBERS spent £13.0 million on staff costs for its' 358 members of staff. The proportion of the staff costs that are staff salaries was assumed to be the same as the Aberystwyth University as a whole, which in 2011/12 was 82%<sup>2</sup>. The combined salaries of IBERS' employees were therefore £10.5 million.

The economic impact of these salaries depends on where the members of staff live. IBERS' data shows that 91% of staff live within Ceredigion and it was assumed that the remainder live elsewhere in Wales. The level of total salary spent in each study area was assumed to be proportional to the number of staff that live in each area.

Although the staff live in different areas, it was assumed that staff expenditure was not limited to the area in which they live. The location of their spending is given as an assumption in Table 5-6. These assumptions are based on BiGGAR Economics' previous experience of assessing the impact of staff expenditure for a wide range of higher education institutes and other types of organisation across the UK.

**Table 5-6 – Staff spending assumptions**

Staff Location	Ceredigion	Rest of Wales	Rest of UK
Ceredigion	50%	30%	15%
Rest of Wales	75%	75%	30%
Rest of UK	100%	100%	100%

Source: BiGGAR Economics

The spending of staff in each of the different study areas was estimated using these proportions. In this way it was possible to estimate that of the £10.5 million paid in staff salaries £5.1 million was spent in

<sup>2</sup> University of Aberystwyth Financial Statements 2011/12

Ceredigion and £7.9 million was spent within Wales. It was assumed that expenditure would occur across a wide variety of sectors in the economy and therefore the direct GVA and employment from this expenditure was estimated using the ratios for the whole economy. The indirect economic impacts were estimated for each of the study areas. Both direct and indirect impacts are shown in Table 5-7.

**Table 5-7 – Staff Spending Calculations**

	Ceredigion	Wales	UK
Total staff spend (£m)	5.1	7.9	10.5
Direct GVA (£m)	1.5	2.3	3.1
Indirect GVA (£m)	0.6	2.1	3.9
Direct Jobs	33	51	68
Indirect Jobs	14	52	99

Source: BIGGAR Economics

In this way it was estimated that the economic impact of spending by IBERS employees amounts to £2.1 million GVA and 47 jobs in Ceredigion, £4.4 million GVA and 103 jobs in Wales and £7.0 million GVA and 167 jobs in the UK. This impact is broken down in Table 5-8.

**Table 5-8 – Staff spending impact**

	Ceredigion	Wales	UK
GVA Impact (£m)	2.1	4.4	7.0
Jobs Impact	47	103	167

Source: BIGGAR Economics

#### 5.1.4 Capital Impacts

IBERS has invested significantly in its capital infrastructure over the last five years. The two main developments include the new IBERS building at Penglais and the National Plant Phenomics Centre (NPPC) at Gogerddan. These projects have involved around £50 million of capital expenditure at the two campuses – an average of around £10 million per year.

The new IBERS teaching and research facility at Penglais campus houses the Bioinformatics and Spatial Modelling laboratories as well as offering a hub for undergraduate and postgraduate teaching.

In parallel with developments at IBERS Penglais, significant new facilities have been created on the Gogerddan campus. These include a new translational genomics lab complex and a BBSRC-funded

National Capability in Plant Phenomics. These new facilities have transformed the Gogerddan campus, providing unique facilities for cutting edge research and student training.

The NPPC features a state of the art automated greenhouse, the only one of its kind in the UK and one of only a few in the world. With the capacity to house up to eight hundred and fifty plants on a series of computer-controlled conveyor belts, scientists will be able to apply different environmental regimes to individual plants as they study the influence of individual genes.

The direct economic impact of this expenditure was then estimated using the GVA/turnover and employee/turnover ratios for the construction sector. The indirect impacts were estimated by applying GVA and employment multipliers for the construction sector. It was assumed that two thirds of construction expenditure would be retained within the Welsh economy and that half of this would be retained within Ceredigion. These impacts are broken down in Table 5-9.

**Table 5-9 – Annual impact of IBERS’ capital investment over the last 5 years**

	Ceredigion	Wales	UK
Total capital spend	3.3	6.7	10.0
Direct GVA (£m)	1.2	2.5	3.7
Indirect GVA (£m)	0.7	3.0	6.5
Direct Job years	25	49	74
Indirect Job years	14	67	144

Source: BiGGAR Economics

The total economic impact in 2012/13 of IBERS’ capital expenditure is given in Table 5 10. This shows that IBERS’ capital investment programme supported £1.9 million GVA and almost 40 years of construction employment in Ceredigion, £5.5 million GVA and 116 years of construction employment in Wales and £10.3 million GVA and almost 220 years of construction employment in the UK.

**Table 5-10 – Capital spending impacts**

	Ceredigion	Wales	UK
GVA Impact (£m)	1.9	5.5	10.3
Jobs Impact	39	116	217

Source: BiGGAR Economics

### 5.1.5 Summary Core Impacts

The core impacts of IBERS are summarised in Table 5-11 and Table 5-12. These show that the total core economic impact of IBERS in 2012/13 was £24.6 million GVA and 439 jobs in Ceredigion, £31.9 million GVA and almost 600 jobs in Wales, £42.1 million GVA and almost 820 jobs at the UK level. These impacts are summarised in Table 5-11 and Table 5-12.

**Table 5-11 – Core GVA Impacts (£m)**

	Ceredigion	Wales	UK
Direct Impact	20.2	20.2	20.2
Supplier Impact	0.4	1.8	4.7
Staff Spending Impact	2.1	4.4	7.0
Capital Impact	1.9	5.5	10.3
<b>Total Core Impact</b>	<b>24.6</b>	<b>31.9</b>	<b>42.1</b>

Source: BiGGAR Economics

**Table 5-12 – Core Jobs Impacts**

	Ceredigion	Wales	UK
Direct Impact	342	342	342
Supplier Impact	11	38	89
Staff Spending Impact	47	103	167
Capital Impact	39	116	217
<b>Total Core Impact</b>	<b>439</b>	<b>599</b>	<b>816</b>

Source: BiGGAR Economics

## 5.2 Students impacts

IBERS' students have an impact on the local and wider economies. The impacts include:

- impacts of student spending; and
- impacts of student part-time work.

There are, of course, wider impacts on the local economy from a large student population living in a relatively small town in terms of creating a vibrant, year round economy. This is discussed along with a summary of the total operational impacts of IBERS in section 10.1.

### 5.2.1 Student Spending Impacts

There are over 1,500 students associated with IBERS, which is 13% of the total student population of Aberystwyth University. These students have an impact on the economy through their spending in a similar way to the staff of the institute. To estimate this impact we have established:

- the average spend of students;
- where they spend it; and
- what they spend it on.

Aberystwyth University publishes the cost of living for students considering studying there, with the annual expenditure of students renting in the private sector in Aberystwyth being £8,085. This expenditure is broken down in table 5-13.

**Table 5-13 – Student expenditure by category**

	Annual expenditure
Accommodation	3,200
Food	1,800
Telephone Calls	200
Extras	390
Books, equipment stationery	100
Clothing	200
Travel Home	195
Insurance	30
Energy Costs	800
<b>Total</b>	<b>8,085</b>

*Source: Aberystwyth University Website - Cost of Living*

The costs associated with going to University vary depending on the accommodation type chosen by the student. Students that live at home will spend less on household expenditure, such as accommodation and energy costs. No data was available regarding the number of students who lived at home, however it was assumed that 50% of those students originally from Ceredigion continued living in the family home during their studies. IBERS provided the location of the students during their studies for the different study areas and it was assumed that all the expenditure of the students occurred in their area of residence.

In this way it is possible to estimate the total expenditure of students of IBERS in each of the different study areas broken down by category. The total spend in each of the study areas are given in Table 5-14, which shows that students spend £7.8 million in Ceredigion and £11.9 million in Wales. The economic impact

generated by this increased expenditure is estimated using the GVA/turnover and turnover per employee for the appropriate sectors. Both the direct and indirect impacts are shown in Table 5-14.

**Table 5-14 – Student spending calculations**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
Total student spend	7.8	11.9	11.9
Direct GVA (£m)	3.3	5.0	5.0
Indirect GVA (£m)	0.9	3.3	4.8
Direct Jobs	78	118	118
Indirect Jobs	18	63	91

Source: *BiGGAR Economics*

In this way it can be shown that the total economic impact of the spending of students of IBERS was £4.2 million GVA and 95 jobs in Ceredigion, £8.4 million GVA and 181 jobs in Wales and £9.8 million GVA and 208 jobs in the UK. These impacts are shown in Table 5-15.

**Table 5-15 – Student spending impact**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
GVA Impact (£m)	4.2	8.4	9.8
Jobs Impact	95	181	208

Source: *BiGGAR Economics*

### 5.2.2 Student Part-time Work Impact

The students of IBERS will also have an impact on the local economy if they choose to undertake part-time work during their studies. The economic impact of this work comes from the additional GVA of the businesses that employ them and the multiplier effect that these additional workers have on the supply chain of those businesses.

The NUS states that just over half of students work part-time to supplement their income<sup>4</sup>. It was therefore assumed that 50% of the students of IBERS worked part-time. It was then necessary to estimate the proportion of the student workforce that is additional, and therefore the positions would not have been filled without the presence of students. Aberystwyth is a town with a small population compared to other University towns and therefore it was assumed that 75% of the student workforce would have been additional.

<sup>4</sup> NUS, *Still in the Red: Student Finance in 2010, 2011*

**Table 5-16 – Student work assumptions**

	Value	Source
Proportion of students who work part-time	50%	NUS, Still in the Red
Average number of hours worked per week	14.0	NUS, Still in the Red
Additional labour	75%	BiGGAR Economics

The additional GVA that the part-time students generate for the businesses in which they are employed is estimated using the GVA per employee for the industries in which students most frequently find work. These industries include the accommodation and food services sector, the retail trade and the arts, entertainment and recreation services. This was then multiplied by the equivalent number of full time students working in each area. In this way it can be estimated that the additional student workers contributed £3.2 million GVA Ceredigion and £4.9 million GVA in Wales.

**Table 5-17 – Student work calculations**

	Ceredigion	Wales	UK
Additional hours worked	5,434	8,143	8,143
FTE equivalent	147	220	220
Direct GVA (£m)	3.2	4.9	4.9

Source: BiGGAR Economics

The GVA and employment multipliers<sup>5</sup> for these industries were then applied to capture the total economic impact of the student work. In this way it was estimated that the economic impact of students working part-time was £4.0 million GVA and 176 jobs in Ceredigion, £7.5 million GVA and 323 jobs in Wales and £8.6 million GVA and 367 jobs in the UK.

**Table 5-18 – Student work impact**

	Ceredigion	Wales	UK
GVA Impact (£m)	4.0	7.5	8.6
Jobs Impact	176	323	367

Source: BiGGAR Economics

### 5.2.3 Summary Student Impact

The impacts of the students of IBERS are summarised in tables 5-19 and 5-20. These show that the total impact of IBERS' students in 2012/13 was £8.2 million GVA and 272 jobs in Ceredigion, £15.9 million GVA and 504 jobs in Wales, £18.5 million GVA and 575 jobs at the UK level and internationally.

<sup>5</sup> The Type 1 multipliers were applied to avoid double counting the impacts of student spending

The presence of, spending and supply of labour provided by IBERS' students clearly has a significant quantitative impact on the local and national economy.

**Table 5-19– Student GVA Impacts (£m)**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
Student spending	4.2	8.4	9.8
Student work	4.0	7.5	8.6
<b>Total Student Impact</b>	<b>8.2</b>	<b>15.9</b>	<b>18.5</b>

Source: BiGGAR Economics

**Table 5-20 – Student Jobs Impacts**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
Student spending	95	181	208
Student work	176	323	367
<b>Total Student Impact</b>	<b>272</b>	<b>504</b>	<b>575</b>

Source: BiGGAR Economics

## 5.3 Tourism impacts

This section considers the tourism activity that is associated with IBERS, in particular it considers the tourism impacts generated by:

- friends and family by visiting staff and students; and
- people attending meetings and events hosted by IBERS.

### 5.3.1 Visits from Friends and Family

In 2012/13 there were a total of 1,893 staff and students associated with IBERS. While these individuals were working or studying at IBERS it would be expected that friends and family, who are not normally resident in the area, will visit them. These trips are described as “visiting friends and relatives” (VFR) and the expenditure that occurs during these trips has an economic impact in the tourism sector.

The Great Britain Tourism Survey and the International Passenger Survey report the details of VFR tourists to Wales from the UK and overseas. In 2012 there were 2.4 million VFR trips to Wales from the UK and 0.3 million from overseas. This shows that every person in Wales received 0.8 domestic VFR visitors and 0.1

overseas VFR visitors. These rates were applied to the total number of staff and students to find the number of VFR trips in each of the study areas. These are given in Table 5-21, which shows there were 1,192 VFR trips to Ceredigion and 1,676 to Wales.

**Table 5-21 – Number of VFR Trips**

	Ceredigion	Wales	UK
Domestic VFR	1,051	1,478	1,478
Overseas VFR	141	198	198
<b>Total Core Impact</b>	<b>1,192</b>	<b>1,676</b>	<b>1,676</b>

Source: BiGGAR Economics

The economic impact from these VFR trips comes from people's spending in the areas they are visiting. The tourism surveys also give details concerning the level of spend per trip for VFR tourists from the UK and overseas. This enabled the total spend from the VFR tourists to be estimated for each of the study areas, which is shown in Table 5-22. This shows that VFR tourists attributed to the staff and students of IBERS spent £0.2 million in Ceredigion and £0.3 million in Wales.

**Table 5-22 – Impact of visits from friends and relatives**

	Ceredigion	Wales	UK
Total VFR spend (£m)	0.2	0.3	0.3
Direct GVA (£m)	0.1	0.1	0.1
Indirect GVA (£m)	<0.1	0.1	0.1
Direct Jobs	3	4	4
Indirect Jobs	1	3	4

Source: BiGGAR Economics

The direct economic impact of this increased spend was estimated using the GVA/turnover and employee/turnover for the industries in the tourism sector. The indirect impacts were estimated by applying the GVA and employment multipliers for the tourism sector.

The total economic impacts from VFR trips are given in Table 5-23. This shows that visitors to the staff and students of IBERS supported £0.1 million GVA and 4 jobs in Ceredigion, £0.2 million GVA and 7 jobs in Wales and £0.2 million GVA and 8 jobs in the UK.



**Table 5-23 – Total impact of visits from friends and relatives**

	Ceredigion	Wales	UK
GVA Impact (£m)	0.1	0.2	0.2
Jobs Impact	4	7	8

Source: BiGGAR Economics

**5.3.2 Business Tourism**

Consultation with IBERS’ staff suggests that IBERS receives a significant number of academic and professional visitors each year who come to meet with academics or attend seminars and other events. Staff involved with the Public Good Plant Breeding programme for example estimated that they receive groups of 20-30 people several times a year and that each of these visitors stays two or three nights in Aberystwyth. In addition, the breeding programme also host an annual conference that is attended by around 80 people, each of whom stay in Aberystwyth for two or three nights.

Based on this it was estimated that the breeding programme generates around 400 overnight stays in Aberystwyth, which generate income for the local tourism sector. The Public Good Plant Breeding programme is part of the Genome Diversity research theme. It was assumed that the other two research themes and Farming Futures would receive a similar number of visitors. Taken together this suggests that in 2012/13, IBERS was responsible for generating around 1,650 overnight visits to local tourism establishments.

Data from VisitBritain shows that visitors attending business events spend an average of £89 per night. The expenditure of IBERS’ business visitors can therefore be estimated as shown in the table below. This shows that there were 2,031 visitor nights in 2012/13, with an associated spend of £0.2 million.

**Table 5-24 – Business/Professional Visitors, 2012/13**

	Ceredigion	Wales	UK
Total Business visitor nights	2,031	2,031	2,031
Total Business visitor spend	0.2	0.2	0.2
Direct GVA (£m)	0.1	0.1	0.1
Indirect GVA (£m)	<0.1	0.1	0.1
Direct Employment	3	3	3
Indirect Employment	1	2	3

Source: BiGGAR Economics

Business visitors to IBERS supported £0.1 million GVA and 3 jobs in Ceredigion, £0.1 million GVA and 5 jobs in Wales and £0.1 million GVA and 5 jobs in the UK

**Table 5-25 – Business/Professional Visitors, 2012/13**

	Ceredigion	Wales	UK
<b>Total GVA (£m)</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>
<b>Total Employment</b>	<b>3</b>	<b>5</b>	<b>5</b>

Source: BiGGAR Economics

### 5.3.3 Summary Tourism Impact

The total tourism impact of IBERS from VFR and business visitors is shown in table 5.27 below. This shows tourism and business visitors supported £0.2 million GVA and 7 jobs in Ceredigion, £0.3 million GVA and 11 jobs in Wales and £0.3 million GVA and 13 jobs in the UK.

As a seaside tourist destination, this additional tourism impact is a welcome addition to Aberystwyth's tourism offer. The wider implications of these impacts are discussed further along with the summary overall operational impacts of IBERS at Chapter 8.

**Table 5-26 – Total Tourism Impact, 2012/13**

	Ceredigion	Wales	UK
GVA (£m)	0.2	0.3	0.3
Jobs	7	11	13

Source: BiGGAR Economics

## 5.4 Summary Operational impacts

Each of the three preceding chapters sets out the economic impact of IBERS' day to day operations. These include core impacts (direct, supplier, capital and staff spending impacts), student impacts and tourism impacts.

Tables 5-27 and 5-28 summarise the operational impacts and show that the total operational impact of IBERS in 2012/13 was:

- £32.9 million GVA and 718 jobs in Ceredigion;
- £48.0 million GVA and 1,114 jobs in Wales; and
- £60.9 million GVA and 1,404 jobs in the UK.

**Table 5-27 Summary operational impacts – GVA (£m)**

	Ceredigion	Wales	UK
Core impact	24.6	31.9	42.1
Student impact	8.2	15.9	18.5
Tourism impact	0.2	0.3	0.3
<b>Total operational impact</b>	<b>32.9</b>	<b>48.0</b>	<b>60.9</b>

**Table 5-28 Summary operational impacts - employment**

	Ceredigion	Wales	UK
Direct impact	439	599	816
Student impact	272	504	575
Tourism impact	7	11	13
<b>Total operational impact</b>	<b>718</b>	<b>1,114</b>	<b>1,404</b>

## 6 TEACHING & LEARNING IMPACTS

In addition to being an acclaimed research institute, IBERS is also an internationally recognised teaching centre. The previous chapter incorporated the economic impacts associated with the operational delivery of teaching. This section considers the wider economic impacts of students learning both on the students themselves and on UK industry.

For IBERS' students, learning provides enhanced future productivity, greater employability and higher earning potential. These opportunities all have an economic impact that we can quantify. Learning also provides unquantifiable impacts, such as benefits to society of an educated population, both in the UK and for international students returning home after completing their studies.

IBERS' students and graduates also represent an important vehicle for knowledge transfer. There are a variety of opportunities for knowledge transfer to occur both before and after students graduate. This section considers these opportunities and benefits they bring to the UK industry.

### 6.1 Student Placements

Like its approach to research, IBERS' approach to teaching is highly applied, with a strong emphasis on addressing real world problems. Links between academic staff and industry are strong and many IBERS' staff have a background in industry or experience of running their own business. This means that students are constantly encouraged to think about how what they are learning might be used in the real world, which enhances the contribution they are able to make to UK industry both while they are studying and after graduating.

#### 6.1.1 Student Work Experience

Work placements form an integral part of the degree programme for many IBERS' students and this can bring real benefits to both the students involved and the companies they work with.

All IBERS' students are required to undertake a period of work experience at some point during their studies. Due to the high number of students studying at IBERS it is not possible for all students to undertake work experience in an area that is directly relevant to their degree course but even work experience in unrelated areas can bring real benefits for students including:

- interview experience;
- CV and cover letter writing;
- presentation;
- organisational and project management skills;
- time management; and
- report writing.

These skills mean that graduates from IBERS are likely to be more productive when they first join the workforce than if they did not have work experience.

Each year around 80 students who are either studying for a foundation degree or who undertaking a foundation study year undertake a work placement in an area relevant to their area of study. Around half of these placements last for six weeks and the remainder last for at least nine months.

During the course of these placements students have the opportunity to gain experience that may help to improve their future employability. Evidence of this is the fact that many placement students are subsequently offered permanent employment with their host company.

Student work placements are also likely to bring benefits to host companies by applying what they have learned at University to real world situations. These benefits are difficult to quantify but are likely to include exposure to current best practice in regards to land management issues and greater awareness of recent advances in plant breeding and animal science.

### 6.1.2 Student Knowledge Transfer Schemes

In 2012/13 IBERS participated in three schemes in which student research contributed to knowledge transfer impacts:

- IBERS had 2 established **Knowledge Transfer Partnerships (KTPs)** in operation. The UK wide knowledge transfer partnership programme facilitates knowledge exchange between academia and industry. A typical KTP involves at least one Associate (a graduate) who is employed by a university or college to work within a company on a specific project of mutual benefit;
- IBERS hosted 29 **Knowledge Economy Skills Scholarships (KESS)** partnerships. These support research projects that match academic expertise with business-focused research needs. Projects need to be connected with a company partner based in the Convergence area of Wales. The research project needs to fit one of the Welsh Government's Priority Sectors (Low carbon economy / Health & Biosciences / Advanced Engineering & Manufacturing / Digital Economy);
- IBERS had **10 CASE studentships**. CASE studentships (formerly known as 'Collaborative Awards in Science and Engineering') are collaborative training grants that provide students with a challenging research training experience, allowing bioscience graduates to undertake research, leading to a PhD, within the context of a mutually beneficial research collaboration between academic and partner organisations.

We are able to provide quantitative economic impacts for the KTP projects, because there are benchmarks for economic impact of these sourced from previous research. A strategic review of the KTP programme undertaken in 2010 found that on average KTPs undertaken in Wales contributed £927,000 GVA to the Welsh economy, equivalent to an annual impact of £154,500 in the six years after the KTP is completed. The same study found that on average, each KTP project supported the creation of three jobs.

<sup>6</sup> *Regeneris Consulting (February 2010), Knowledge Transfer Partnerships Strategic Review*

By multiplying the impacts from this strategic review by the number of KTP projects undertaken by IBERS in each of the study areas, it was possible to estimate the economic impact that the KTPs have in each area. In this way it was estimated that these partnerships contributed £309,000 GVA to the UK economy each year and support 6 jobs. This impact is summarised in Table 6-1.

**Table 6-1 – Impact of Knowledge Transfer Partnerships**

Location of Impact	Ceredigion	Wales	UK
GVA	£154,500	£154,500	£309,000
Jobs	3	3	6

Source: BiGGAR Economics

No evidence is currently available with which to quantify the economic impact of other types of student knowledge transfer schemes; however, their impact is likely to be similar to the Knowledge Transfer Partnerships. For this reason, the impact quantified above can be regarded as an underestimate.

## 6.2 Impact of Learning on Future Productivity

One of the main ways in which knowledge is transferred from IBERS into industry is when IBERS graduates start working and begin applying what they have learned in the work place. The skills students learn and the experiences they have while at University directly enhance their future productivity. This enables them to contribute more to their employer and generate a greater benefit for the UK economy than they would otherwise be able to. The GVA of this productivity gain includes the additional profits that graduate employers are able to generate by employing graduates and the additional employment costs they are willing to pay in order to generate these additional profits.

The subject of graduate earnings premiums has been well researched so information about the earnings premium of graduates is readily available and can be used to provide a measure of the additional contribution graduates make to the UK economy each year. Unfortunately information about the additional profits of graduate employers is not readily available so the impact presented in this section is likely to underestimate the true productivity impact of learning.

### 6.2.1 The Graduate Premium of IBERS' Students

Information about the graduate premium for different subject areas is provided in a research paper produced by the Department for Business Innovation & Skills<sup>7</sup>, which considered data from the Labour Force Survey between 1996 and 2009. The analysis considered the after tax earnings of a graduate compared to the after tax earnings of a non-graduate. The direct and indirect costs were then subtracted from the gross graduate premium for each degree subject to give the net graduate premium.

<sup>7</sup> Department for Business Innovation & Skills (June 2011), *The Returns to Higher Education Qualifications*.

The earnings premium that an individual graduate can expect to achieve over their working life varies with subject studied. Graduates with agricultural degrees for example might expect to earn a graduate premium of around £4.5 million while graduates with biological sciences degrees might expect an earnings premium of almost £10 million.

The number of IBERS' students who graduated in 2012/13 is shown in Table 6-2, along with the total graduate premium associated with each subject area. By multiplying the number of graduates from each area by the relevant graduate premium it was possible to estimate that the total graduate premium of all IBERS' graduates in 2012/13 was £25.3 million.

**Table 6-2 – Graduate Premium Assumptions by degree subject, IBERS**

	UG Graduates	PG Graduates	Graduate Premium
Agriculture	76		£4,562,101
Biological sciences	152		£9,982,671
Physical /environmental sciences	25		£2,328,273
Postgraduate degree		167	£8,382,482
<b>Total</b>	<b>253</b>	<b>167</b>	<b>£25,255,527</b>

Source: BIGGAR Economics, based on BIS research and graduate numbers provided by IBERS

The graduate premium impact for each of the study areas can be estimated by applying the proportion of graduates who live in each study area to the total graduate premium. For first degrees, it was assumed that 4% of students are international and leave the UK after graduating, 96% of graduates remain in the UK, 41% remain in the Wales and 12% remain in Ceredigion. For postgraduate degrees, we have assumed that 14% of graduates are international and return home, 86% remain in the UK, 52% in Wales and 38% in Ceredigion. Using these assumptions, we estimate that the annual personal graduate premium of IBERS' graduates is distributed geographically as shown in Table 6-3.

**Table 6-3 – Location of Graduate Premium**

	Ceredigion	Wales	UK
Undergraduate	£2,081,739	£6,902,609	£16,215,654
Postgraduate	£3,193,326	£4,390,824	£7,184,984
<b>Total</b>	<b>£5,275,066</b>	<b>£11,293,433</b>	<b>£23,400,638</b>

Source: BIGGAR Economics

## 6.3 Wider Economic Impacts of Learning

The graduate premium described above focuses on the quantifiable economic benefit of each year's cohort of graduates, but it does not take account of the significant wider benefits of higher education to the individual. These benefits have been well documented<sup>8</sup> and include:

- reduced risk of unemployment;
- better physical health;
- reduced risk of depression; and
- greater civic engagement.

One of the distinctive features of IBERS' approach to teaching is its emphasis on widening participation. This has resulted in IBERS having an unusually high proportion of mature students and students who come from non-traditional backgrounds. For many of these students, studying at IBERS represents a second chance to establish a successful career (or second career). For these students, the wider impacts listed above are likely to be particularly important.

There are also a range of benefits that accrue to the international community from UK higher education. In 2012/13 there were 187 non-UK students studying at IBERS. The impact that these students have while in the UK is captured as part of the student impacts discussed in section 5.2. Although many of these students will return home after completing their studies they may take additional benefits back to their home nations.

The connections that these students make during their time in the UK may also generate future benefits for the UK economy. For example, as students progress in their chosen careers they may use personal and professional contacts they have formed while at IBERS to arrange business deals that could lead to contracts for UK based companies.

IBERS' international connections may also help to generate economic impact for the UK economy by creating opportunities for cross-border academic collaboration, knowledge transfer and commercialisation.

<sup>8</sup> *Institute of Education, University of London (July 2001), The wider benefits of higher education, published by HEFCE.*

## 6.4 Summary Teaching and Learning Impact

The impact of IBERS' teaching activity is summarised below.

**Table 6-4 – Summary teaching and learning impact**

	Ceredigion	Wales	UK
Knowledge Transfer Partnerships - GVA	£154,500	£154,500	£309,000
Knowledge Transfer Partnerships - GVA jobs	3	3	6
Graduate Premium - GVA	£5,275,066	£11,293,433	£23,400,638

Source: BIGGAR Economics



## 7 COMMERCIALISATION IMPACTS

IBERS is an internationally recognised research centre. It delivers basic, strategic and applied research in response to global challenges such as food security, bioenergy and sustainability, and the impacts of climate change. The direct impact of research activity was estimated as part of the core impacts described in chapter 5, but research also generates significant wider benefits. These impacts are usually realised when the findings of academic research are applied within industry through commercialisation and knowledge transfer activities.

IBERS undertakes a variety of activities designed to facilitate knowledge transfer, some of which can be quantified and others that cannot. Its research and commercialisation activity has an impact on the economy through a variety of channels, including:

- the development of new seed varieties;
- contract and collaborative research with industry; and
- the formation of new companies.

The impact of each of these activities is discussed in the sections that follow:

### 7.1 Development of New Plant Varieties

One of the most distinctive features of IBERS' activity is its role in the development of new plant varieties. This activity is unusual because IBERS contributes to every stage of seed development; from undertaking the fundamental science behind the breeding programme right through to commercial seed development. As a result of this work, IBERS has developed innovative grass, clover, oat and miscanthus varieties.

These varieties have a significant impact both in the market and on end users. This impact was recognised in 2013 when IBERS won the Times Higher Education Award for Outstanding Contribution to Innovation and Technology for its work on the breeding and development of high sugar grasses (see case study at Figure 9-1).

The direct economic impact of these varieties is reflected in the market value of seeds sales and is considered in this section. IBERS' varieties also have significant wider benefits for end users, the impact of which is considered in sections 1.1 and 9.1.

#### 7.1.1 Market Value of IBERS' varieties

IBERS currently markets two main types of varieties: oats and forage species.

Grass breeding at IBERS is focused mainly on the development of novel varieties of ryegrasses and legumes such as white clover, which are the most widely used forage species in UK agriculture. There is

also an amenity grass breeding programme that breeds varieties for amenity uses such as golf courses, sports pitches and lawns.

IBERS' forage and amenity grass varieties are developed collaboratively with long-standing commercial partners Germinal Holdings Ltd (and Germinal Ireland). Germinal estimates that the seed sales of IBERS' grass varieties generates around £5.5 million of turnover for the company each year<sup>9</sup>.

Oat breeding has been carried out by IBERS and its predecessors since the early 1900's and has been responsible for the introduction of many of the oat varieties familiar to UK consumers today. IBERS' oat varieties are developed collaboratively with another long-standing commercial partner - Senova Ltd.

It is estimated that varieties developed by IBERS are used to sow approximately 65% of the 130,000 ha of land in the UK that is currently used for growing oats each year<sup>10</sup>. Consultation with IBERS' staff suggest that the cost of sowing oats is typically around £10.50 per hectare, which suggests that the market value of IBERS' oat varieties in terms of seed sales is around £0.8 million per year.

The revenue generated from seed sales equates to additional turnover for the seed development companies that market the varieties. The economic impact of this turnover was estimated using ratios and multipliers for the Support activities for crop production, Wholesale of grain and support activities for animal production sectors. In this way it was estimated that IBERS' work on seed development contributed £2.9 million GVA to the UK economy in 2012/13 and supported 55 jobs.

## 7.2 Collaborative Industrial Research

IBERS has very strong collaborative approach to working with industry and has well established commercial relationships with numerous industrial partners. These relationships have led to a multitude of consultancy and contract research projects, many of which have delivered tangible benefits to the industrial partner.

These benefits often take many years to come to fruition. This means that the impact of collaborative research undertaken in 2012/13 is likely to be realised in several years' time and that the economic impacts realised in 2012/13 are likely to have been generated by work undertaken several years ago. Despite this, the ongoing nature of IBERS' relationships with industry means that it is reasonable to use income received in 2012/13 as the basis for estimating the impact realised that year. It should however be noted that recent increases in the amount of competitive research income secured by IBERS means that this is likely to be a conservative estimate of the future impact of collaborative industrial research.

In 2012/13 IBERS received more than £1.3 million from UK industry. This included a contribution of £0.3 million from Waitrose to support the development of the UK agri-food supply chain. Consultation with IBERS staff suggests that approximately £620,000 of this related to on-going work with commercial plant

<sup>9</sup> Aberystwyth and Bangor Universities, *Impact case study (REF 3b) (breeding of high sugar grasses)*.

<sup>10</sup> Aberystwyth and Bangor Universities, *Impact case study (REF 3b), (breeding of novel types of oat)*.

breeding partners. As the impact of plant breeding was considered in the previous section, this income was therefore excluded here to avoid double counting.

As with any commercial investment decision, businesses take the decision about whether or not to proceed with a particular project on the basis of a cost/benefit analysis. Consultation with staff from IBERS' Animal and Microbial Sciences Research Division with very close links to industry suggest that typically companies only proceed with projects that they expect to deliver a return on investment of at least 300%. This implies that the total additional turnover that industrial partners expect to generate by working with IBERS is equal to around three times the total amount invested in collaborative projects. This suggests that the contract research undertaken at IBERS in 2012/13 is expected to generate around £2.1 million additional turnover for IBERS' industrial partners.

The economic impact of this turnover was then estimated using ratios and multipliers for the agricultural, animal and crop production sectors. In this way it was estimated that collaborative industrial research undertaken by IBERS generated £3.3 million for the UK economy in 2012/13 and supported 64 jobs across the UK.

As an illustration it is helpful to consider the current impact of a collaborative research project IBERS contributed to around 10 years ago with the Welsh company, Castell Howell Foods. This is described in the case study in Figure 7-1.



**Figure 7-1 – Celtic Pride premium beef**

With a turnover of around £80 million and around 400 employees Castell Howell Foods is the largest independent food wholesaler in Wales. The current success of Castell Howell Foods owes much to a collaborative project undertaken with IBERS, feed producer Wynnstay Plc and a farmers' cooperative, the Welsh Meat Company in 2002 and the subsequent development of the highly successful Celtic Pride brand of premium Welsh beef.

Castell Howell's relationship with IBERS began in 2002 when the company realised it had very little product differentiation. This meant it was selling exactly the same beef products to all its different customers – from hospitals and schools to five star hotels and restaurants.

In order to become more competitive the company needed to develop a new product line of premium quality Welsh beef that would deliver a "wow factor" for customers at the top end of the market. To do this the company worked closely with IBERS to develop a supply chain protocol that would cover every aspect of beef production from how animals were reared and fed right through to how the end product was processed and packaged.

The project was highly collaborative and gave those involved at every stage of the production process, including scientists at IBERS, opportunities to provide advice to and learn from others at different stages of the production process. Scientists at IBERS were particularly influential in developing the farming elements of the protocol and were able to provide advice on strategies for improving the live weight gain of animals. The outcome of the project was a new "gate to plate" supply chain protocol that Castell Howell Foods now uses to deliver a consistent premium quality product called Celtic Pride.

The Celtic Pride brand has proved extremely popular with customers. Before engaging with IBERS Castell Howell Foods was slaughtering about six cattle a week procured directly from farmers but by 2013 this had increased to around 100 cattle a week.

This has made a significant contribution to company growth. In 2002 Castell Howell had a turnover of around £14 million and employed around 140 people. By 2013 employment in the company had more than doubled, turnover had increased almost six fold and the company was making a direct contribution of around £13 million GVA to the Welsh economy. Much of this growth can be attributed to the success of the Celtic Pride brand.

All of the cattle used to produce Celtic Pride beef are raised and slaughtered in Wales. It is estimated that this makes a further indirect contribution of £12 million GVA to the Welsh economy and supports a further 226 jobs. As Celtic Pride products are particularly popular with hotels and restaurants, the project has also made an important, if unquantifiable, contribution to the Welsh tourism and hospitality sector.

*Source: BiGGAR Economics consultation with Castell Howell Foods*

## 7.3 New Company Formation

Largely for geographical reasons, the focus of IBERS' approach to commercialisation has been more on the collaborative development and exploitation of intellectual property with industrial partners than on the creation of new spin-out companies. Despite this, the Institute has succeeded in nurturing a small number of start-ups, spin-outs and spin-ins over the years, some of which are now very successful. There are currently five active companies associated with IBERS: Aber Instruments patented a unique method for measuring live biomass which is used by biopharmaceutical and brewing companies;

- Aber Instruments patented a unique method for measuring live biomass which is used by biopharmaceutical and brewing companies;
- Innovis is a supplier of sheep breeding technologies to the UK livestock industry;
- Natural Feeds and Fertilisers produces natural fertilisers and organic livestock feeds, as well as alternatives to chemical pesticides, fungicides and anthelmintics;
- Phytoquest delivers research and services concerned with the production of innovative natural ingredients and compounds emerging from the convergence of food, pharmaceuticals, and cosmetics; and
- Silage Solutions offers consultancy and research on many aspects of silage production and feeding.

As none of these businesses would have been created were it not for the research activity at IBERS, all of the GVA they generate and jobs they support can be attributed to IBERS.

Information provided by IBERS suggests that together, these companies directly employed 60 people in 2012/13 and had a combined turnover of around £7.6 million. The direct GVA of these companies was estimated by applying relevant turnover/GVA ratios from the UK Annual Business Survey to the turnover of each company. In this way it was estimated that the direct GVA impact of these companies in 2012/13 was £2.3 million. As all of the companies are based in Ceredigion, all of this direct impact was retained within the local area.

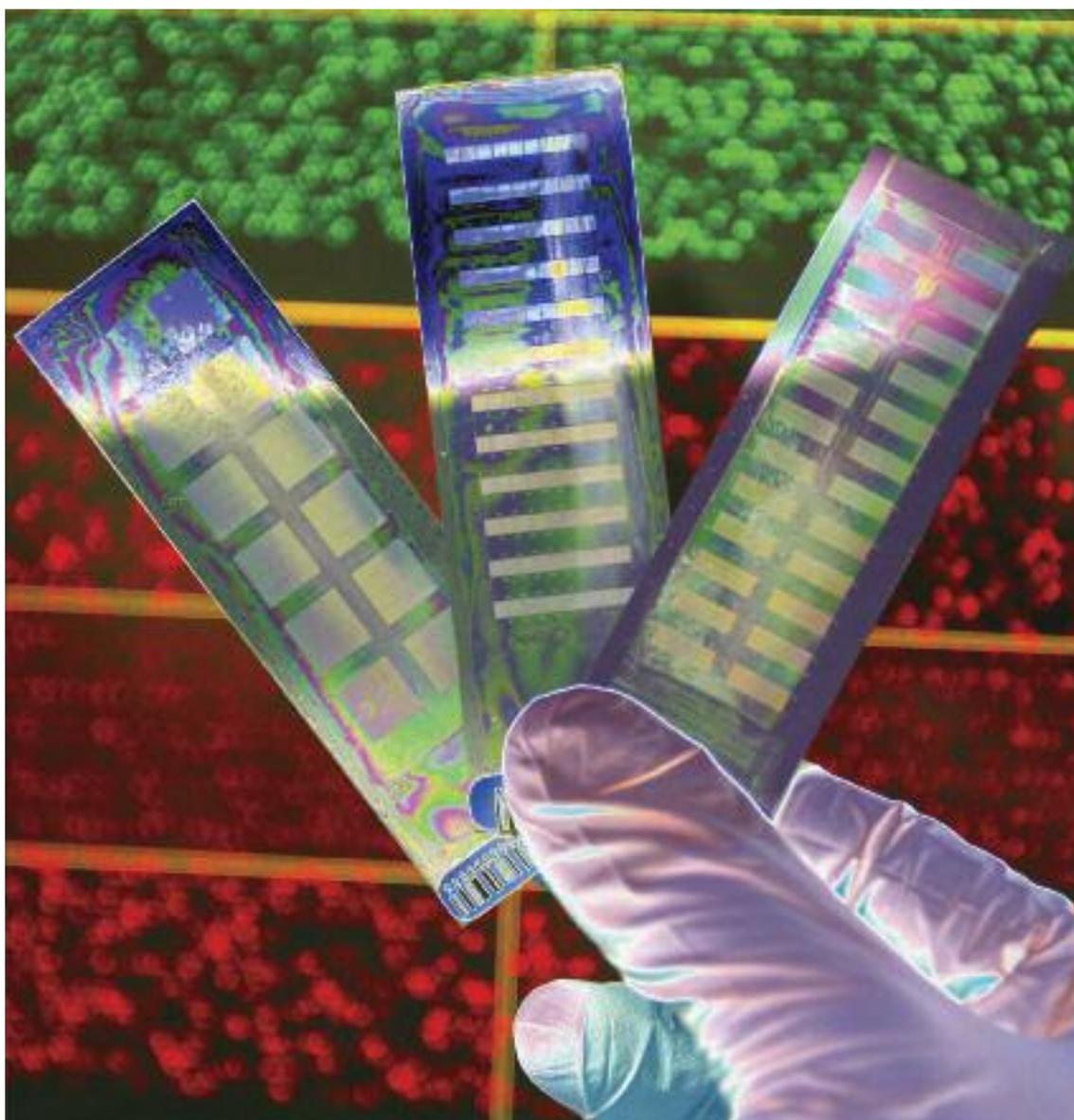
The indirect impacts were estimated using employment and GVA multipliers for industries in which each company operates. In this way it was estimated that the new companies associated with IBERS indirectly contributed £4.9 million GVA and 67 jobs in the UK in 2012/13.

This impact is summarised in Table 7-1. This shows that in 2012/13 IBERS' new companies delivered a GVA impact of £7.8 million and 127 jobs across the UK, of which £6.3 million GVA and 107 jobs were in Wales and £4.4 million GVA and 80 jobs were in Ceredigion.

**Table 7-1 – IBERS active new companies, Impacts**

Location of Impacts	Ceredigion	Wales	UK
Direct GVA	£2,890,1723	£2,890,173	£2,890,173
Indirect GVA	£1,476,609	£3,445,422	£4,922,031
Direct Employment	60	60	60
Indirect Employment	20	47	67
<b>Total GVA</b>	<b>£4,366,782</b>	<b>£6,335,594</b>	<b>£7,812,204</b>
<b>Total Employment (jobs)</b>	<b>80</b>	<b>107</b>	<b>127</b>

Source: BIGGAR Economics



**Figure 7-2 – Aber Instruments**

Based on research activities at what was then the University of Wales, Aberystwyth, Aber Instruments was founded in 1988. The company invented and patented a unique method for measuring live biomass based on Radio-Frequency Impedance. Within 3 years the first systems were sold to major biopharma and brewing companies. Today, Aber instruments is a global leader in on-line biomass measurement. It maintains a very close collaborative relationship with the University in an effort to understand cellular processes further and pass that knowledge on to the marketplace.

The company has supplied over 1000 fermentation monitoring systems world-wide for the on-line measurement of viable biomass concentration. On-line, real-time monitoring of viability during fermentation reduces costs and improves product quality. Practitioners in large breweries including Anheuser Busch, SABMiller, Inbev, Coors, Diageo, Heineken, Suntory and San Miguel have adopted the Yeast Monitor as part of their standard operating procedures. The new Futura instrument, which uses the same technology, was launched in 2009 and is now used by major biotechnology companies including Genetech, Novo, Biogen Idec, GlaxoSmithKline, Centocor, Sandoz, Eli Lilly and Genzyme to monitor biomass in a much wider range of fermentations.

Aber Instrument's manufacturing facility is based in Aberystwyth, backed by a support team and international distributor network in Europe, America and Asia. The company trades in markets across the globe.

The table below shows that Aber Instruments has a significant economic impact at the UK, Welsh and local levels. In 2012/13 it generated £2.6 million GVA and 59 jobs in the UK, of which £2.2 million GVA and 49 jobs were in Wales and £1.6 million GVA and 36 jobs were in Ceredigion.

**Impact of Aber Instruments:**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
Direct GVA	£1,203,663	£1,203,663	£1,203,663
Indirect GVA	£406,163	£947,716	£1,353,880
Direct Employment	26	26	26
Indirect Employment	10	23	33
<b>GVA</b>	<b>£1,609,827</b>	<b>£2,151,379</b>	<b>£2,557,543</b>
<b>Employment</b>	<b>36</b>	<b>49</b>	<b>59</b>

Source: BiGGAR Economics

## 7.4 Summary Commercialisation impacts

The commercialisation activity described in this Chapter contributes a total of £14.1 million GVA to the UK economy and supports 246 jobs. The impact in Wales is £7.0 million GVA and 121 jobs. In Ceredigion, IBERS' research and commercialisation activity delivers £4.5 million GVA and 84 jobs. This impact is summarised in Table 7-2.

**Table 7-2 – summary commercialisation impact**

	Ceredigion	Wales	UK
<b>Seed sales</b>			
GVA (£m)	0.2	0.7	2.9
Jobs	4	14	55
<b>Collaborative research</b>			
GVA (£m)	-	-	3.3
Jobs	-	-	64
<b>New company formation</b>			
GVA (£m)	4.4	6.3	7.8
Jobs	80	107	127
<b>Total Commercialisation Impact</b>			
<b>GVA (£m)</b>	<b>4.5</b>	<b>7.0</b>	<b>14.1</b>
<b>Jobs</b>	<b>84</b>	<b>121</b>	<b>246</b>

Source: BiGGAR Economics

## 8 MARKET VALUE OF IBERS' VARIETIES

In section 7-1 it was estimated that the sale of seeds to produce varieties of oats developed by IBERS generated around £0.8 million per year in sales revenue for seed growers in the UK; however, this value represents only a small fraction of the total value of the crop. This chapter considers the wider impact of the oats grown from IBERS' varieties on the UK food sector.

### 8.1 Market Value of Oats Grown from IBERS' Varieties

Oats are used for a variety of different purposes in the UK. The oil extracted from oats is used in premium cosmetics, oats are an important feed for poultry and horses but the biggest market is for human consumption. The market for oats for instant cereal alone is estimated to be worth around £120 million while the market for porridge is said to be worth a further £40 million. The market for ready to eat cereals, granolas and mueslis is estimated to be worth a further £19 million while the growing market for oat based bars and biscuits is believed to be worth around £10 million. Taken together this suggests that the UK market for oats for human consumption alone is worth at least £189 million.

It has been estimated that IBERS' oats varieties currently represent around 65% of the oats used in the UK each year. This suggests that almost £123 million of this market is attributable to IBERS' varieties. As discussed in section 7-1, the development of IBERS' varieties is undertaken collaboratively with a commercial seed developer so it was assumed that half of these sales could be attributed directly to IBERS.

The extent to which this represents an additional benefit to the UK economy depends on whether IBERS' varieties have actually helped to increase the overall size of the market or simply enabled growers to switch from planting one variety of oats to another. The rapid growth that has occurred in the market for oats in recent years suggests that the former scenario is more likely.

IBERS has made a significant contribution to this growth by helping to develop varieties with beneficial traits such as higher oil content (which makes oats a more nutritious animal feed) and improved health benefits for human consumption. This suggests that if IBERS' oats varieties had not been developed the overall size of the market would be considerably smaller.

The value of this market is reflected in the turnover of companies that sell oat products for human consumption. The economic impact of these companies can be estimated by dividing the turnover supported by IBERS' varieties by a turnover/GVA ratio in this sector. The number of jobs supported by these sales was then estimated by dividing the total turnover by an estimate of turnover/employee in the sector. In this way it was estimated that IBERS' oats varieties generated £10.0 million GVA for the UK economy in 2012/13 and supported 470 jobs. The indirect impacts of this were then estimated by applying appropriate GVA and employment multipliers. This suggests that IBERS' support of the UK oats market contributed a total of £19.3 million GVA to the UK economy and 805 jobs in 2012/13.

## 9 AGRICULTURAL PRODUCTIVITY

The previous chapter considered the direct economic impacts of research undertaken by IBERS in terms of returns to IBERS' commercial research partners. This chapter considers the wider impacts of this research on end users and consumers.

### 9.1 Livestock Productivity

IBERS has been responsible for developing ryegrasses and clover varieties that are the most widely used forage crops in the UK. The economic impact generated by the sale of seeds for these varieties was considered in section 7-1 but this did not consider the wider contribution that these varieties make to livestock production in the UK.

Grass and forage is an essential component in livestock production, typically making up around 75% of the dietary requirement of ruminants<sup>11</sup>. Germinal Holdings Ltd – the commercial partner responsible for marketing IBERS' varieties - supplies 28% of the seed required for the 325,000 ha of grassland sown in the UK each year. Plant varieties bred by IBERS represent 68% of Germinal Holdings Ltd seed sales.

Taken together this suggests that nearly 62,000 hectares of grassland are sown with IBERS' varieties each year and that this forage supplies around 14% of the nutritional input required by ruminants reared in the UK each year. Small improvements in the nutritional value or agronomic performance of IBERS' varieties of grass and clover can therefore have a very significant impact on the overall performance of the UK livestock sector.

A particularly good example of how IBERS' research has generated productivity improvements within the livestock sector is the work that has been done on high sugar grasses. A case study of this work is provided in Figure 9-1.

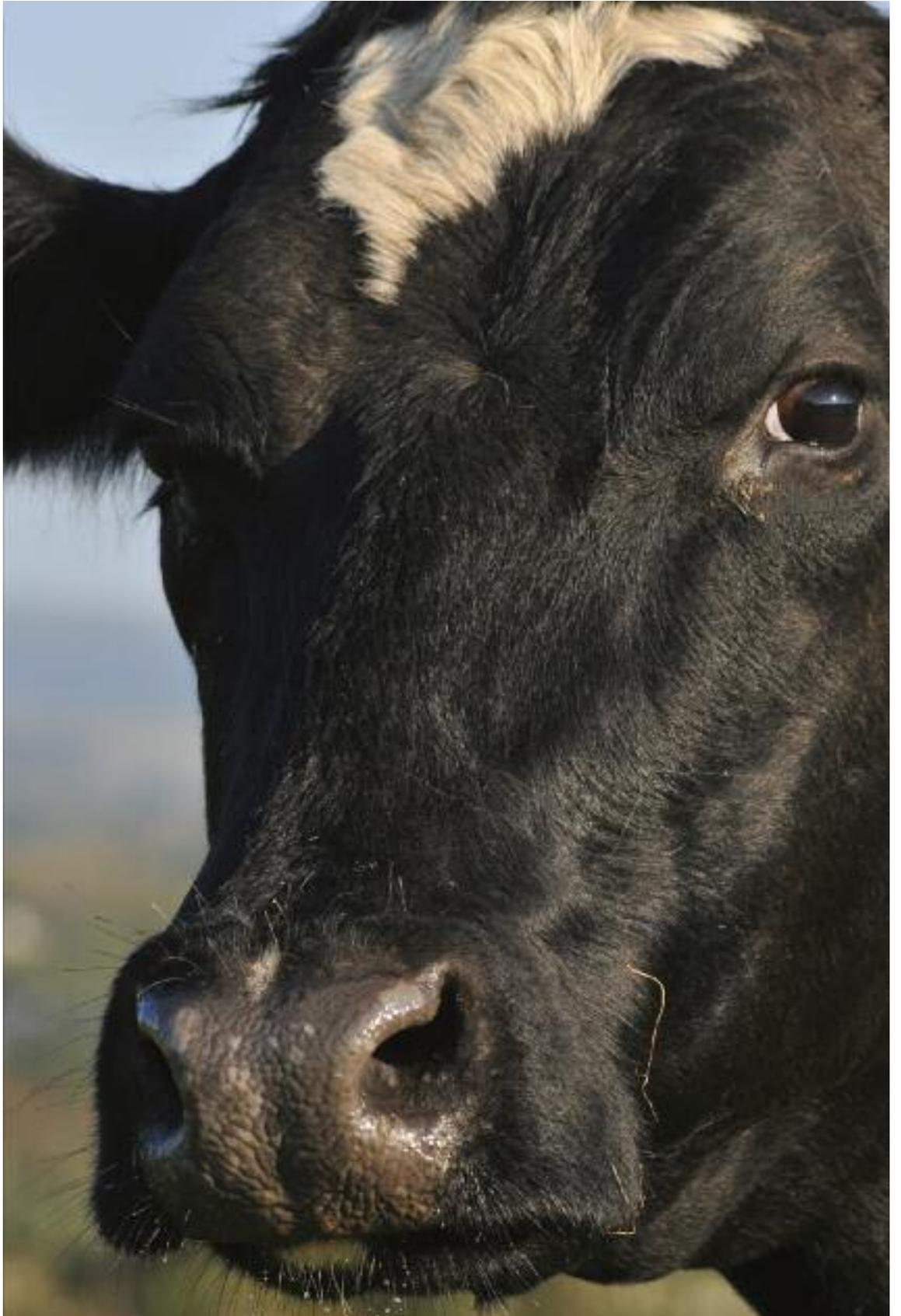
This case study shows that IBERS' research into high sugar grasses has helped to generate a productivity improvement within the UK dairy sector of £78.2 million over 5 years, or £15.6 million per year. In 2012 the total value of dairy production in the UK was £3.8 billion<sup>12</sup>. This suggests that in 2012/13 IBERS generated a productivity improvement that accounted for 0.4% of the value of the sector.

Dairy cattle of course represent only one component of ruminant production in the UK. Other components include beef and veal production and mutton and lamb production, which were respectively worth £2.8 billion and £1 billion in 2012. Grass fodder is an important part of the diet for these animals in just the same way as it is for dairy cattle so it is reasonable to expect that improvements have also been realised within the wider ruminant production chain.

By assuming that the annual improvement within the beef and veal and mutton and lamb production sectors is similar to that experienced in the dairy sector, it can be estimated that IBERS' varieties have

<sup>11</sup> *Cotswold Grass Seeds Direct website as at 14/02/14.*

<sup>12</sup> *DEFRA (2012), Agriculture in the UK.*



generated a productivity improvement of £11.5 million for the beef and veal sector and £4.1 million for the mutton and lamb sector. This equates to a total productivity improvement of £31.3 million per year.

As described in the previous case study, the proportional gains to beef and lamb farmers in terms of improvements to live weight gain have actually been higher than the gains experienced by dairy farmers in terms of higher milk production. This suggests that the impact quantified in the previous chapter could well be an underestimate.

## 9.2 Upland Management

The UK's uplands account for 43% of all its agricultural land (up to 80% in Wales) and this land carries 60% of sheep and beef livestock and the majority of commercial timber production. Upland river catchments also provide 70% of the UK's water supply, are a major carbon store, biodiversity haven and tourist attraction and encompass several severely disadvantaged areas.

Upland agricultural output has fallen during the past 15 years. For food security and economic stability in the face of climate change and globalisation it would be advantageous to reverse this trend and this has been an important focus for much of the research undertaken by IBERS in recent years. Improving the productivity of the UK's uplands might be achieved in a variety of different ways including:

- changing land management practices in order to improve productivity of existing operations;
- identifying new ways of using unproductive land; or
- developing new uses for low value crops.

All of these activities help to improve the productivity of agricultural land in the UK, which generates a productivity benefit for the UK economy. In order to illustrate this productivity impact it is helpful to consider the effects of IBERS' recent research on upland grazing systems. This is done in the case study at Figure 9-2.

The economic benefits described in this case study have been generated over a period of around 10 years. This implies that the marginal impact of this research in 2012 was around £1.5 million, which represents 0.02% of the total value of ruminant production in the UK that year.

### 9.2.2 Pwllpeiran Upland Research Platform

As part of the new AIEC development, IBERS propose to invest around £2.5 million in the Pwllpeiran Upland Research Platform. The objective of the Pwllpeiran Upland Research Platform will be to link the on-going work within IBERS to industrial and societal need and to evaluate opportunities within an uplands environment by establishing a major platform at the heart of pastoral agriculture.

It is anticipated that the uplands research platform will help to:

- define new environmentally-friendly farming systems that help protect and enhance biodiversity and ecosystem services within our uplands whilst providing farmers with sustainable incomes;
- develop red meat animal production systems that minimise their environmental footprint by incorporating innovations in nutrition, management and genetics and will rebalance production to the uplands currently suffering from reductions in biodiversity;
- anticipate development in new management and modelling tools that will allow upland agriculture to be visualised and managed in a spatially-aware fashion to ensure benefits are maximised and costs, both financial and environmental, are minimized;
- build on existing strategic relationships with Waitrose and other retail sector suppliers, and their supply chain links, to drive the translation of research into commercial activity.

### Figure 9-2 – Upland grazing systems

**Forty three per cent of agricultural land in the UK is located in the hills and uplands. Often this land is amongst the least productive agriculturally so identifying ways of improving the productivity of these areas can have a significant impact on the UK agricultural sector.**

Following changes to the Common Agricultural Policy, the number of cattle being kept on rough grazing fell and there were concerns that this could exacerbate biodiversity declines. To address these concerns, scientists at IBERS set about quantifying the benefits of retaining cattle within the uplands.

This research involved ten years of field-scale studies at the Bronydd Mawr and Pwllpeiran research centres. The research confirmed the vital role that cattle can play in restoring and maintaining biodiversity within priority habitats. The research was also able to demonstrate that grazing both cattle and sheep on improved upland pasture (rather than just one or the other) could generate a 10% improvement in sheep performance.

The findings of this research were very influential and have been used to underpin the development of a number of important agri-environment schemes. In Wales the research informed the development of mixed grazing options within the Glastir Entry (Option 15c and 15d) and Glastir Advanced (Option 41b) agri-environment schemes. In 2012 around 1,700 Glastir Entry contracts were signed, covering a total area of 154,000 hectares.

The research has also provided an evidence base for policy implementation in England. In particular it has influenced the development of the priority UL18 cattle grazing option within the Upland Entry Level Scheme (UELS) that was launched in 2010. The cattle grazing option has been one of the most popular UELS options across England and to date has been included within 3200 agreements covering an area of nearly 200,000 hectares.

The Farm Business Survey in Wales based in IBERS in 2012 covered 88 farms covering a total upland area of 8,844 hectares. The value of sheep reared on these uplands amounted to £3.8 million – or an average value of £428 per hectare.

A 10% productivity improvement on these farms would therefore equate to almost £43 per hectare. By applying this value to the number of hectares that have signed up to the mixed-grazing agri-environment schemes referred to above, it can be estimated that this research may have contributed £15.1 million GVA to the Welsh economy.

## 9.3 Cumulative Agricultural Productivity Gains

The case studies described in Figure 9-1 and Figure 9-2 suggest that recent research undertaken at IBERS has improved the productivity of the UK ruminant production sector by around 0.4%. It is however important to note that this does not represent the entire agricultural productivity impact generated by IBERS in 2012 but only the *marginal additional increase* realised that year.

The nature of agricultural productivity improvement is permanent and cumulative. This means that gains realised in one year will be realised again in each subsequent year as each new technological innovation is reapplied to new forage varieties. On-going research means that the number of innovations is continually increasing, causing the total cumulative impact each year to increase. In order to estimate this impact, it is therefore necessary also to consider the marginal increases that have been generated by historic innovations developed by IBERS.

Two of the most significant of these innovations were considered as part of a previous economic impact assessment undertaken on behalf of IBERS in 2009<sup>13</sup>. These innovations are considered below.

### 9.3.1 Greater Reliance on Forage

One of the most significant contributions that IBERS has made to the productivity of ruminant production is to help increase the contribution of grassland to livestock feeding across the UK. It is estimated that in the 1970s expensive concentrate feeds accounted for around 24% of ruminant diets in the UK. By 2007 it was estimated that this contribution had fallen to 17%.

Much of this change is believed to have been possible by IBERS' research on improving forage production and quality and on increasing forage utilisation through improved silage and grazing management. For UK grassland farmers, this greater reliance on forage for grazing and silage was estimated to have been worth around £400 million per year in savings on purchased feeds in 2009 – or around £454 million in 2012 prices.

### 9.3.2 Fertiliser Cost Savings

Although the recent agricultural productivity gains discussed in this chapter have been associated with IBERS' work on new varieties of high sugar grasses, IBERS' forage varieties also include varieties of clover. Previous and on-going research undertaken by IBERS has led not only to the development of new clover varieties but also improved clover management techniques. This research has led to increased use of clover on UK grassland farms that was estimated to provide potential fertiliser cost savings to farmers in the UK of between £6.8 million and £13.5 million per year in 2008-9 - or between £7.7 and £15.3 million in 2012 prices.

<sup>13</sup> DTZ (October 2009), *Economic Impact of the Institute of Biological, Environmental and Rural Sciences: Research and Operational Activities*.

### 9.3.3 Total Current Agricultural Productivity Benefit

The combined value of the impacts described in sections 9.3.1 and 9.3.2 amounted to £462 million in 2012 prices. In 2012 the combined value of ruminant production in the UK amounted to £7.6 billion. This suggests that the value of historic productivity benefits generated by IBERS' research are equivalent to 6.1% of the total value of ruminant production in the UK in 2012. Combined with the marginal additional benefit generated by recent research (section 9.3), this suggests a total productivity benefit of 6.5% of livestock production in 2012.

Although the research that enabled this benefit to be realised was undertaken by IBERS, this was undertaken in close collaboration with IBERS' commercial partners. For this reason it is appropriate to attribute half of the total productivity benefit to IBERS. This suggests that the total livestock productivity benefit attributable to IBERS in 2012 amounted to £247.4 million GVA.

Based on data from DEFRA it is estimated that Wales currently accounts for around 15% of the value of the UK livestock sector so it was assumed that around 15% of this impact was retained within Wales. This equates to a productivity benefit of £37.6 million.

Some care is required in interpreting this benefit because it is not directly comparable to the other benefits considered in this report. Whereas the benefits described elsewhere in this report have measured increases in the amount of economic activity in the UK, this impact measures an improvement in the efficiency with which the UK economy operates. This means that rather than increasing the overall size of the UK economy, this impact has instead helped to ensure that finite resources are used more efficiently.

In order to understand this it is helpful to consider the wider context in which IBERS operates.

Global population growth and increasing disposable incomes in the developing world have and will continue to generate unprecedented pressure on global demand for food. Basic economics dictates that if this demand cannot be met through an expansion in supply then prices must increase. Agricultural land is a finite commodity, particularly in the UK, so there is limited scope to increase domestic food supply by simply allocating more land to agricultural production. In order to fulfil its increasing demand for food it is therefore vital that the UK becomes more efficient in how it produces and uses food.

The research undertaken by IBERS has enabled livestock producers in the UK to operate more efficiently, either by reducing the cost of inputs such as feed and fertiliser or by increasing gains from a given quantity of inputs, such as feed. These efficiency improvements have therefore helped to mitigate the upward pressure on food prices that have been experienced in the UK over recent years. As upward pressures on global food prices increase in the coming years the contribution of research undertaken by institutes such as IBERS will become ever more important.



## 10 WIDER IMPACTS

This section describes the wider benefits generated by IBERS' research that cannot be fully quantified.

### 10.1 Local Economic Resilience

Chapter 5 of this report described the operational impacts that IBERS generated in 2012/13 as a result of its day to day activities, the purchases made by the Institute and its staff and students and the contribution it makes to the local tourism sector. It was estimated that these operational impacts contributed £31.6 million GVA to the Ceredigion economy and supported 690 jobs.

To help understand the scale of these impacts, it is useful to consider them within the context of the regional economy, described at Chapter 4. This analysis (Section 4.1) showed that in 2012/13 there were 24,200 employees in Ceredigion. The impact of IBERS is therefore responsible for almost 3% of employee jobs in the local economy. It is highly significant, therefore, both as a direct employer and in stimulating other jobs locally.

#### 10.1.1 High Value Employment

This report has also found evidence that the quality of jobs provided within IBERS compares well with other opportunities available locally. Section 4.3 highlighted that the median weekly pay in Ceredigion in 2013 was £428.80. Based on data provided by IBERS it was estimated that the median weekly salary of IBERS staff in 2013 was £592. The availability of this kind of high-value employment should help to retain skilled workers in Aberystwyth and support long-term economic resilience in the county.

#### 10.1.2 A Vibrant Local Economy

IBERS' students also play an important role in supporting the resilience of the Ceredigion economy. The quantitative analysis described in 5.2 shows a student impact in Ceredigion of 272 jobs and £8.2 million GVA. Along with this comes a wider impact on the vibrancy of the local area, ensuring a year round market for the County's services industry, in particular its night time economy. Enhancing the night-time economy in Aberystwyth is one of the objectives of Ceredigion County Council so IBERS therefore also plays a role in helping to achieve local economic development objectives.

Section 5.2 also quantified the impact of students because of the part time work they undertake during their studies. So not only do they provide a market for goods and services within Ceredigion, they also provide a well-qualified supply of employees to the local labour market.

#### 10.1.3 A Year Round Tourism Industry

Section 5.3 of this report quantified the contribution that IBERS makes to Ceredigion's tourism market as a result of the personal and professional visitors who come to see IBERS students and staff each year. In addition to the quantitative impact it is also anticipated that some of the business tourism visitors who come to visit IBERS' staff may subsequently come back purely as tourists.

Importantly the visitors who come to Aberystwyth because of IBERS do so throughout the year. Tourism is usually very seasonal in seaside resort towns like Aberystwyth so this is an important benefit for the local tourism sector.

IBERS also contributes to the tourism 'offer' of Aberystwyth through the facilities it provides in the town. For example, it has an Olympic sized equestrian arena, which may fit well with Ceredigion's "Holidays for Horses" tourism initiative.

#### **10.1.4 Securing Local Services**

The local economic activity generated by IBERS also helps to secure important local services. For example, Ceredigion County Council used IBERS' presence in Aberystwyth as part of its lobbying efforts to encourage the Welsh Government to locate parts of the Natural Resources and Food Department in the town.

The Council has also recently been involved in lobbying efforts to try and secure additional rail services between Aberystwyth and London. An important part of these efforts was to highlight the needs of Aberystwyth University students (including IBERS' students), who frequently travel in and out of the town.

## **10.2 Competitiveness of UK Agri-food Sector**

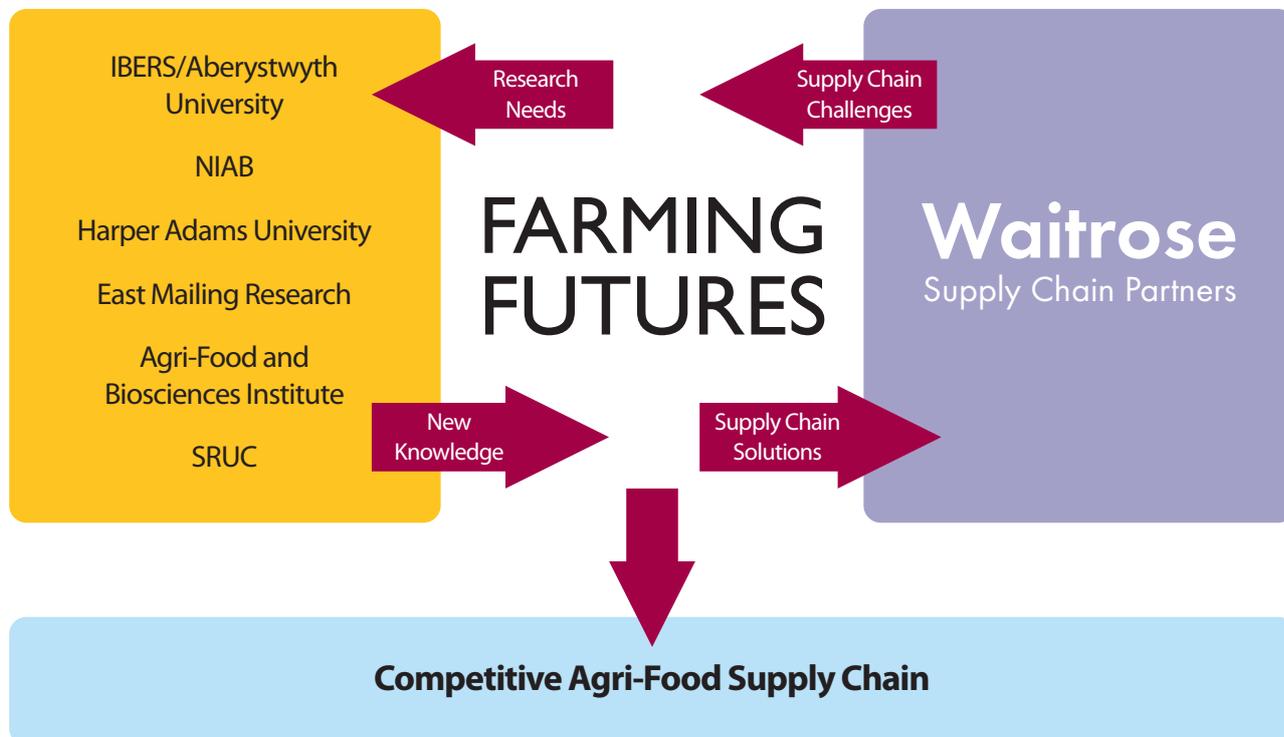
IBERS also helps to support the competitiveness of the UK agri-food sector through the contribution it makes to Farming Futures. Farming futures is a formal structure set up to facilitate dialogue between industry and academia that grew out of initial discussions between IBERS and Waitrose.

Farming Futures aims to create a profitable and sustainable agricultural industry driven by innovation, long-term thinking and climate change action. The need for such a partnership was driven by a need to address the competing priorities of increasing food production in the UK while simultaneously reducing the greenhouse gas emissions.

Farming Futures is led by IBERS but partners in the group now also include:

- the National Institute of Agricultural Botany (NIAB) in Cambridge;
- Harper Adams University near Newport;
- East Malling Research in Kent;
- The Agri-Food and Biosciences Institute in Belfast; and
- Scotland's Rural College (SRUC) near Edinburgh.

Farming Futures aims to rebuild connections between academics and professionals working in the UK agri-food sector in order to address the disconnect that has opened up over the past 20 years between fundamental and applied research. The partnership aims to encourage the private sector to invest in the UK food supply chain in order to reduce waste and carbon emissions and improve the competitiveness of the UK agri-food sector. This process is illustrated in Figure 10-1.

**Figure 10-1 – Farming Futures contribution to UK agri-food supply chain**

Source: BiGGAR Economics based on Farming Futures Annual Report 2013

The Partnership has been extremely influential in the development of the UK strategy for agricultural technologies that was published in December 2013<sup>14</sup>. The strategy aims to better integrate the UK's food and farming businesses with its "world-class" science base in order to "unlock a new phase of global leadership in agricultural innovation". In doing so the strategy aims to support the continued development of a sector that it estimates contributes £96 billion a year to the UK economy – or 7% of GVA

### 10.3 Food Security

According to the UN, food security exists "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". With the global population estimated to increase to 9 billion by 2050, experts expect that global food production will have to increase by 70% compared to 2005-7 levels<sup>15</sup>. This means that food security is likely to remain a growing area of concern.

Food insecurity has important implications both at home and overseas. For consumers in the UK, food prices have increased by 26% between 2007 and 2011, more than 12% in real terms<sup>16</sup>. Overseas, one of the consequences of growing food insecurity has been increasing political instability.

<sup>14</sup> Department for International Development (December 2013), UK strategy for agricultural technologies.

<sup>15</sup> DEFRA (August 2009), UK Food Security Assessment, our approach.

<sup>16</sup> Global Food Security, UK Facts and figures.

There are two ways in which IBERS makes a particular contribution to food security, both domestically and overseas these are:

- food availability – i.e. the supply of food available; and
- stability – i.e. the resilience of this supply to sudden shocks such as drought and disease.

Domestically IBERS helps to improve food availability by undertaking research that improves the productivity of UK agriculture and livestock production (see chapter 8 for examples). Overseas IBERS' research has been particularly beneficial in helping to secure the stability of food supplies.

For example over the past five years scientists at IBERS have used novel techniques of genetic marker-aided selection to development of new high yield, disease and drought-resistant varieties of pearl millet.

Pearl millet is an important food crop for both humans and animals in some of the harshest environments of Africa and South Asia. In India, where 40% of the world's millet is grown, at least 70% consists of genetically uniform hybrids, which are particularly vulnerable to downy mildew, the single most destructive pearl millet disease.

By 2011, IBERS' varieties of pearl millet were being grown on over 700,000 ha in rural India and it is estimated that this has directly improved the food security of three million people<sup>17</sup>.

## 10.4 Human Health Benefits

Like food security, the link between human health and economic growth is a fundamental one because an unhealthy workforce is less productive than a healthy one. Research undertaken by IBERS that helps to improve human health therefore has a positive effect on economic performance. A good example of how IBERS' research has helped to generate benefits for human health is the IBERS' oat-breeding programme.

In recent years eating oats has been shown to contribute to a reduced risk of coronary heart disease because of their  $\beta$ -glucan content. IBERS' research on variation in  $\beta$ -glucan content in oats identified sources of high  $\beta$ -glucan that have now been incorporated into the oat breeding programme. This means that oats bread from IBERS' varieties provide greater health benefits for consumers.

As discussed in section 8.1, IBERS' varieties account for approximately 65% of the oats used within the UK and have made a significant contribution to the diversification of oat based products within the breakfast cereal and snack market in recent years. This means that IBERS' research has made a direct contribution to increasing the healthy breakfast and snack options available to UK consumers.

Another area of IBERS' work that could have a significant impact on human health is work on metabolomics, which provides a methodology for surveying the chemical composition of biological and environmental samples. This work could provide a methodology for determining dietary exposure and individual responses to diet constituents in humans and domesticated animals from blood and urine analysis.

<sup>17</sup> Aberystwyth University, REF 2014 case study.

This could be used to provide more accurate information on the diet and nutritional status of the UK population using biomarker technology. This could help government departments and health professionals to improve public health interventions and could also be of value to individual consumers.

## 10.5 Contribution to International Development

IBERS' research contributes to international development by helping to improve food security in the developing world, by helping to address debilitating tropical diseases and by enabling other countries to obtain an equitable share of benefits derived from their natural resources.

### 10.5.1 International Food Security

IBERS' work on pearl millet varieties has had a direct impact on international economic development because of the income and employment it has generated for seed producers. It is estimated for example that in 2011 the pearl millet crops referred to in the previous section generated a net income of Rs 300 million (£3.6M) for seed producers in the Indian state of Andhra Pradesh and a total of 900,000 person days of employment.

The indirect impact of this activity is however much greater. Food security and economic development are fundamentally linked because if an individual does not have reliable access to sufficient food to meet their daily requirements, then they will be unable to engage in any other sort of economic activity. For this reason, food security is a pre-requisite for international economic development.



### **10.5.2 Addressing Tropical Diseases**

IBERS also contributes to international development by helping to develop approaches for dealing with diseases that are particularly prevalent in parts of the developing world. For example, IBERS' scientists have particular expertise in one of three species of flat-worm that is responsible for the neglected tropical disease schistosomiasis.

At present more than 200 million people suffer from this chronic and debilitating disease. It is estimated that 90% of sufferers live in poverty-stricken areas of sub-Saharan Africa where up to 300,000 individuals will die each year.

Scientists at IBERS are in the process of developing new strategies for controlling the parasite that causes this disease. If successful, this could have major benefits for some of the most disadvantaged populations of the developing world.

### **10.5.3 Equitable Use of Natural Resources**

Following the United Nations Conference on Environment and Development (the Rio "Earth Summit") in 1993, the UN's Convention of Biological Diversity (CBD) entered into force. The principal underlying this convention is that every country is sovereign over its own genetic resources.

The Convention was inspired by the world community's growing commitment to sustainable development. It represented a dramatic step toward the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources.

New crop breeding programmes are dependent on the collection and characterisation of diverse genetic resources. The CBD means that in future, where genetic resources are collected from one country and commercially exploited elsewhere, the benefits of the exploitation will be shared with the donor country.

Scientists working on the *Miscanthus* breeding programme at IBERS have pioneered the implementation of the CBD by negotiating international agreements on benefit sharing. These agreements will enable the species to be domesticated in accordance with the CBD, which means that any commercial gains from the breeding programme will be shared with the donor country.

As a result of this work, structures are now in place for the breeding programme that could be used for other species and by other institutions elsewhere in the world. This should help to ensure that in future countries that donate genetic resources, such as plant specimens, obtain an equitable share in the benefits derived from these resources. This could have important implications for international economic development.

## 10.6 Climate Change Mitigation

Research undertaken at IBERS also makes an important contribution to climate change mitigation.

One of the ways this is achieved is by developing varieties of forage grass that reduce the amount of methane and nitrous oxide emissions produced by ruminants. As discussed in Figure 9-1 this work has made a significant contribution to reducing the greenhouse gas emissions produced by UK agriculture.

As discussed in Figure 11-1, scientists at IBERS are also developing novel plant based substitutes for many products that are currently based on oil. If successful these efforts could help to significantly reduce future reliance on fossil fuels, which would have a positive environmental impact.

Work undertaken at IBERS also has the potential to help mitigate some the impact of climate change. For example, current work on new varieties of grass could help to reduce the future risk of flooding in the UK. This work has involved on the development of natural hybrids between ryegrass and fescue species that have large well-developed root systems.

The root-soil interactions of these species help to bring about a change in soil structure, which improves water retention. This has been shown to reduce rainfall run-off by 51% compared with equivalent grasses that were grown alongside and that are currently used extensively throughout the UK.

Research by the Environment Agency suggests that flooding in England in 2012 could have cost the UK economy close to £600 million. Flooding in 2013/14 has been even worse so it is likely that these costs will be even greater. IBERS' research on these grass varieties therefore has a significant potential economic impact.

## 10.7 Better Public Policy

IBERS' research makes an important contribution to public policy in a number of different areas and this can have positive economic benefits. For example, research undertaken at IBERS on the benefits of mixed grazing in upland farms has been used to underpin the development of a number of important agri-environment schemes in both England and Wales. These schemes have helped to deliver quantifiable productivity improvements for farmers working in these areas (see case study at Figure 9-2).

Research conducted at IBERS has also helped to improve development planning decisions in the UK. This has occurred because scientists have provided specialist advice about grassland fungi that led to the notification of two SSSIs (sites of special scientific interest) and to changes in SSSI notification guidelines.

## 11 FUTURE IMPACT OF IBERS

This chapter considers the future economic impact of IBERS. The approach used to estimate each of the future impacts is exactly the same as the approach used to estimate the corresponding current impact.

### 11.1 Future Operational Impacts

This section quantifies the future economic impact of IBERS. It is based on the current projections contained within the draft AIEC business case.

#### 11.1.1 Future Core Operational Impacts

The future operational impacts of IBERS will be largely determined by the extent to which current activity increases as a result of the development of the new AIEC. The proposals for the AIEC are expected to increase IBERS' revenue by £10.3 million by 2020. It is also expected that non-pay expenditure (i.e. expenditure on supplies and services) will increase to £2.5 million over the same period. This growth is expected to be in addition to the current activity undertaken at IBERS.

Using the methodology set out in section 5.1.1, this suggests that by 2020 IBERS could be directly contributing £27.5 million GVA to the UK economy each year.

It is expected that staff costs will increase by £3.3 million by 2020. Assuming that the average staff costs are maintained then this implies that by 2020 IBERS will be almost 450 jobs.

Using the methodology described in section 5.1.2 it can be estimated that by 2020 IBERS' expenditure on supplies would generate £6.1 million GVA and support around 115 jobs by 2020. Using the methodology described in section 5.1.2 it can also be estimated that IBERS' additional expenditure on staff costs would increase the total impact of staff spending to £8.8 million GVA by 2020 and that this spending would support around 210 jobs.

In order to develop the AIEC Aberystwyth University proposes to invest £35 million in the development of a new campus on its Gogerddan site. Of the total amount invested, up to £2.5m is earmarked to develop the Pwllpeiran Upland Research Platform, in the Cambrian Mountains, a unique facility which will concentrate on enhancing and improving upland agriculture through research based innovations, training and development. New infrastructure and facilities will be developed to attract companies and researchers interested in creating commercially viable new products, based on modern approaches to plant breeding.

Using the methodology set out in section 5.1.4 it can be estimated that this expenditure will contribute a total of £36.0 million GVA for the UK economy and support around 760 years of construction related employment.

### 11.1.2 **Future Impact of Other Operational Impacts**

It is expected that the investment that will be made in the AIEC will make IBERS more attractive to potential students and help to increase the number of students applying to study at IBERS each year. Eventually it is likely that this will be reflected in student numbers, which would increase the impacts associated with student spending and part-time employment.

For example, one of the flagship initiatives that will be developed as part of the new AIEC campus is a new facility for delivering executive training. The new facility will be developed within the historic mansion house at Plas Gogerddan, which will be refurbished to provide state-of-the-art executive training facilities for Continuous Professional Development. AIEC will particularly target senior executives from the retail sector where there is a perceived need for training and coaching in areas such as genetically modified organisms (GMO), policy and synthetic biology which are emerging science-led themes. The centre's facilities will also be used to support the entrepreneurial training of students, staff and graduates.

At this stage it is not possible to estimate how much student numbers may increase so it is not possible to quantify this future impact but it is reasonable to expect that there would be some growth. Any growth in student numbers would also lead to an increase in the number of visits from friends and family, which would lead to an increase in tourism expenditure. As the future number of students cannot be estimated at this stage, it is not possible to quantify the future scale of this impact.

The increase in staff numbers and activity envisaged as part of the AIEC would also help to generate a small additional tourism impact. This impact was estimated using the same methodology outlined in section 5.3. Using this methodology it was estimated that by 2020 IBERS could be generating a tourism impact of £0.4 million GVA per year and supporting 15 tourism related jobs across the UK.

## 11.2 **Future Impact of Commercialisation**

The future impact of commercialisation activity will be driven by the research that is currently being undertaken by IBERS. Consultations undertaken to inform this study identified numerous examples of research that has the potential to generate additional economic impact in the future. In some cases the scale of these potential impacts could be very substantial.

The nature of research commercialisation means that some of these will prove more fruitful than others but at this stage it is impossible to judge which may be which. It is also very difficult to predict exactly how the impact from different areas of research might be realised.

In some cases research may lead to the formation of a new spin-out company. For example, current research within the Animal and Microbial Sciences theme has led to the development of a patented system to test the effectiveness of anthelmintic drugs that is much faster than the current process available to the pharmaceutical sector. This process may become the basis for a new spin-out contract research organisation delivering anthelmintic screening services.

In other cases research may lead to the development of new products or processes, which could support additional employment within existing businesses. A particularly good example of this is the work that is currently being undertaken as part of the BEACON project. A case study of this work is provided in Figure 11-1.

### **Figure 11-1 – Biorefining**

**Oil based platform chemicals are currently used in the manufacture of a huge variety of consumer goods ranging from hair styling products to plastics. In recent years concerns about the environmental impact of fossil fuels has encouraged the industries that rely on these chemicals to consider bio-refining as a future source of renewably sourced chemical feed-stocks.**

Bio-refining is the process of converting living and recently dead biological material (biomass) into a variety of marketable products and energy. A bio-refinery therefore performs the same function as an oil refinery but uses plant matter rather than crude oil. Platform chemicals derived in this way have advantages in terms of renewability and reduced environmental impact. In the longer term such products are also more economically sustainable in the face of rising oil prices.

The BEACON project is led by Aberystwyth University in collaboration with partners at Bangor and Swansea Universities. It was established with £10.6 million from the European Regional Development Fund. The objective of the project is to establish links between the business community and academia within Wales in order to develop new products and processes that will support economic growth, create highly skilled jobs and encourage inward investment.

As a result of this project one of IBERS' industrial partner has now constructed a pilot bio-refinery facility in order to demonstrate the technology. If successful, this could stimulate further investment by other companies and in other parts of the UK.

It is impossible to estimate what the ultimate economic impact of this project could be; however, the project has already supported the creation of more than 30 new jobs. It has been estimated that by 2025 Europe's bioeconomy could generate 130,000 jobs and support €45 billion so it is likely that this impact could increase significantly over the coming years

Given the difficulties of identifying which areas of research may lead to commercialisation outcomes and what these outcomes may be, attempting to quantify the future impact of commercialisation activity by estimating the future impact of each individual area of research is unlikely to deliver robust results. Instead a better approach is to consider the overall impact that might be associated with future levels of industrial engagement.

The starting point for doing this was the benefits that IBERS expects to realise as a result of the development of the new AIEC. These benefits include:

- an increase in the amount of investment made in commercially driven R&D from around £800,000 per year to around £850,000;
- the creation of 150 new jobs, either in new companies or by increasing employment in existing companies;
- an increase in the amount of income received from joint projects with industry to £3.3 million per year;
- the development of 25 new processes, products, technologies or services; and
- the provision of assistance to 300 SMEs and commercial partners.

These benefits are likely to be complementary rather than additional to one another. For example the support provided to the 300 SMEs and commercial partners referred to in the final bullet point is likely to lead to the development of some of the 25 new products, processes, technologies and services identified in the fourth bullet point, which is in turn likely to lead to the creation of some of the new jobs identified in the second bullet point.

For this reason the future impact of commercialisation activity was quantified by estimating the impact of the 150 new jobs that IBERS expects to create. Using the methodology described in section 7.2 it was estimated that by 2020 commercialisation activity associated with IBERS could be contributing £22.6 million GVA to the UK economy each year and supporting 396 jobs. A breakdown of this impact within each of the study areas is provided in Table 11-1.

**Table 11-1 – Future impact of IBERS’ commercialisation activity**

Location of Impacts	Ceredigion	Wales	UK
Total GVA (£m)	7.3	11.3	22.6
Total Employment (jobs)	135	195	396

Source: BIGGAR Economics

## 11.3 Future Impact on Agricultural Productivity

### 11.3.1 Oats

It is estimated that the UK oats market is currently growing at around 5% per year. It is assumed that this rate of growth could continue for the next four years. If this occurs then it can be estimated that by 2020 the total value of the market could be £265.9 million. Using the approach described in section 1.1, it can be estimated that by 2020 the impact of this market that can be attributed to IBERS could amount to £23.4 million GVA and supporting 979 jobs.

### 11.3.2 Biomass

As a result of changes made to the Common Agricultural Policy in 2003 livestock numbers in many upland areas across the UK fell. As a result, large areas of the country that were formally used for rough grazing have been allowed to revert to scrub. If left unchecked then this usually results in the land becoming dominated by just one or two plant species, which has an adverse impact on biodiversity in the affected areas. In order to combat this, land managers currently cut down and dispose of unwanted plant growth.

In recent years, as the amount of scrub-land has increased, disposal costs have become an increasing problem for many land managers. In order to address this, scientists at IBERS began investigating ways in which the waste biomass could be used more productively.

As a result of this research, a process has been developed to convert the waste biomass into char and oil. Scientists at IBERS are now investigating the various ways in which these products might be used (see case study at Figure 11.1). Any new products that may be developed will generate commercial returns for the companies involved (see section 11.2) but they will also create demand for biomass, which could help to generate income for farmers and other land-managers.

Consultation with IBERS staff suggests that the UK has the potential to produce around 1 million tonnes of biomass each year without impacting on food production. Biomass for fuel currently costs around £64/tonne so the future market for biomass crops in the UK could be as much as £64 million per year.

The future GVA impact of this was estimated by applying a turnover to GVA ratio for the UK agriculture sector. The employment impacts were then estimated using average turnover/employee in the agricultural sector and indirect effects were captured using multipliers for the agricultural sector.

In this way it was estimated that by 2020, if opportunities for biomass market are fully exploited then this new market could be generating £93.3 million GVA for the UK economy and providing employment for around 1,460 people.

It is impossible to predict the extent to which this opportunity might be realised; however, even if only 20% of the UK's potential biomass resource were to be exploited, this could still generate almost £13 million per year of additional turnover for the UK agricultural sector. This opportunity will also not be realised by IBERS alone but will require continued collaboration with industrial partners. For this reason it would not be realistic to attribute all of this impact to IBERS.

In order to illustrate the potential scale of this benefit it was therefore assumed that by 2020 the UK will be exploiting 20% of its available biomass resource and that half of the impact of this new market can be attributed to IBERS. Using these assumptions it was therefore estimated that by 2020 IBERS contribution to the UK biomass market could be generating £9.3 million GVA for the UK economy and supporting around 150 jobs.

### 11.3.3 Summary Future Impact of IBERS Varieties

Taken together IBERS' varieties of oats and new biomass crops developed as a result of IBERS research could be contributing £32.7 million GVA to the UK economy by 2020 and supporting around 1,125 jobs. This impact is summarised in Table 11-2.

**Table 11-2– Future impact of IBERS’ varieties**

	Ceredigion	Wales	UK
<b>Oats</b>			
GVA	-	0.9	23.4
Jobs	-	36	979
<b>Biomass</b>			
GVA	-	1.1	9.3
Jobs	-	19	146
<b>Total Future Impact of IBERS’ Varieties</b>			
<b>GVA</b>	-	<b>2.0</b>	<b>32.7</b>
<b>Jobs</b>	-	<b>55</b>	<b>1,124</b>

Source: BiGGAR Economics

## 11.4 Future Agricultural Productivity Benefit

The future impact of IBERS’ current research on the productivity of the UK agri-food sector is considered below.

### 11.4.1 Future Impact on Livestock Production

As discussed in the case study at Figure 9-1, it is expected that on-going research into high sugar grasses would increase the returns to UK farming by a further £30.9 million over five years. This equates to an annual impact of £6.2 million. This implies that by 2020 IBERS the annual productivity benefit realised by the UK livestock production sector from IBERS’ research could amount to almost £254 million GVA for the UK economy. A breakdown of this impact is provided in Table 11-3.

**Table 11-3 – Summary agricultural productivity impacts**

	Ceredigion	Wales	UK
<b>Marginal livestock productivity gain</b>			
GVA	-	0.9	6.2
<b>Historic cumulative productivity gain</b>			
GVA	-	37.6	247.4
<b>Total Agricultural Productivity Benefit</b>			
<b>GVA</b>	-	<b>38.6</b>	<b>253.6</b>

Source: BiGGAR Economics



## 12 SUMMARY

This section summarises the quantifiable and wider economic impacts generated by IBERS in 2013 and the future benefits that might be generated by 2020.

### 12.1 Summary of Current Quantifiable Impacts

This report estimates that in 2012/13 IBERS contributed £94.5 million GVA to the UK economy, of which £55.9 million was retained within Wales and £37.6 million was retained within Ceredigion. The current GVA impacts are summarised in Table 12-1.

**Table 12-1 – Annual economic impact of IBERS in 2012/13 – GVA (millions)**

Location of Impacts	Ceredigion	Wales	UK
<b>Core Operational Impacts</b>			
Direct impact	£20.2	£20.2	£20.2
Supplier impact	£0.4	£1.8	£4.7
Staff spending impact	£2.1	£4.4	£7.0
Capital spending	£1.9	£5.5	£10.3
<b>Total core operational impact</b>	<b>£24.6</b>	<b>£31.9</b>	<b>£42.1</b>
<b>Operational Student impacts</b>			
Student spending impact	£4.2	£8.4	£9.8
Student part-time work impact	£4.0	£7.5	£8.6
<b>Total student impact</b>	<b>£8.2</b>	<b>£15.9</b>	<b>£18.5</b>
<b>Operational Tourism Impacts</b>			
Visits from friends and family	£0.1	£0.2	£0.2
Business tourism impact	£0.1	£0.1	£0.1
<b>Total tourism impact</b>	<b>£0.2</b>	<b>£0.3</b>	<b>£0.3</b>
<b>Teaching and learning impact</b>			
Knowledge transfer partnerships	£0.2	£0.2	£0.3
<b>Commercialisation impacts</b>			
Seed sales	£0.2	£0.7	£2.9
Collaborative industrial research	-	-	£3.3
New company formation	£4.4	£6.3	£7.8
<b>Total commercialisation impact</b>	<b>£4.5</b>	<b>£7.0</b>	<b>£14.1</b>
<b>IBERS plant varieties</b>			
Oat market	-	£0.7	£19.3
<b>TOTAL CURRENT IMPACT</b>	<b>£37.6</b>	<b>£55.9</b>	<b>£94.5</b>

Source: BiGGAR Economics, totals may not sum due to rounding

In addition, this report has also estimated that IBERS contributes £270.8 million GVA each year to the UK economy in the form of productivity improvements associated with graduate productivity and the performance of the UK livestock sector. A breakdown of this impact is provided in Table 12-2.

**Table 12-2– Total current productivity improvement - million GVA**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
Graduate premium	£5.3	£11.3	£23.4
Agricultural productivity	-	£37.6	£247.4
<b>Total current productivity improvement</b>	<b>£5.3</b>	<b>£48.9</b>	<b>£270.8</b>

Source: BiGGAR Economics

Taken together the total value that IBERS generated for the UK economy in 2012/13 amounted to £365.4 million GVA. This included £104.8 million in Wales, which in turn included £42.9 million in Ceredigion. This is summarised in Table 12-3.

**Table 12-3– Total current impact of IBERS - GVA (millions)**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
GVA impacts	£37.6	£55.9	£94.5
Productivity improvement	£5.3	£48.9	£270.8
<b>Total impact</b>	<b>£42.9</b>	<b>£104.8</b>	<b>£365.4</b>

Source: BiGGAR Economics

In 2012 IBERS received a total of £30.0 million in public funding. This means that for each £1 received in public funding, IBERS generated £12.18 GVA for the UK economy.

This report has also estimated that in 2012/13 IBERS supported around 2,460 jobs across the UK including almost 1,270 in Wales and more than 800 in Ceredigion. Current employment impacts are summarised in Table 12-4.

**Table 12-4 – Current annual economic impact of IBERS in 2012/13 - jobs**

<b>Impact</b>	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
<b>Core Operational Impacts</b>			
Direct impact	342	342	342
Supplier impact	11	38	89
Staff spending impact	47	103	167
Capital projects	39	116	217
<b>Total core operational impact</b>	<b>412</b>	<b>531</b>	<b>801</b>
<b>Operational Student impacts</b>			
Student spending impact	95	181	208
Student part-time work impact	176	323	367
<b>Total student impact</b>	<b>272</b>	<b>504</b>	<b>575</b>
<b>Operational Tourism Impacts</b>			
Visits from friends and family	4	7	8
Business tourism impact	3	5	5
<b>Total tourism impact</b>	<b>7</b>	<b>11</b>	<b>13</b>
<b>Teaching and learning impact</b>			
Knowledge transfer partnerships	3	3	6
<b>Commercialisation impacts</b>			
Seed sales	4	14	55
Collaborative industrial research	n/a	n/a	64
New company formation	80	107	127
<b>Total commercialisation impact</b>	<b>84</b>	<b>121</b>	<b>246</b>
<b>Agri-food sector productivity</b>			
Oat market	n/a	30	805
<b>TOTAL CURRENT IMPACT</b>	<b>805</b>	<b>1,268</b>	<b>2,461</b>

Source: BiGGAR Economics, totals may not sum due to rounding

## 12.2 Summary Wider Impacts

This study has also found evidence that IBERS generates significant wider benefits for the local and UK economies. These include:

- Helping to make the **local economy more resilient** by providing high value employment, making Aberystwyth a more vibrant place to live, supporting a year round tourism and night time economy and helping to secure important local services;
- working with companies in the food supply chain to **improve the competitiveness of the UK agri-food sector**, which generates £96 billion a year for the UK economy, or 7% of UK GVA;
- **improving food security in the UK and overseas** by increasing the available supply of food through improvements in agricultural productivity and improving the resilience of the food supply to shocks such as drought and disease;
- **contributing to the mitigation of climate change**, by developing varieties of animal fodder that reduce the greenhouse gas emissions produced by ruminants, developing plant-based alternatives to fossil fuels and developing varieties of grass that could help to reduce the risk of flooding;
- **contributing to international economic development**, by helping to improve food security and human health in the developing world and by enabling other countries to gain an equitable share in the benefits arising from the commercial exploitation of their natural resources;
- **generating human health benefits** by breeding more nutritious varieties of cereal; and
- **improving public policy decision making and land-management practice.**

## 12.3 Summary of Future Quantifiable Impacts

This report has also considered what the annual economic impact of IBERS could be in 2020, once the recently started AIEC is fully operational. It was estimated that by 2020 IBERS could be contributing £116.8 million GVA to the UK economy, of which £65.0 could be retained within Wales and £46.5 million could be retained within Ceredigion. The future GVA impacts are summarised in Table 12-5.

This report has also estimated that by 2020 IBERS could be contributing £277.0 million GVA each year to the UK economy in the form of productivity improvements associated with graduate productivity and the performance of the UK livestock sector. This impact could be higher if the development of the new AIEC results in an increase in the number of students graduating from IBERS each year. A breakdown of this impact is provided in Table 12-2.

**Table 12-5 – Future annual economic impact of IBERS by 2020 – GVA (millions)**

Impact	Ceredigion	Wales	UK
Core Operational Impacts			
Direct impact	£27.5	£27.5	£27.5
Supplier impact	£0.6	£2.4	£6.1
Staff spending impact	£2.6	£5.5	£8.8
<b>Total core operational impact</b>	<b>£30.7</b>	<b>£35.4</b>	<b>£42.3</b>
Operational Student Impacts			
Student spending impact	£4.2	£8.4	£9.8
Student part-time work impact	£4.0	£7.5	£8.6
<b>Total student impact</b>	<b>£8.2</b>	<b>£15.9</b>	<b>£18.5</b>
Operational Tourism Impacts			
Visits from friends and family	£0.1	£0.2	£0.2
Business tourism impact	£0.1	£0.1	£0.2
<b>Total tourism impact</b>	<b>£0.2</b>	<b>£0.3</b>	<b>£0.4</b>
Teaching and Learning Impact			
Knowledge transfer partnerships	£0.2	£0.2	£0.3
Commercialisation Impacts			
<b>Total commercialisation impact</b>	<b>£7.3</b>	<b>£11.3</b>	<b>£22.6</b>
IBERS' Varieties			
Oat market	n/a	£0.9	£23.4
Biomass market		£1.1	£9.3
<b>Total impact of IBERS varieties</b>		<b>£2.0</b>	<b>£32.7</b>
<b>TOTAL FUTURE IMPACT</b>	<b>£46.5</b>	<b>£65.0</b>	<b>£116.8</b>

Source: BIGGAR Economics

**Table 12-6– Future total productivity improvement - million GVA**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
Graduate premium	£5.3	£11.3	£23.4
Livestock productivity	-	£38.6	£253.6
<b>Total future productivity improvement</b>	<b>£5.3</b>	<b>£49.8</b>	<b>£277.0</b>

Source: BiGGAR Economics

Taken together, by 2020 IBERS could be generating at least £393.9 million GVA each year for the UK economy. This includes £114.8 million in Wales, which in turn included £51.8 million in Ceredigion. This is summarised in table 12-7.

**Table 12-7– Future total impact of IBERS - GVA (millions)**

	<b>Ceredigion</b>	<b>Wales</b>	<b>UK</b>
GVA impacts	£46.5	£65.0	£116.8
Productivity improvement	£5.3	£49.8	£277.0
<b>Total future impact</b>	<b>£51.8</b>	<b>£114.8</b>	<b>£393.9</b>

Source: BiGGAR Economics

This report has also estimated that the £35 million capital expenditure required to develop the new AIDC campus could generate £36.0 million GVA for the UK economy and support around 760 years of construction related employment. It is estimated that £19.4 million of this GVA and more than 400 of these years of employment might be generated within Wales and of this, £6.7 million GVA and 136 of these years of employment could be within Ceredigion.

This report has also estimated that by 2020 IBERS could be supporting around 2,900 jobs across the UK including almost 1,370 in Wales and almost 940 in Ceredigion. Future employment impacts are summarised in Table 12-8.

**Table 12-8 – Future annual economic impact of IBERS by 2019/20 – jobs**

Impact	Ceredigion	Wales	UK
Core Operational Impacts			
Direct impact	448	448	448
Supplier impact	15	49	116
Staff spending impact	59	129	209
<b>Total core operational impact</b>	<b>521</b>	<b>626</b>	<b>773</b>
Operational Student Impacts			
Student spending impact	95	181	208
Student part-time work impact	176	323	367
<b>Total student impact</b>	<b>272</b>	<b>504</b>	<b>575</b>
Operational Tourism Impacts			
Visits from friends and family	4	7	8
Business tourism impact	4	6	7
<b>Total tourism impact</b>	<b>8</b>	<b>12</b>	<b>15</b>
Teaching and Learning Impact			
Knowledge transfer partnerships	3	3	6
Commercialisation Impacts			
<b>Total commercialisation impact</b>	<b>135</b>	<b>195</b>	<b>396</b>
Impact of IBERS' Varieties			
Oat market	n/a	36	979
Biomass	-	19	146
<b>Total impact of IBERS' varieties</b>	<b>-</b>	<b>55</b>	<b>1,124</b>
<b>TOTAL FUTURE IMPACT</b>	<b>939</b>	<b>1,368</b>	<b>2,890</b>

Source: BiGGAR Economics



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