(11)

# PROGRAMA DE FORMACIÓN PARA LA INNOVACIÓN AGRARIA



# INFORME TÉCNICO Y DE DIFUSIÓN

XX Congreso Internacional de Praderas.
Programa de Formación para la Participación.

Octubre 2005

# INFORME TÉCNICO Y DE DIFUSIÓN

## 1. Antecedentes Generales de la Propuesta

| | |
|---|---|
| **Nombre** | XX Congreso Internacional de Praderas, Programa de Formación para la Participación. |
| **Código** | FIA-FP-L-2004-1-P079 |
| **Postulante** | Augusto Alejandro Abarzúa Reyes |
| **Entidad Patrocinante** | Agrícola Nacional S.A.C.E I. (ANASAC) |
| **Lugar de Formación** | Irlanda, Dublín |
| **Tipo de Formación** | Congreso. |
| **Fecha de realización** | Inicio, 24 de Junio 2005<br>Término, 03 de Julio 2005 |

## Justificación y Objetivos de la Propuesta

Desde mis inicios como Ingeniero Agrónomo siempre he estado ligado al tema de las praderas y su impacto en los sistemas de producción de leche y carne en la zona sur de Chile, actualmente me desempeño como Product Manager de Forrajeras de Agrícola Nacional, empresa que lleva mas de 57 años en la producción y comercialización de semillas forrajeras en nuestro país y el extranjero. A través de los últimos años se ha trabajado intensamente en entregar las mejores herramientas a fin de contribuir a incrementar sobre la base de pasturas la rentabilidad de los sistemas ganaderos, siendo un objetivo importante el fuerte soporte técnico y de extensión que respalda el desarrollo.

Es así y como parte de la política de la empresa no solo entregamos a los agricultores las mejores semillas forrajeras, sino que también el mayor soporte técnico a nivel nacional. Parte importante de mi trabajo es participar en el desarrollo y la investigación de la adaptabilidad de nuevas semillas en distintos lugares de Chile. Hoy día por ejemplo tenemos convenios de investigación con el INIA, desde Chillán hasta Coyhaique, y Universidades como la Católica del Maule, de Concepción, De la Frontera y Austral de Chile entre otras.

Finalmente la política de apertura de nuestro país a mercados mas exigentes y fuertemente competitivos exige captar tecnología que permita un mejoramiento contiínuo del sistema productivo actual. Y en segundo término conocer algunas de las exigencias medioambientales que a futuro nos exigirán nuestros mercados de destino.

## El Objetivo General

El objetivo general de nuestra participación en el GRASSLAND CONGRESS es captar las tecnologías necesarias para que a través de nuestro trabajo de extensión y soporte técnico el agricultor pueda mejorar su competitividad.

## Objetivo Específico

La reducción de los márgenes económicos, ha ido empujando a los ganaderos a mejorar fuertemente sus sistemas productivos, en éste contexto la pradera ha jugado un rol fundamental. La captación y posterior difusión de tecnologías tiene como objetivos específicos:

1. Mejorar la eficiencias de utilización de las praderas, Actualmente en la zona sur del país el 90% del uso de los forrajes se realiza por pastoreo directo con una eficiencia que no supera el 60%, lo cual afecta directamente los ingresos del productor, existiendo investigación de distintos países que relacionan la maximización de los consumos de praderas con la rentabilidad del sistema.
2. Maximizar la Calidad de los forrajes Conservados. Durante el período invernal alrededor del 90% de los predios lecheros del sur de Chile utiliza forrajes conservados, en una importante proporción de éstos la gran limitante para maximizar la producción es la baja calidad de los alimentos conservados, esto lleva consigo la incorporación de cantidades crecientes de concentrados a fin de mejorar la calidad de la dieta total. Afectando negativamente la rentabilidad general del sistema.
3. Reducir las perdidas en cantidad de materia seca en los procesos de conservación de forrajes. Las perdidas en ensilajes oscilan entre un 8 y un 40% del material, siendo estas agrupadas en evitables y no evitables.
4. Identificación de nuevas líneas de investigación tendientes a mejorar la calidad de las forrajeras en producción animal. A su vez establecer contacto con investigadores de Institutos europeos como el IGER y el Agricultural Research Institute of Northern Ireland.

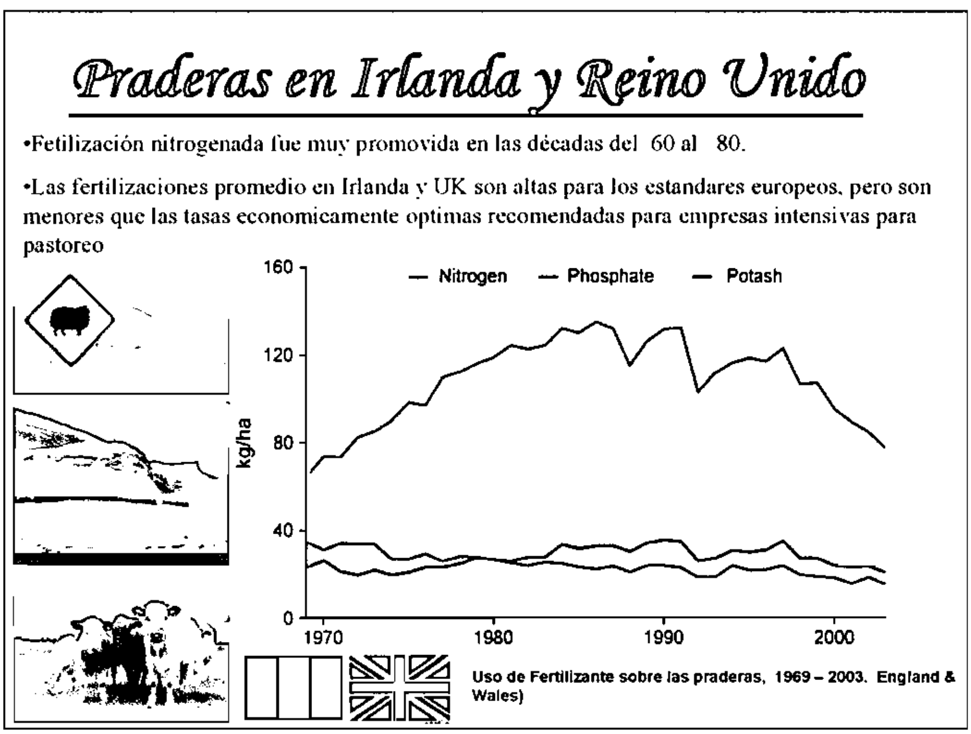
## 2. Breve Resumen de los Resultados

El Impacto Global que se pretende lograr con la participación en el Congreso es una Mejora en la Competitividad de los Sistemas Ganadero-Pastoriles de Chile, dado que nuestro trabajo actual apunta básicamente a entregar la tecnología necesaria para el desarrollo técnico económico del sector y como se mencionó en la propuesta nos permite llegar anualmente en forma directa sobre mas de 4.000 agricultores, asesores, agentes de venta y colegas profesionales a través de las más diversas actividades de difusión, como son organización de seminarios, días de campo, charlas, página Web (anasac.cl) etc.

El poder asistir a éste congreso donde se presentaron trabajos de investigadores de más de 60 países permitió conocer las principales líneas de investigación a nivel mundial en el tema de las praderas, sobresaliendo la importancia que ha cobrado en los últimos años la calidad de los productos, la seguridad alimentaria y su impacto sobre la salud humana. Al mismo tiempo se espera una demanda creciente de productos pecuarios, determinada no solo por el crecimiento económico sino también por el aumento de la demanda de países asiáticos como India y China.

Durante los 5 días de participación en el Congreso se pudieron captar importantes conclusiones que a continuación se detallan:

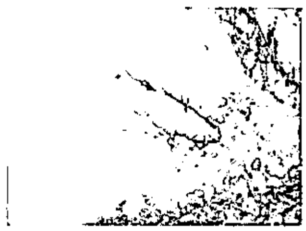
1. Durante décadas se trabajo intensamente en el desarrollo de herramientas que mejoraran la producción de forrajes (fuerte uso de fertilizantes y cultivares forrajeros más productivos) descuidando dos temas de gran importancia como son la calidad de los productos y su impacto sobre la polución mundial. En el siguiente cuadro se muestra por ejemplo la evolución de las aplicaciones de fertilizantes en los últimos 30 años y su creciente descenso.

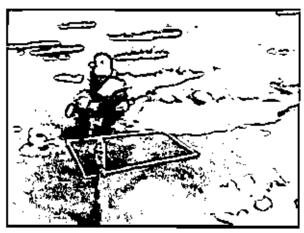



2. Hoy en día la gran preocupación de los fitomejoradores está en sacar al mercado variedades forrajeras que al menos mantengan los niveles productivos anteriores pero que representen un verdadero avance en términos de calidad y una marcada reducción de los niveles de contaminación. (variedades más eficientes en el uso de los nutrientes)

## *Praderas en Irlanda y Reino Unido*

### Contaminación de las aguas

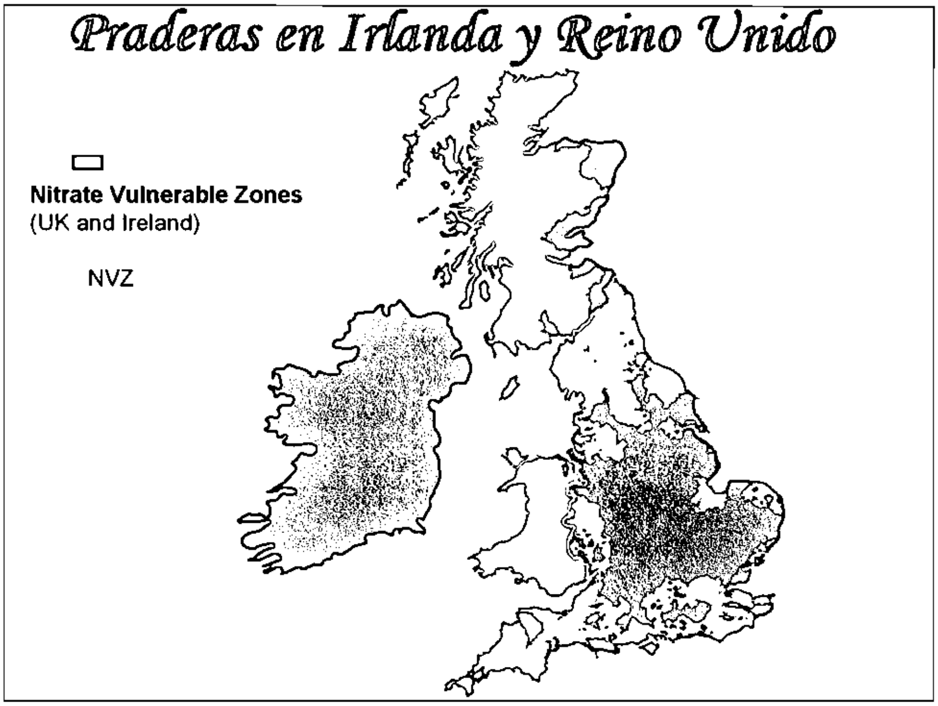




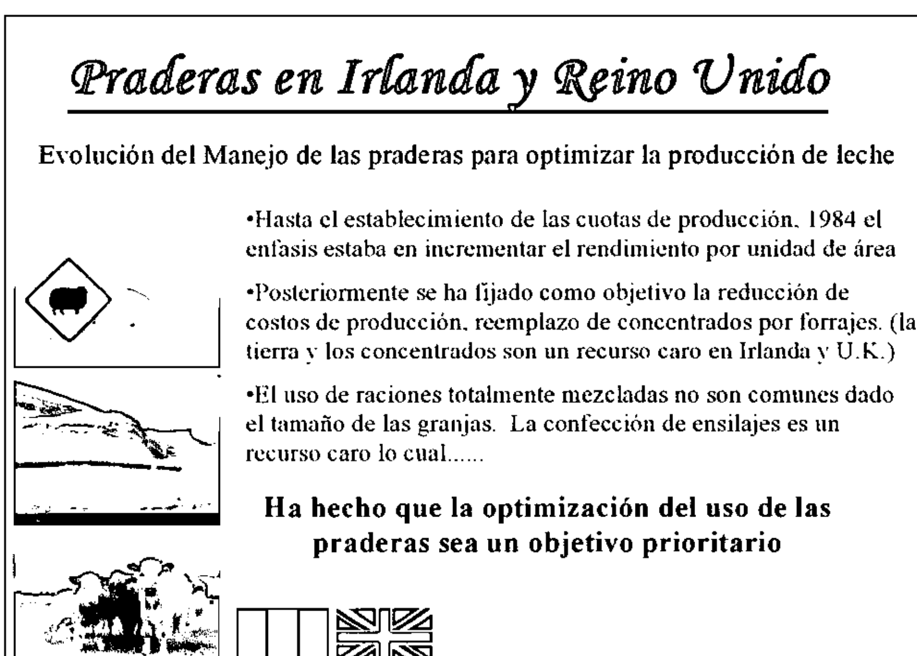
- Efluentes de Ensilajes). 1990's
- Polución difusa de nitratos

3. Existe una fuerte demanda de los consumidores hacia la elección de alimentos cada vez más seguros y sanos, y en el caso de productos de origen animal que además sean trazables

4. La intensificación de la producción en Europa por décadas apuntó a maximizar los rendimientos, con fuerte uso de fertilizantes, especialmente las fuentes nitrogenadas, esto ha llevado hoy día a una zona de riesgo de contaminación por nitratos que cubre toda Irlanda, Escocia y Gales y gran parte de Inglaterra, donde hoy día el uso de purines está restringido a solo 6 meses al año (primavera y verano) y a no permitir el uso más allá de los 170 u de nitrógeno por hectárea por año.



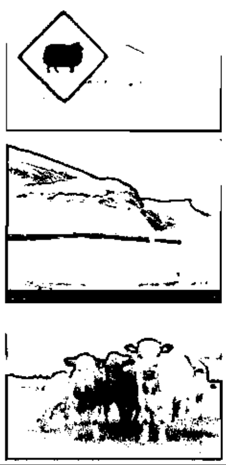

5. Desde la instauración de las cuotas de producción en Europa en 1984 se ha generado una pérdida de competitividad creciente de su ganadería, lo que al menos los tiene al día de hoy, tras 20 años de subsidios, en una posición muy frágil y expectante frente a lo que puede ser la disminución creciente de los subsidios a nivel mundial. Sin Embargo los cambios que han venido ocurriendo en los últimos 20 años los ha llevado a la optimización cada vez mayor del recurso forrajero.



6. Resulta claramente auspicioso el futuro de países como el nuestro, que han mantenido una ganadería productiva y rentable sin la presencia de subsidios a la producción tanto en forma directa como indirecta.
7. Los recursos forrajeros mas usados son las ballicas Inglesas (Lolium perenne) asociado a trébol Blanco (Trifolium repens). Muy similar a lo usado en la zona sur de Chile, ésta mezcla representa mas del 70% de las praderas que anualmente se establecen en la IX y X región de Chile, por lo que es fundamental tener los ojos puestos en lo que están trabajando los centros de investigación en éste tema.

## Praderas en Irlanda y Reino Unido

**Algunas consideraciones de las Praderas mas usadas**



- Ballica Perenne (Lolium perenne) es la especie mas sembrada (con un porcentaje superior al 80%), seguido por ballicas de rotación.
- Trébol blanco (Trifolium repens) es la leguminosa mas ampliamente usada.
- En tiempos recientes mucha investigacion se ha llevado a cabo en trebool rosado, con gran impacto en granjas organicas, otras como la lotera (Lotus sp) se ha recomendado en suelos de mayoes limitaciones.
- En muy menor grado y raramente usada tenemos la Alfalfa (Medicago sativa).
- El 73%de las praderas reciben Nitrógeno, el 60 % Fosfatos, el 59% potasio y 6% sulfatos con tasas de aplicación priomedio de 89-20-25 y 44 kg/ha Respectivamente.

**Resultados en el corto plazo:**

1. Difusión de nuevas tecnologías aplicables al ámbito técnico-comercial de forrajeras
2. Mejorar los sistemas de conservación de forrajes actualmente en uso en el país.
3. Mejorar el soporte técnico dado a los agricultores en forma directa o a través de nuestra red de distribuidores

**Resultados en el mediano y largo plazo:**

4. Mejorar el uso de los recursos forrajeros disponibles en el país y de posibles nuevos, como es el caso de cultivares Altos en Azúcar
5. Intercambio comercial con nuevas empresas forrajeras

6. Difundir e Implementar los nuevos modelos de mejoramiento de la eficiencia de pastoreo que actualmente se están desarrollando en el mundo
7. Consolidar los contactos técnicos con investigadores de nivel mundial en nuestra área de trabajo (Forrajeras de clima templado)

## 3. Itinerario de Trabajo Realizado. presentación de acuerdo al siguiente cuadro:

| Fecha | Actividad | Objetivo | Lugar |
|---|---|---|---|
| 25/06/2005 | o Llegada a University College Dublin | Ubicación en la Universidad, donde se realizará el Congreso y tomar el alojamiento por los días de duración del Congreso | Dublín, Ireland |
| 26/06/2005 | o **Inscripciones**<br>o **Ceremonia de Inauguración**<br>o **Presentación de Las Pasturas en Irlanda y el Reino Unido** | Tomar la inscripción y confirmar la asistencia<br>Participar en la ceremonia de Inauguración<br>Conocer la caracterización edafoclimática de las praderas en Irlanda y el Reino Unido como base de su sistema de producción | Dublín, Ireland |
| **27/06/2005** | **1. Asistencia a 1° sesión Plenaria**<br>1. Demanda de Productos peduarios de praderas<br>2. Mejoramiento de Gramíneas y plantas forrajeras<br>3. Mejorameiento de la calidad de los productos de las praderas | <br>Muy interesante presentación de CL Delgado ((IFPRI) el cual promueve un auspícioso futuro en términos de demanda mundial de alimentos<br>2 presentaciones de resultados de fitomejoradores en el nuevo escenario mundial de mejoramiento<br>4 presnetaciones que muestran los factores que afectan la calidad de las plantas forrajeras | Dublín, Ireland |
| **28/06/2005** | **1. Asistencia a 2° sesión Plenaria**<br>1. Praderas y forrajes para mejorar la calidad de vida y reducir la pobreza<br>2. Nutrición animal y Calidad del Forraje | <br>Como podemos mejorar la calidad de vida y reducir la pobresa en el mundo<br>Interiorizarse acerca del manejo de la nutrición animal en sistemas de base pastoril | Dublín, Ireland |

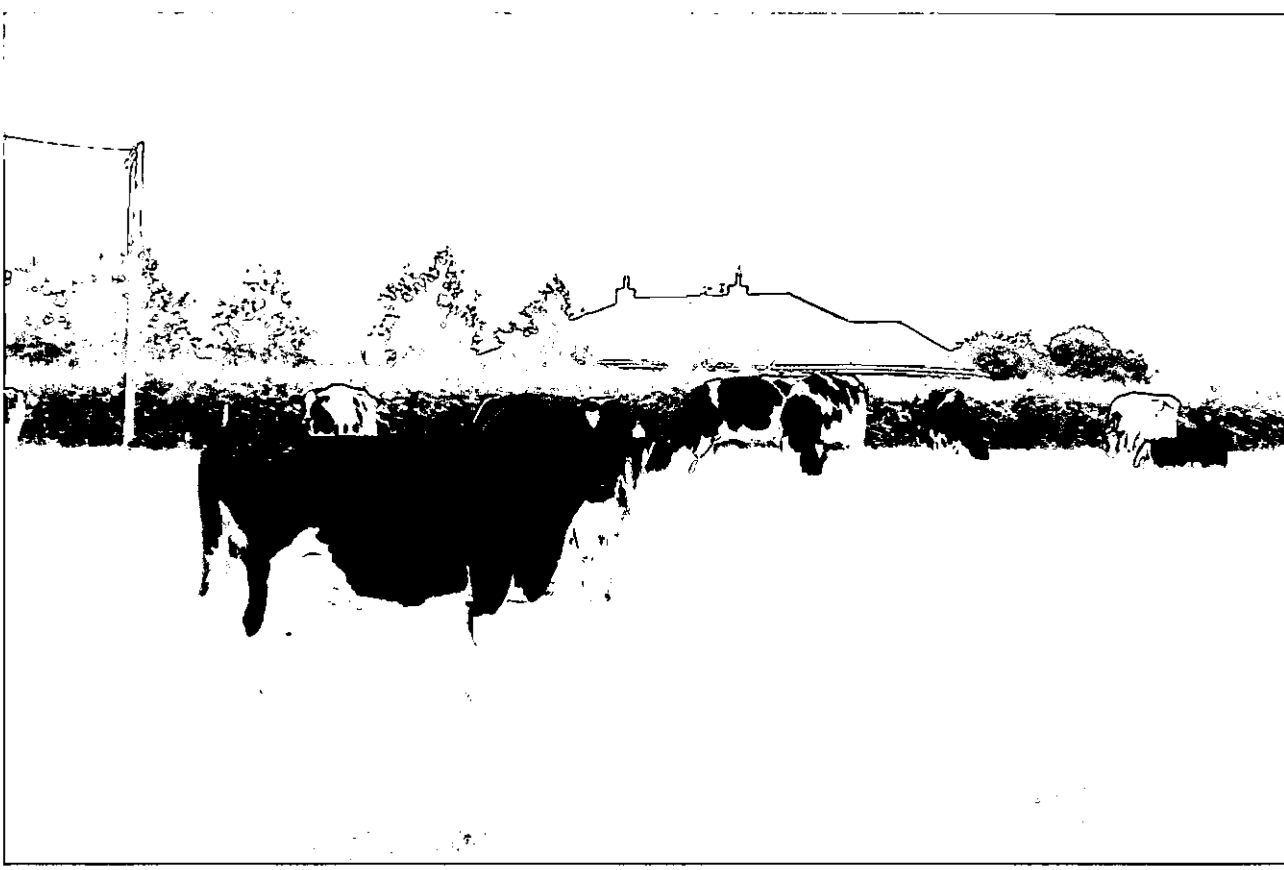
| | | | |
|---|---|---|---|
| **29/06/2005** | o **Visita técnica a la Granja de Investigación de la University College of Dublin,**<br>o **Visita a los ensayos de producción de forrajes**<br><br>o **Visita a los predios de producción ovina de la UCD y recorrido por el sistema de producción de carne** | Conocer los avances en las técnicas de producción de maiz en una zona de alta pluviometría con baja intensidad lumínica.<br><br>Conocer la producción de carne ovina y bovina en terrenos quebrados y de limitados accesos. | Dublín, Ireland |
| **30/06/2005** | 1. **Asistencia a 3° sesión Plenaria**<br>1. Praderas, Producción y Medio Ambiente<br>2. Sistemas integrados de Producción<br>3. Herramientas para el manejo de pasturas | Conocer las interacciones entre la producción de forrajes sustentable y el medioambiente<br><br>Interiorizarse de los nuevos lineamientos existentes en el manejo de pasturas de alta calidad y producción | Dublín, Ireland |
| **01/07/2005** | 1. **Asistencia a sesión Plenaria**<br>2. Estrategias para disminuir la estacionalidad de la producción en sistemas basados en praderas<br>3. Impacto de la Globalización en los sitemas pastoriles en el mundo | Nuevo enfoque del sistema de producción<br><br>Como ha afectado la globalización los sistemas productivos en distintas zonas del mundo. | Dublín, Ireland |
| **02/07/2005** | o Viaje de regreso a Chile | | |
| | o Realización de las actividades de difusión | | |

## 4. Resultados Obtenidos

La actividad de Formación consistió en la participación en el **XX Congreso Internacional de Praderas** como asistente tanto a las jornadas plenarias como en el recorrido de cada uno de los posters en los temas relacionados con nuestra formación profesional. Los conocimientos adquiridos se plasman en presentación de Power Point que forma parte del material de Difusión que se adjunta.

Los resultados obtenidos superan ampliamente lo esperado y programado. El poder interactuar con investigadores de todo el mundo en el tema de las praderas resulta en una experiencia invaluable, que además alienta fuertemente a transmitir en Chile acerca de la importancia de éste recurso y como su correcta utilización puede ayudarnos a mejorar la calidad de vida de nuestro país.

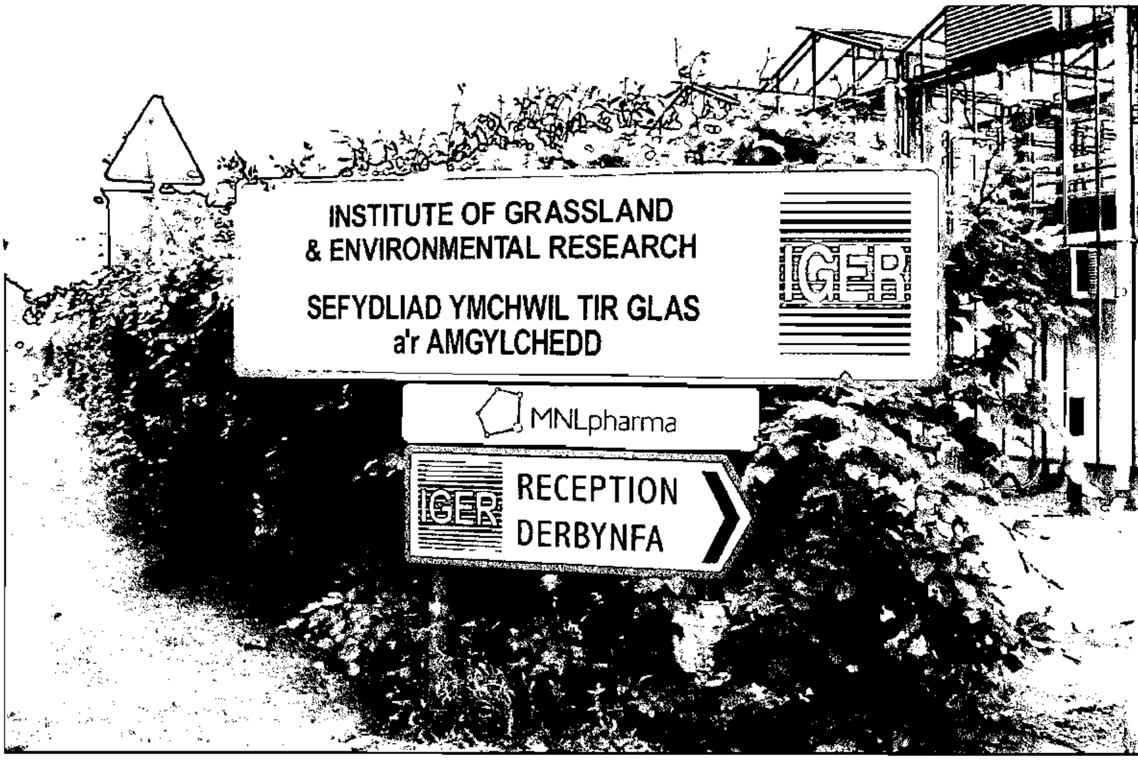
Por otro lado y dado que por nuestro trabajo en Chile tenemos posibilidad a diario de conversar y compartir con agricultores de la zona centro y sur resultó de gran valor la visita a un par de granjas lecheras, donde en terreno se discutieron las directrices de su sistema productivo, y palpar en terreno las restricciones medioambientales que actualmente poseen, donde destacan el uso del nitrógeno acotado a no más de 170 u/ha/año y la imposibilidad de aplicaciones de purines durante el invierno y el otoño, lo que en muchos casos los obliga a tener que pagar por su retiro.



Otro punto muy importante tubo que ver con la visita a la granja experimental de la UCD (Universidad de Dublín) donde se mostraron algunas nuevas tecnologías desarrolladas durante los últimos 15 años lo que a permitido incorporar a la producción de maíz para ensilaje en una zona en que históricamente no era posible su realización dada la baja intensidad luminosa y por bajas temperaturas retrasos en las fechas de siembra. A través del desarrollo de una tecnología que cubre la semilla al momento de la plantación con un material biodegradable se genera un aumento de la temperatura del suelo y una protección contra las heladas en los primeros estados lo cual permite adelantar la fecha de siembra en hasta un mes con el consiguiente incremento de los rendimientos. La incorporación del cultivo del maíz por otro lado, les permite a los agricultores la incorporación de estiércoles de lechería de difícil manejo y fuertemente contaminantes de no incorporarlos controladamente al suelo.

Respecto del tipo de animales, llama la atención la alta calidad genética de sus animales, sin embargo esto contrasta con el bajo rendimiento en leche que obtienen, lo cual es explicado por la existencia de cuotas de producción. Un tema recurrente entre los agricultores y autoridades es lo que ocurrirá el día que cesen los subsidios a la producción agrícola.

Como actividad complementaria realizamos el viaje hasta Aberytzwyth en Gales donde se encuentra el IGER, Instituto de Investigación en pasturas y medioambiente de Gales, pionero a nivel mundial en el tema de la High Sugar, establecimos contacto con Pete Wilkins, prestigioso fitomejorador y Mervyn Humphreys director de tal menera de poder algunos nuevos materiales recientemente liberados por ellos. Actualmente ya tenemos tres variedades en Ensayos de Parcela en el Sur de Chile. Las siguientes fotografías muestran nuestro recorrido por la estación.



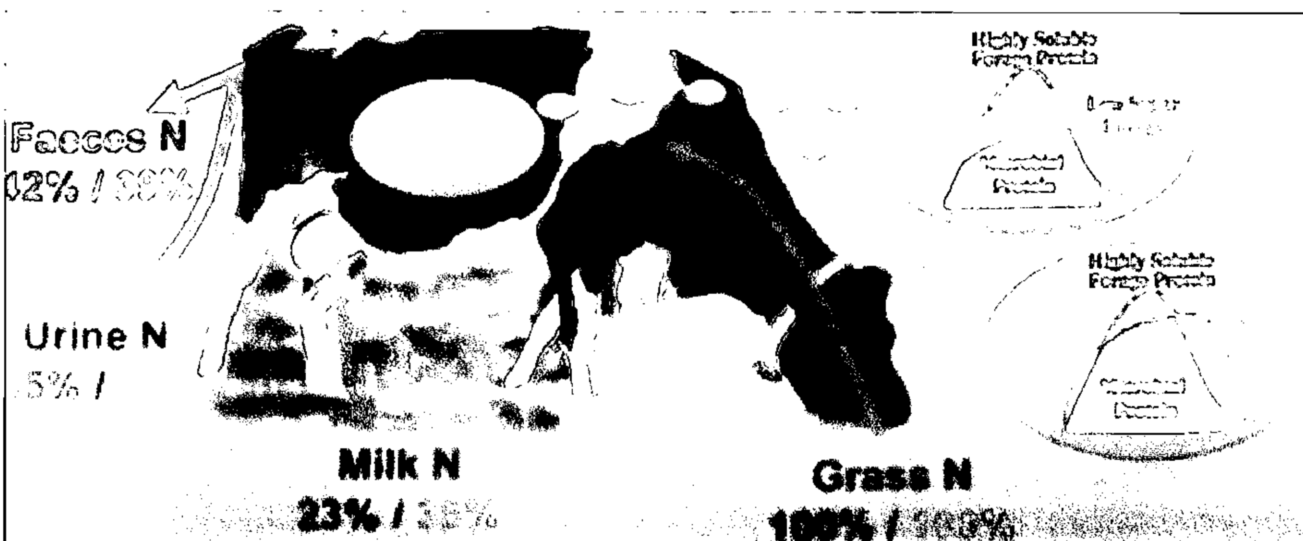

Entrada del Instituto de Investigación en pasturas y Medioambiente de Gales y Vista general de los ensayos de cultivares Híbridos Tetraploides. Julio 2005.

5. Aplicabilidad

**Leche:** Nuestro país posee una producción láctea con alrededor del 600.000 vacas lecheras, (comparados con más de 1.100.000 vacas de Irlanda y más de 2.200.000 del reino unido) fuertemente concentrada en la IX sur y décima región, donde el sistema es eminentemente pastoril, al igual que es Europa insular. Ellos han mejorado enormemente en el tema de la fertilidad de suelos y en el desarrollo de especies pratenses (ballicas) especialmente adaptadas al pastoreo. Hoy día son un modelo importante en éste tema, para lo cual debieran ser considerados por instituciones gubernamentales la traída a nuestro país de expertos en el tema que muestren acá su trabajo y resultados.

Otro tema que ya está siendo incorporado es el desarrollo de cultivares de ballicas y tréboles con altos contenidos de azúcar en hojas y en la base de los macollos. LO cual no solo mejora el rebrote sino que también aumenta el porcentaje de utilización del nitrógeno de la pradera en el rumen del animal, mejorando la respuesta productiva (hasta en 1 lt/vaca/día) y reduciendo la pérdida de nitrógeno del suelo y la contaminación de napas. En ese sentido estamos empezando a probar materiales forrajeros de origen europeo (Gran Bretaña) que podrán ser incorporados a nuestro país en años sucesivos.

Fig. 1.- ***Esquema que presenta la mayor eficiencia cuantitativa de las ballicas altas en azúcar con respecto a las ballicas convencionales en cuanto a la síntesis y utilización de la proteína en una vaca lechera.*** (IGER, 1998),




**Nota: Cifras en rojo corresponde a Ballicas con alto nivel de azúcar, cifras en azul corresponde a Ballicas convencionales**

En esta figura se explica, como esta mayor cantidad de azúcar disponibles en las nuevas variedades de ballicas, influye en forma positiva en el metabolismo de las proteínas (nitrógeno) del forraje al aumentar considerablemente la síntesis de proteína microbial lo cual hace aumentar la proteína que se fija en la leche de 23% a 35% y disminuye la proteína que se pierde por la orina de 35% a 26% y por las heces de 42% a 39% Esta menor excreción de nitrógeno a través de la orina y heces, es para los lecheros europeos de gran importancia, dado los problemas de contaminación por nitrógeno que estos países están sufriendo en el área rural

**Carne**: En el tema de la carne pudimos conocer los gustos del consumidor europeo, en términos de la exigencia de la trasabilidad y la demanda de alimentos cada vez mas seguros y saludables. Por otro lado claramente se mostró la creciente demanda a nivel mundial de éstos productos, y como en la medida que los granos a nivel mundial tenderán alza surge una real alternativa para los sistemas pastoriles de producción como los nuestros. Además se mostraron los grandes beneficios del sistema de producción de carne pastoril en términos de acidos grasos, y del calidad de la carne en vitamina E y una menor decoloración en vitrina.

Respecto de los CLA, estos provienen de la Bio- degradación ruminal de los ácidos grasos poliinsaturados (PUFA) y se ha determinado que aumentan en el producto animal en la medida que son alimebtados con dietas mayoritariamente de praderas, ayudando a controlar la diabetes, combatiendo la obesidad e incluso frente a problemas cardíacos y ciertos tipos de cáncer.

Respecto de las razas de carne empleada corresponde mayoritariamente a animales de origen continental, con fuerte influencia de animales tardíos como el Charolais y el Blonde D'Aquitania. Ëstos como se puede ver en la fotografía dominan en la República de Irlanda. En el caso del Reino Unido existe una mayor fuerza de las tradicionales razas de carne insulares como Angus, Shorton y el Hereford.

## 6. Contactos Establecidos

| Institución/Empresa | Persona de Contacto | Cargo | Fono/Fax | Dirección | E-mail |
|---|---|---|---|---|---|
| Wrightson | Wayne Nichol | Programme Leader Nutrition | | PO 939 Christchurch, New Zealand | |
| Dexcel | Errol Thom | | | Hamilton, New Zealand | |
| Iger | Mervyn Humphreys | Head of Department IGER | | Aberystwyth Ceredigion SY23 3EB UK | |
| Iger | Mike Humphreys | Grass Breeding and Grass Trait DevelopmentIGER | | Aberystwyth Ceredigion SY23 3EB UK | |
| Iger | Pete Wilkins | Principal Research Scientist | | Aberystwyth Ceredigion SY23 3EB UK | |
| Lembke | Wilbert Luesink | Grass Breeder | | D23999 Malchow/Poel | |
| Universidad de Puerto Rico | Rafael Ramos Santana | Investigador en Forrajes | | HC-5 Box 10322 Corozal, PR 00783-9713 | |
| | | | | | |

## 7. Detección de nuevas oportunidades y aspectos que quedan por abordar

.

Creo totalmente necesario posterior a la participación en éste Congreso que quienes participamos apoyemos al FIA en concretar la venida a Chile de algunos destacados investigadores de Universidades y Centros de investigación europea con quienes es recomendable mantener contactos que se forjaron en éste viaje. Varios de quienes viajaron habían realizado estudios de postgrado, y además de conocer mantienen relación cercana con destacadas personalidades de nuestra área.

Un ejemplo importante que no me cabe duda que cobrará mucha fuerza es el que tiene que ver con las regulaciones medioambientales que actualmente se exigen en Europa y que mas temprano que tarde nos exigirán para que nuestros productos lleguen hasta esos mercados.

Un segundo tema importante a abordar es la producción de alimentos saludables que puedan tener efectos benéficos directos sobre la salud humana, habiendo cobrado mucha importancia el tema de los CLA (ácidos grasos linolénicos conjugados).

## 8. Resultados adicionales

Como ANASAC y actividad complementaria al viaje, pudimos llegar hasta el IGER en Aberytswyth (Wales) Centro de Investigación pionero en el mundo en el desarrollo de cultivares forrajeros High Sugar, luego de dos días en el y de recorrer los ensayos con la compañía de Pete Wilkins y Mervyn Humphreys hemos establecido contacto directamente con ellos para comenzar la evaluación en Chile de nuevos materiales forrajeros. Actualmente estamos evaluando cultivares desarrollados por el IGER pero a través de Germinal Holding, quien licita los cultivares desarrollados por el centro.

## 9. Material Recopilado

| Tipo de Material | Nº Correlativo (si es necesario) | Caracterización (título) |
|---|---|---|
| Charla Impresa | Anexo 1 | Charla de Augusto Abarzúa entregada en cada actividad de Difusión |
| Charla En CD | Anexo 2 | Charla Presentada en cada actividad de Difusión |
| Libro (Fotocopia) | Anexo 3 | XX International Grassland Congress: Offered papers |
| Libro (Fotocopia) | Anexo 4 | Utilization of Grass in temperate animal systems |
| Libro (Fotocopia) | Anexo 5 | Grassland: a global resourse |
| Libro (Fotocopia) | Anexo 6 | Silage Production |
| Libro del Tour | Anexo 7 | UCD Research Farm |

1. Aspectos Administrativos

10.1. <u>Organización previa al inicio de la actividad de formación</u>

a. Apoyo de la Entidad Patrocinante

_X___bueno ____ regular ____ malo

Existió un fuerte apoyo de ANASAC desde el momento en que se presentó la idea a la gerencia, dado que resulta una extraordinaria oportunidad para nuestro trabajo habitual el haber podido participar en el Congreso

b. Información recibida por parte de FIA para realizar la Postulación

_X___Detallada ____ aceptable ____ deficiente

La base de postulación es clara y no presenta dificultad para llenarla.

c. Sistema de Postulación al Programa de Formación de FIA

_X___Adecuado ____ aceptable ____ deficiente

El sistema de postulación me pareció muy ágil y rápido.

d. Apoyo de FIA en la realización de los trámites de viaje (pasajes, seguros, otros)

_X___bueno ____ regular ____ malo

El apoyo del FIA fue muy bueno, ya que no existió problema alguno con pasajes y otros, además siempre existió una preocupación en pro del buen resultado de todo.

e. Recomendaciones (señalar aquellas recomendaciones que puedan aportar a mejorar los aspectos administrativos antes indicados)

En base a recomendaciones administrativas ningún comentario, ya que todo estuvo perfecto, pero solo un comentario, y dado que he mostrado muchas veces la gira en charlas con profesionales y agricultores y agradecido al FIA por el apoyo creo sería beneficioso potenciar el Programa de Formación, dando más difusión a la existencia de éste extraordinario instrumento.

10.2. Organización durante la actividad (indicar con cruces)

| Ítem | Bueno | Regular | Malo |
|---|---|---|---|
| Recepción en país o región de destino según lo programado | X | | |
| Cumplimiento de reserva en hoteles | X | | |
| Cumplimiento del programa y horarios según lo establecido por la entidad organizadora | X | | |
| Facilidad en el acceso al transporte | X | | |
| Estimación de los costos programados para toda la actividad | X | | |

En caso de existir un ítem Malo o Regular, señalar los problemas enfrentados durante el desarrollo de la actividad de formación, la forma como fueron abordados y las sugerencias que puedan aportar a mejorar los aspectos organizacionales de las actividades de formación a futuro.

## 11. Programa de Actividades de Difusión

Se realizaron 4 Charlas en Los Ángeles en el marco de los talleres de Capacitación a los equipos de venta de nuestros distribuidores. Se trata de Agrónomos y Técnicos Agrícolas que trabajan en terreno visitando agricultores y realizan apoyo técnico a la venta. Estos tienen fuertemente una orientación a producción de leche y carne y a cultivos tradicionales como el maíz y el trigo. Las fechas en que se realizaron fueron las siguientes:

- Los Angeles, Lunes 11 de Julio a las 11:00 am Equipo de COAGRA (11 personas)
- Los Angeles, Lunes 11 de Julio a las 19:00 Bioleche (15 personas)
- LosAngeles, Miércoles 23 de Agosto 11:00 am Equipo de Copeval (12 personas)
- Los Angeles, Miércoles 23 de Agosto 15:00 am Equipo de Tattersal ( 8 personas)

Se realizaron 2 Charlas en Chillán la primera en el Hotel Isabel Riquelme abierta a agricultores y profesionales ligados a los equipos de venta de los siguientes distribuidores (Coopeval, Coagra, Comercial SR, Bioleche y Tattersall). La segunda se realizó en Parral y se organizó en conjunto con Ganaparr (Ganadera Parral) y el PDP que los agrupa (Carnes Ñuble).

- Chillán, 12 de Julio a las 10:00 Reunión ampliada a agricultores y distribuidores (30 personas)

- Parral, 26 de Julio a las 19:00 hrs, Agricultores de GANAPARR y PDP de Carnes Ñuble

Se realizaron finalmente 2 actividades en Temuco, la primera en Conjunto con INIA Carillanca en Pitrufquén en las oficinas de UNICAL y la segunda en el sector Faja Maisan organizada en conjunto con Agrocomercial Bornand.

- Pitrufquén, Martes 19 de Julio 14:30, 27 agricultores y 4 técnicos del PDP Surlat, organizada en Conjunto con Oriella Romero y Fernando Ortega de INIA Carillanca
- Temuco, 19 de Agosto a las 19:00 hrs, en sector Faja Maisan, asistencia 60 agricultores.

11.1. Descripción de las actividades de difusión:

Tipo de actividad realizada y objetivo principal Las actividades de Difusión se realizaron en base a una Charla tipo que se adjunta tanto impresa como en CD. Ésta consta de 72 láminas en que se muestra el tipo de ganadería que tanto Irlanda como el Reino Unido poseen, posteriormente se presentan las problemáticas a las que están viendo enfrentados los ganaderos europeos, y los principales lineamientos de la investigación a nivel mundial. Se incluye fotografías del Congreso y de actividades anexas al congreso. Al iniciar cada una de las charlas se agradece al FIA por el apoyo en éste tipo de actividades y al terminar la presentación se promueve el uso de éste instrumento de formación.

Fecha y lugar de realización Las fechas y los lugares se detallan a continuación

- Los Angeles, Lunes 11 de Julio a las 11:00 Hotel Los Angeles
- Los Angeles, Lunes 11 de Julio a las 19:00 Hotel Los Angeles
- LosAngeles, Miércoles 23 de Agosto 11:00 Hotel Los Angeles
- Los Angeles, Miércoles 23 de Agosto 15:00 Hotel Los Angeles
- Chillán, 12 de Julio a las 10:00 Hotel Isabel Riquelme
- Parral, 26 de Julio a las 19:00 Hostería Los Acacios
- Pitrufquén, Martes 19 de Julio 14:30 Oficina UNICAL
- Temuco, 19 de Agosto a las 19:00, Cooperativa Faja Maisan

Temas tratados o exposiciones realizadas En cada una de las reuniones (salvo la de Pitrufquén) se presentaban dos Charlas, la primera es una Charla técnica de Alternativas Forrajeras de Primavera y la segunda es la titulada Irlanda 2005, donde se presenta el viaje al Congreso.

Destinatarios de la actividad: Se indica en el Punto 11 para cada actividad, pero fueron eminentemente agricultores y profesionales ligados directamente a la ganadería de la zona centro sur y sur de nuestro país.

Nombre y tipo de las organizaciones u otras instituciones relevantes en el tema o sector que tuvieron representación en la asistencia al evento. La Charla de Pitrufquén fue organizado en Conjunto con INIA Carillanca (Oriella Romero y Fernando Ortega) con la única finalidad de mostrar los resultados del viaje al Congreso, Las demás actividades en el punto 11 se indica a quienes estuvo dirigidas.

Indicar si se trató de una actividad abierta No fueron actividades completamente abiertas, ya que se invitó a los asistentes.

11.2. Especificar el grado de éxito de las actividades propuestas, En general creemos que fueron actividades exitosas, ya que el tema es extenso y se cuenta con gran cantidad de material que posibilitó realizar presentaciones amenas y muy interesantes

11.3. Indicar si se entregó algún material a los asistentes, Se usó Data Show y se exhibió sobre telón. El material no fue entregado a todos solo a quienes solicitaros se les entregó una copia del CD.

| Tipo de material | Nombre o identificación | Idioma | Cantidad |
|---|---|---|---|
| 8 Charlas con Datashow | Irlanda 2005, XX Congreso Internacional de Praderas. Augusto Abarzúa | Españo | 8 |
| Charla en PDF | Se subirá a la página WEB de la empresa de forma que quienes lo deseen puedan entrar a la presentación. | Español | 1 |

# ANEXO N° 1

# Charla Impresa

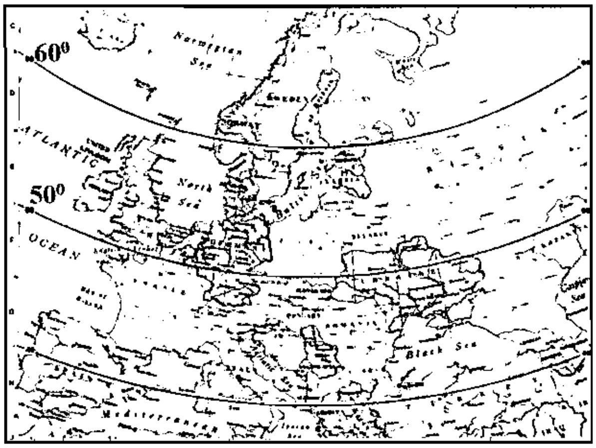
# Irlanda
## 2005

GOBIERNO DE CHILE
FUNDACION PARA LA
INNOVACIÓN AGRARIA

*¿qué es lo primero que se nos viene a la cabeza al pensar en Irlanda ?*

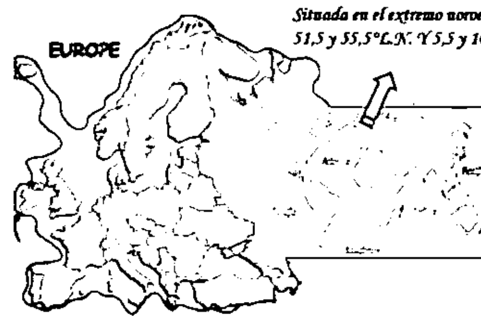
- *País lleno de historia, leyendas y tradiciones*
- *Que hoy en día tiene una floreciente economía, una vida cultural dinámica y una próspera población que ha impactado en las artes, la religión, la política y los deportes*

**Irlanda es idílica e intrínsecamente verde**

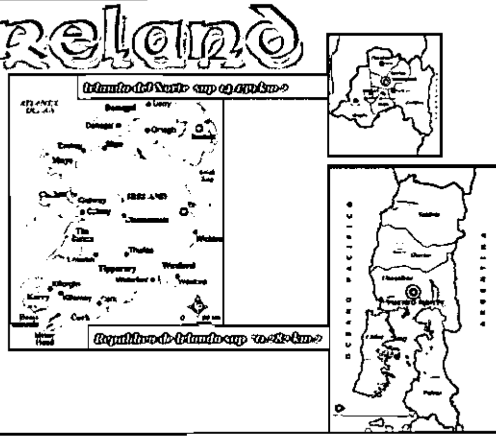



# Ireland

*Situada en el extremo norveste de europa*
*51,5 y 55,5°L.N. Y 5,5 y 10,5° L.O.*

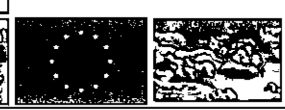



# Ireland



# Ireland

**Población:** 3.960.000 con un 44% de la poblacion menor de 25 años
**Capital :** Dublin
**Languaje:** Inglés y Gaelic
**Religión:** 95% Católica Romana, 3.4% Protestante
**Gobierno:** República
**Ingreso per cap:** US$29,300
**Crec. anual:** 4.3%
**Inflación:** 4.6%
**Principales Industrias:** Computación e Informática, Tecnologia de la Información, Productos alimenticios, Textiles y ropa, Productos farmeceuticos, Turismo



# Ireland

*Recursos Naturales:*

*Zinc, Plomo, Gas Natural, Petróleo, Cobre, piedra caliza, dolomita, turba, plata*

*Uso de la tierra:*

*71 % Praderas*

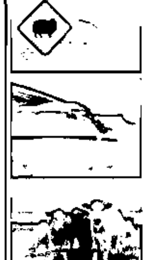
*14 % Tierra arable*

*5 % Bosques*

*10 % Otros*

## *Praderas en Irlanda y Reino Unido*

•Muy alto porcentaje de pasturas del area total agricola (Irlanda) .



| | Irlanda | Reino Unido |
|---|---|---|
| Area Total Agricola (000 ha) | 4.370 | 18.449 |
| Praderas | 3.466 | 6.848 |
| Praderas de Montaña | 468 | 4.465 |
| Maiz de Forraje | 16 | 119 |
| *Area agricola para ensilaje | 29 | 38 |
| Tubérculos. Cultivos verdes | 5 | 55 |
| Vacas Lecheras (000) | 1.156 | 2.192 |
| Vacas de Carne (000) | 1.187 | 1.700 |
| Ovejas (vientres) | 3.615 | 14.926 |

**Fuente: CSO Irlanda y DEFRA U.K.**
*** Planta entera de cereales**

## Praderas en Irlanda y Reino Unido

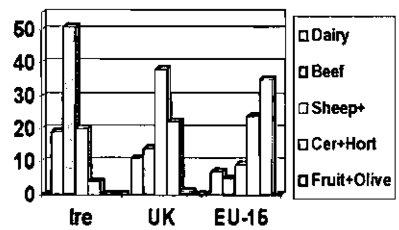
•Reducido tamaño promedio de las granjas (Irlanda).

| | Irlanda | Reino Unido |
|---|---|---|
| Tamaño de las Granjas (ha) | 31 | 68 |
| Granjas Lecheras (%) | 19 | 11 |
| Granjas de Carne (%) | 51 | 14 |
| Ovejas (%) | 20 | 38 |
| Cereales, Otros cultivos, Hoticolas | 4 | 22 |

Fuente: Charlier 2003

## Praderas en Irlanda y Reino Unido

•Proporción de las Granjas en Irlanda, Reino Unido y Europa




## Praderas en Irlanda y Reino Unido

• Clima maritimo con una larga estación de crecimiento, en que su limitante es la intensidad de la radiacion y la temperatura.

| Precipitación mm | Irlanda | Inglaterra | N Z | |
|---|---|---|---|---|
| Enero | 76 | 64 | 46 | |
| Abril | 53 | 45 | 53 | |
| Julio | 59 | 55 | 68 | |
| Octubre | 81 | 64 | 44 | |

Fuente: Keane & Sheridan 2004

## Praderas en Irlanda y Reino Unido

• Clima maritimo con una larga estación de crecimiento, en que su limitante es la intensidad de la radiacion y la temperatura.

| Temperaturas | Irlanda | Inglaterra | N Z | |
|---|---|---|---|---|
| Enero | 4.8 | 3.4 | 17.2 | |
| Abril | 7.9 | 7.7 | 12.2 | |
| Julio | 15 | 16 | 5.8 | |
| Octubre | 10.2 | 10.4 | 11.8 | |

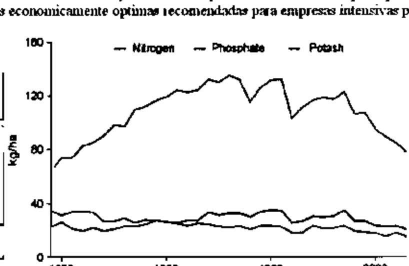
| Sol (hrs) | Irlanda | Inglaterra | N Z | |
|---|---|---|---|---|
| Enero | 50 | 53 | 215 | |
| Abril | 139 | 153 | 143 | |
| Julio | 131 | 205 | 126 | |
| Octubre | 83 | 101 | 187 | |

Fuente: Keane & Sheridan 2004

## Praderas en Irlanda y Reino Unido

•Fetilización nitrogenada fue muy promovida en las décadas del 60 al 80.

•Las fertilizaciones promedio en Irlanda y UK son altas para los estandares europeos, pero son menores que las tasas economicamente optimas recomendadas para empresas intensivas para pastoreo




Uso de Fertilizante sobre las praderas, 1969 – 2003. England & Wales)

## Praderas en Irlanda y Reino Unido

• DIRECTRICES DE LA EU EN EL USO DE NITRATOS.

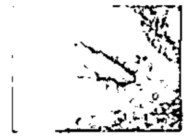
- Objetivo reducir el contenido de nitratos en la superficie y la lixiviación con el fin de el evitar que lleguen a las fuentes de agua.
- Las areas peligrosas corresponden a zonas donde el contenido de nitrato del agua presenta risk of. >50mg/l nitrate
- Estas son zonas vulnerables para nitratos.

## Praderas en Irlanda y Reino Unido

**Manejo de purines y nutrientes del suelo.**

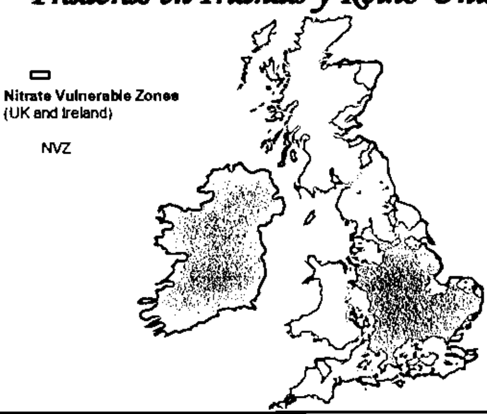
## Praderas en Irlanda y Reino Unido

**Contaminación de las aguas**



- Efluentes de Ensilajes). 1990's
- Polución difusa de nitratos

## Praderas en Irlanda y Reino Unido




## Otros problemas que afectan significativamente a los ganaderos

- Compactación de suelo y la erosión

- Generación de amonio y metano, y el efecto invernadero

## *Praderas en Irlanda y Reino Unido*

• DIRECTRICES DE LA EU EN EL USO DE NITRATOS.

- Purines y estiércoles reducir el aporte de N sobre pasturas a 250kg/ha (puede bajar a 170kg/ha)
- No aplicación de estos productos en otoño e Invierno.

## *Praderas en Irlanda y Reino Unido*

**Algunas consideraciones de las Praderas mas usadas**

• Ballica Perenne (<u>Lolium perenne</u>) es la especie mas sembrada (con un porcentaje superior al 80%), seguido por ballicas de rotación.

• Trébol blanco (<u>Trifolium repens</u>) es la leguminosa mas ampliamente usada.

•En tiempos recientes mucha investigacion se ha llevado a cabo en trebool rosado, con gran impacto en granjas organicas, otras como la lotera (<u>Lotus sp</u>) se ha recomendado en suelos de mayoes limitaciones.

• En muy menor grado y raramente usada tenemos la Alfalfa (<u>Medicago sativa</u>).

•El 73% de las praderas reciben Nitrógeno, el 60 % Fosfatos, el 59% potasio y 6% sulfatos con tasas de aplicación priomedio de 89-20-25 y 44 kg/ha Respectivamente.

## *Praderas en Irlanda y Reino Unido*

**Consideraciones de los sistemas de Conservación de Forrajes**

El ensilaje es el medio dominte de conservacion de forraje, 83% en Irlanda y 70% en UK, con solo el 16 y 18% para Heno

Los aditivos son altamente [illegible] los bacterianos y enzimas mas usados que acidos y sales

El area de conservacion de forraje ha caido en un 19% del 94 al 2000, en UK [illegible] puede reflejar la caida en el numero de animales y al vez [illegible] que el [illegible] caro comparado con el pastoreo [illegible]

## *Praderas en Irlanda y Reino Unido*

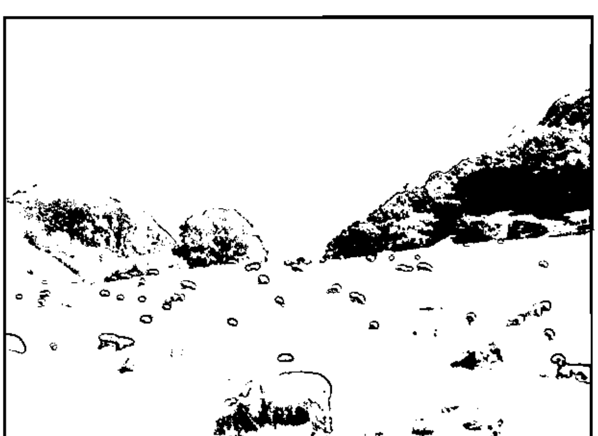
Evolución del Manejo de las praderas para optimizar la producción de leche

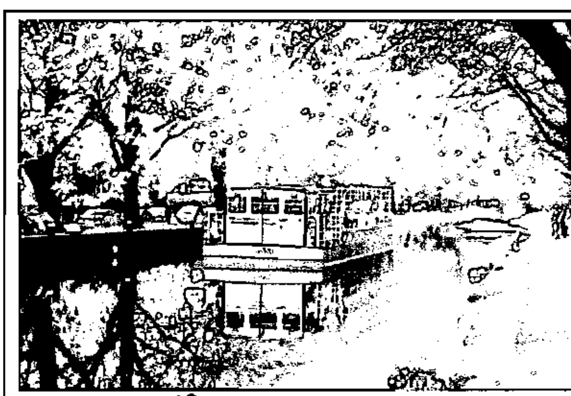
•Hasta el establecimiento de las cuotas de producción, 1984 el enfasis estaba en incrementar el rendimiento por unidad de área

•Posteriormente se ha fijado como objetivo la reducción de costos de producción, reemplazo de concentrados por forrajes. (la tierra y los concentrados son un recurso caro en Irlanda y U.K.)

•El uso de raciones totalmente mezcladas no son comunes dado el tamaño de las granjas. La confección de ensilajes es un recurso caro lo cual......

**Ha hecho que la optimización del uso de las praderas sea un objetivo prioritario**

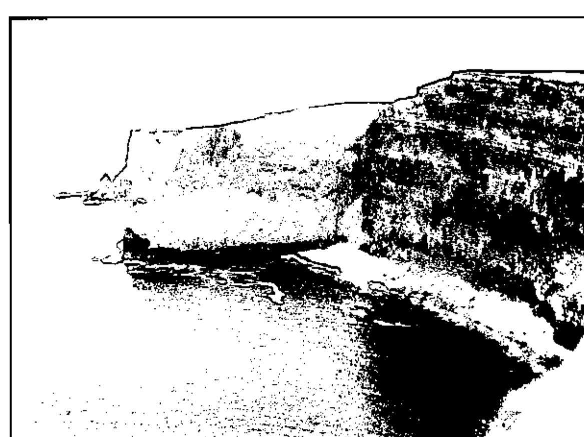


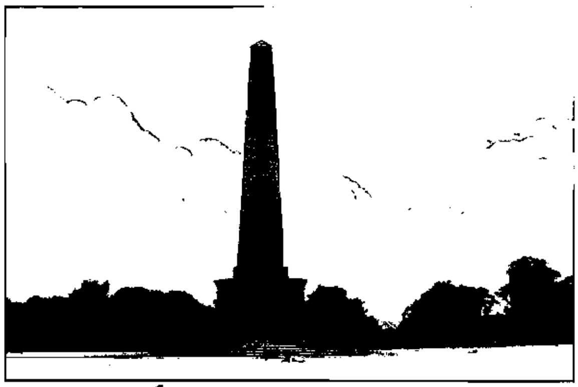


*Vistas de Dublin*



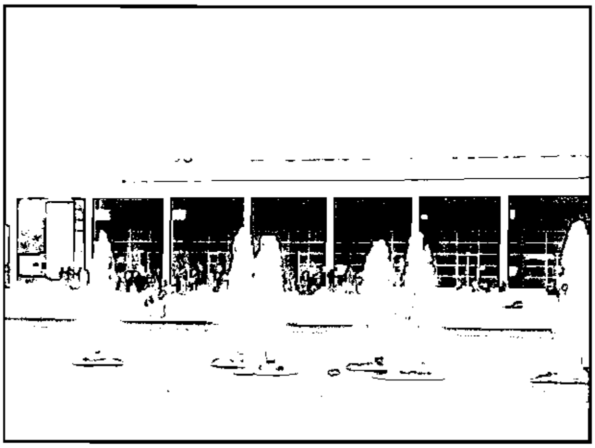

*Cliffs (Galway)*





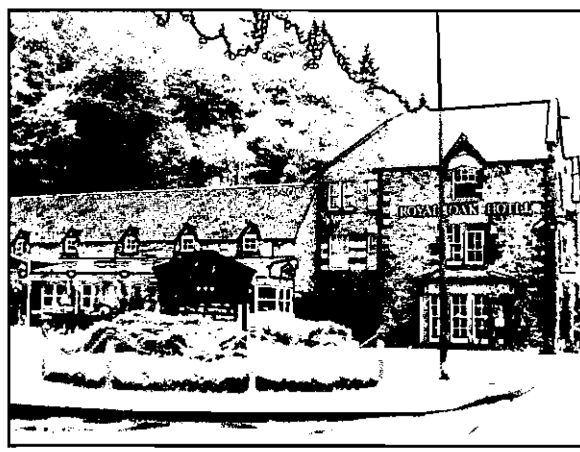
*Phoenix Park*

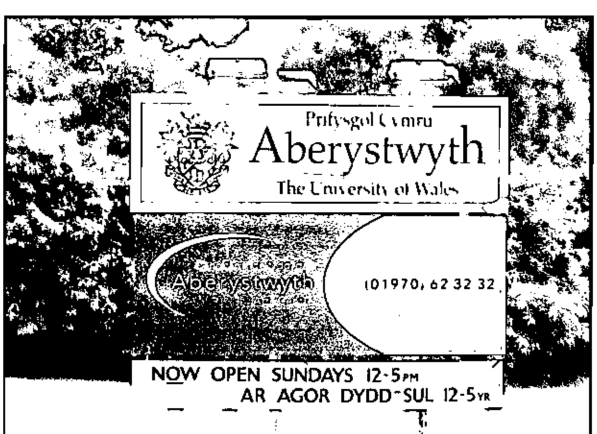
*Trinty College*

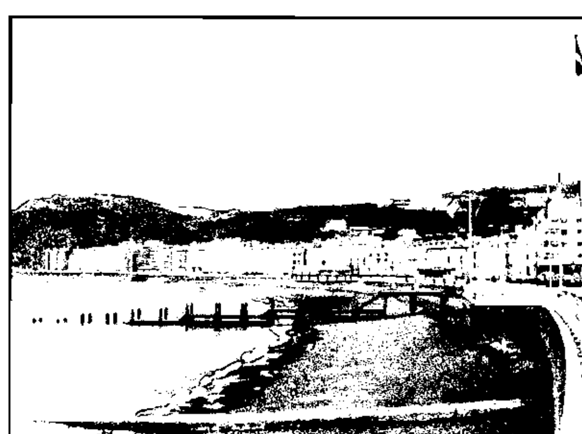


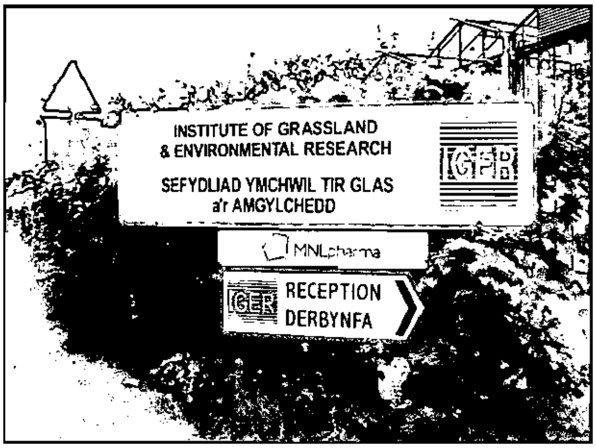
Investigación a nivel mundial esta apuntando a :

- Mejorar La Calidad de los Forrajes
- Aumentar la eficiencia de Utilización de los Nutrientes
- Disminuir la contaminación medioambiental
- Producción creciente de alimentos mas saludables
  - Generación de CLA en la leche
  - Aumento de los Consumos de Acidos grasos linolenicos conjugados

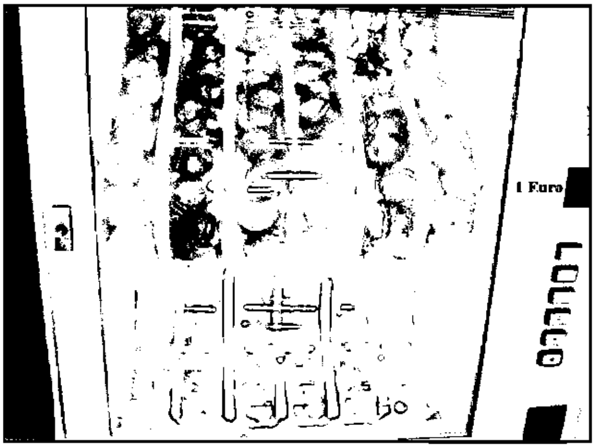


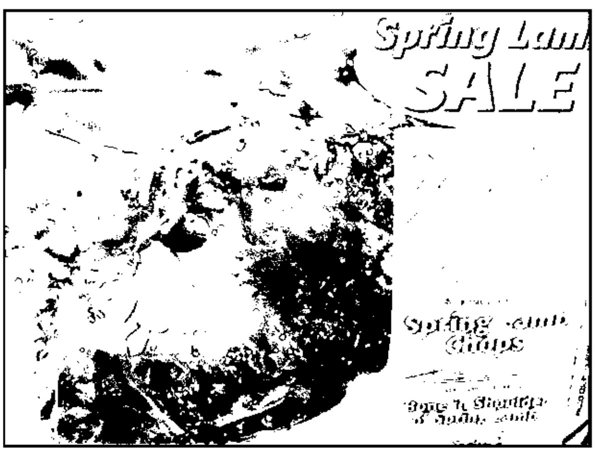




INSTITUTE OF GRASSLAND
& ENVIRONMENTAL RESEARCH
SEFYDLIAD YMCHWIL TIR GLAS
a'r AMGYLCHEDD
IGER
MNLpharma
IGER RECEPTION
DERBYNFA

*Ganadería*




# Irlanda
## 2005

GOBIERNO DE CHILE
FUNDACION PARA LA
INNOVACION AGRARIA

# ANEXO N° 2

## Charla en CD (Se Adjunta)

# ANEXO N° 3

## Libro: XX International Grassland Congress: Offered papers

(solo portada y capítulos iniciales)

# XX International Grassland Congress: Offered papers


edited by
F.P. O'Mara
R.J. Wilkins
L. 't Mannetje
D.K. Lovett
P.A.M. Rogers
T.M. Boland

This book contains 829 papers presented at the XX International Grassland Congress, held in Dublin, Ireland, from 26 June to 1 July 2005. The papers cover the three themes of the congress:

- Efficient Production from Grassland
- Grassland and the Environment
- Delivering the Benefits from Grassland

This material represents a valuable collection of papers describing current research in all aspects of grassland science in all physical and climatic regions of the world. Under the theme of Efficient Production from Grassland, the subject areas covered included grass and forage breeding, forage quality, overcoming seasonality of production, animal production, animal-plant relations and grass and forage agronomy. In the area of Grassland and the Environment, the interaction of grassland and climate change, greenhouse gases and carbon sequestration is explored, and there are comprehensive sections on biodiversity, soil quality and nutrients, and grassland and water resources. In the final theme Delivering the Benefits from Grassland, the adoption of new technology, participatory research, tools for grassland management and decision support systems are considered. There is also a section examining the role of grasslands in improvement of livelihoods, and a sections exploring the role of the IGC and grassland societies in technology interaction and influencing policy. This book also contains a brief [illegible] of the IGC written by Professor Ross Humphreys which charts the ev[illegible] of the congress, and will also serve as a reference source for [illegible]

Other publications related to the International Grassland Congress:

- Grassland - a global resource 907699871X
- Optimisation of nutrient cycling and soil quality for sustainable grasslands 9076998728
- Molecular breeding for the genetic improvement of forage crops and [illegible] 9076998736
- [illegible] in marginal environments 9076998744
- [illegible] 9076998752
- [illegible] [illegible]imal systems 9076998760

Wageningen Academic Publishers

XX IGC 2005 IRELAND & UNITED KINGDOM

# A brief history of the International Grassland Congress

L.R. Humphreys
*School of Land and Food Sciences, University of Queensland, Brisbane, 4072, Australia, Email: l.humphreys@uq.edu.au*

## Key points

1. Nineteen International Grassland Congresses met over the period 1927-2001 in every continent except Africa. Scientists from North America, Western Europe and Australia and New Zealand dominated proceedings.
2. Analysis of 6 representative Congresses indicates a considerable homeostasis of disciplinary content. The plant genetic base for grassland improvement, plant physiology, plant ecology and soil science contributed 46 to 57 per cent of papers, which were mainly complemented by studies of grazing management and animal production from forage.
3. Environmental science, systems theory, socio-economic perspectives and technology transfer emerged with more force in recent Congresses.

**Keywords:** International Grassland Congress, history, scientific disciplines, plant and animal production, environment

## Locations and attendance

The dates and locations of the Congresses are listed in Appendix Table 1. The International Grassland Congress first met in Germany from 20-31 May 1927. The principal participants were 16 scientists from Austria, Denmark, Finland, Germany, Norway, Sweden and Switzerland, who assembled in Bremen and made a study tour through north-west Germany, visiting Emden, Berlin and Dortmund before taking the train to Leipzig. Here there were two days of scientific discussion at the Zoo, revisited subsequently as the site of the 50th Anniversary XIII Congress in 1977. The Congress under the presidency of Prof. A. Falke of Leipzig had a further study tour through grassland production sites in Saxony before dissolving at Dresden.

The second Congress, which met in 1930 in Sweden and Denmark under the presidency of Dr A. Elofson of Uppsala was enlarged to 58 participants from 13 countries (including Canada). The third Congress in Switzerland in 1933 with Prof. A. Volkart of Zurich as President had scientists from Turkey and South Africa present, but it was not until the IV Congress in 1937 at Aberystywyth, United Kingdom, that the meeting could claim a global constituency. There were some 365 participants from 37 countries; all 11 regions of the world as defined by the 1977 International Grassland Congress Constitution were represented with the exception of the Middle East. The leadership of R.G. Stapledon of the Welsh Plant Breeding Station was pre-eminent. At this meeting it was agreed that the funds of the International Grassland Congress Association be banked in Germany and that the next Congress be held in the Netherlands in 1940. The intervention of the Second World War delayed the V Congress until 1949 and the funds of the Association were not recovered.

The VI International Grassland Congress, held at State College, Pennsylvania, USA in 1952, built on the European foundations of the movement to enlarge its scientific content and global representation, and accorded a new maturity. The world regions with an established history of grassland research (North America, Western Europe, Australia and New Zealand) accounted for 75% of the 271 scientific papers presented, and the participation of other regions increased to 25%.

The location of subsequent Congresses usually alternated between continents: America (4), Oceania (3), Asia (1), Europe (5) but no Congress has been held in Africa. The VII Congress in 1956 at Palmerston North, New Zealand, had a restricted representation but the VIII Congress at Reading, UK (591 participants from 53 countries), indicated the continued strength of grassland science. At this Congress an Executive Committee representative of eight regions of the world was elected with a rotating membership so that members would serve for a period covering the two intervals between three Congresses. This Committee was charged with providing a continuing organisation which would advise future host country committees. The full membership of the Congress voted for the IX Congress venue of Brazil, and this was held in 1965 at São Paulo, the first Congress to be located in a tropical country. In Brazil it was decided that the venue of the XI Congress would be Australia (118 votes, Canada 63 votes, USSR 63 votes). The X Congress moved closer to the Arctic Circle in 1966 at Helsinki, Finland, where USSR (128 votes) was selected over Canada (108 votes) for the XII Congress site. The designation of Executive Committee was altered to that of a "Continuing Committee", which was *inter alia* given the responsibility "to select the host country for the forthcoming Congress and to announce the name of that host country at the intermediate Congress". The XI Congress was mounted in 1970 at Surfers' Paradise, Queensland, Australia.

The question of the venue of the XIII Congress aroused controversy at the XII Congress in 1974 in Moscow. The Continuing Committee, empowered by the Constitution adopted in 1966 at Helsinki, determined the Republic of Ireland as the venue. This decision was challenged by the Host Committee in Moscow who put the question to a free vote of full Congress members, of whom 64% were from the northern Eurasia region. This resulted in a decision for the XIII Congress to be held in 1977 at Leipzig, German Democratic Republic. (It is reported that at this meeting a USSR official on the platform turned to R.J. Bula, the North American proxy delegate on the Continuing Committee, when the vote was announced and asked "So how do you enjoy democracy?"). A further resolution led to the promulgation of a new constitution which was adopted at the Leipzig Congress and which reaffirmed the power of the Continuing Committee to determine future venues, subject to one country-one vote procedure at the Congress in the event of a disagreement in the Continuing Committee. The Continuing Committee was enlarged to representatives of 11 regions and an additional representative from the previous host country.

S.C. Pandeya, the outgoing chairman of the Continuing Committee, had expected to invite the XIV Congress to India, but the defeat of the Gandhi government by Mr Desai put paid to this proposition and no invitation from other countries was forthcoming. Canada had previously sought to host congresses but 1977 was not a propitious time to find support. The American Forage and Grassland Council, led by R.F. Barnes and J.E. Baylor, ventured in faith and the XIV Congress at Lexington, Kentucky, USA, resulted in 1981. The XV Congress in 1985 was the first Congress to be held in Asia and at Kyoto, Japan, a large delegation of scientists from China attended for the first time.

Previous Congresses in Europe had been held in cold northern latitudes and the XVI Congress in 1989 at Nice, France, was the first Mediterranean location and attracted a higher proportion of participants (13%) from the designated Mediterranean region countries, whilst France provided 24% of the attendance. The XVII Congress in 1993 was unusual in that it arose from the joint invitation of New Zealand and Australia, and its locations in Palmerston North, Hamilton, and Christchurch, New Zealand, and Rockhampton, Queensland, provided a range of ecological conditions including both temperate and tropical pastures. This was the largest and most representative Congress with 1200 delegates from 82 countries. The scientific contribution and leadership of indigenous participants from the developing countries increased substantially at the XVI and XVII Congresses; in the early Congresses their rather meagre representation often arose from expatriate scientists from developed countries. The invitation of Canada to host the XVIII Congress in 1997 was accepted by the 1993 Continuing Committee, and this led to a similarly large and representative Congress. A resolution was adopted at this Congress to continue to explore the possibilities for closer collaboration with the International Rangeland Congress (IRC). The XIX Congress took place in 2001 at São Pedro, São Paulo, Brazil. An up-dated and revised Constitution was adopted at that Congress. The XX Congress is being held in 2005 in the Republic of Ireland and the United Kingdom.

**Table 1** Regional participation (per cent) in International Grassland Congresses

| Region | Period | | | | | |
|---|---|---|---|---|---|---|
| | 1927-1937 | 1949-1952 | 1956-1966 | 1970-1981 | 1985-1993 | 1997-2001 |
| North America | 4 | 27 | 19 | 21 | 15 | 19 |
| Central America | <1 | 3 | 2 | 2 | 1 | 3 |
| South America | <1 | 2 | 20 | 2 | 4 | 25 |
| Southern Asia | <1 | 2 | <1 | 1 | 2 | 4 |
| Oceania | 1 | 6 | 15 | 21 | 22 | 15 |
| East Asia | <1 | <1 | <1 | 3 | 23 | 9 |
| Middle East | <1 | <1 | <1 | <1 | 1 | 3 |
| Mediterranean | 1 | 3 | 1 | 2 | 6 | 5 |
| Western Europe | 87 | 54 | 36 | 27 | 20 | 11 |
| Northern Eurasia | 3 | 0 | 4 | 18 | 2 | 3 |
| Africa | 2 | 3 | 2 | 1 | 3 | 5 |

The regional participation (Table 1) is estimated for non-orthogonal periods designated to coincide with the Congresses chosen for later discussion of the evolution of thematic content. The naming of the regions in Table 1 has been modified to reflect current understanding. Changes in regional representation partly reflect the location of Congresses in each period but there has never been strong participation from the countries of Central



America, Middle Eas
Congresses are listed
Tables 2 and 3.

**The International Ra**

The management of r
topic at International
working in this gene
developing a better
exacerbated in the US
of the American Forag
to form a separate org
by the decision at th
acceptance of the Rep
perceived as the Easte

The first International
1984 by the second Co
these 79% came from
Delhi, India, and the f
to the USA in Utah,
Reciprocal representat
being made to hold a j
the thrust of the two m

**Changes in the balan**

**Overview**

The changing themes
identifying 110 topics
synoptic papers, biome
improvement (Table 2
content; this was not
convenience.

The content of six Con
was chosen as the fir
voluntary papers and w

This analysis revealed
grassland improvemer
physiology, plant ecol
Congresses. Animal
interface were the othe
and socio-economic pe

**The 1937-1952 period**

The general theme of
included the papers w
elsewhere and whose r
dealt with humid or
predominance of non-s
with pastures, leys and

The plant genetic basi
improved species; in 1
certification of seed for

America, Middle East and Africa. More detail is available in Humphreys (1997). Office bearers of the Congresses are listed in Appendix Table 1 and members of the Congress committees are listed in Appendix Tables 2 and 3.

### The International Rangeland Congress

The management of rangelands, focused on natural pastures in the arid and semiarid zones, has always been a topic at International Grassland Congresses and has received varying attention. However, some scientists working in this general area considered there was a need for a separate international meeting directed to developing a better science of the manipulation, improvement and utilisation of rangelands. This was exacerbated in the USA by the dichotomy of effort between members of the Society of Range Management and of the American Forage and Grassland Council, whose primary interests were in sown grasslands. The decision to form a separate organisation which would mount International Rangeland Congresses was further stimulated by the decision at the XII International Grassland Congress in 1974 to reject the Continuing Committee's acceptance of the Republic of Ireland as the venue for the XIII Congress and to retain the Congress in what was perceived as the Eastern Bloc venue of the German Democratic Republic.

The first International Rangeland Congress was held in 1978 at Denver, Colorado, USA, and was succeeded in 1984 by the second Congress at Adelaide, Australia. This was attended by 499 participants from 42 countries; of these 79% came from Oceania, North America and Western Europe. The third Congress in 1988 met in New Delhi, India, and the fourth Congress was held in 1991 at Montpellier, France, whilst the fifth Congress returned to the USA in Utah. Further Congresses were held in Townsville, Australia, and Durban, South Africa. Reciprocal representation on the two Congress Continuing Committees was arranged from 1981, and plans are being made to hold a joint IGC/IRC Congress at Hohhot, Inner Mongolia, China, in 2008, which would integrate the thrust of the two movements.

### Changes in the balance of themes

#### Overview

The changing themes which have occupied scientists at International Grassland Congresses were analysed by identifying 110 topics grouped within 10 main themes, and additionally including four miscellaneous themes: synoptic papers, biometrics, agricultural engineering and animal production not specifically related to grassland improvement (Table 2). Papers presented at Congresses were allocated to each sub-theme according to its major content; this was not necessarily the theme of the Congress session to which it may have been allocated for convenience.

The content of six Congresses that were held at a mean interval of 11 years from 1937 to 2001 was studied: 1937 was chosen as the first Congress that could claim a good international status. All six Congresses accepted voluntary papers and were held in regions with a history of research in grassland science.

This analysis revealed a considerable homeostasis of disciplinary content over the 64 years. The science of grassland improvement has relied first on an interest in its plant genetic base, and plant genetics, plant physiology, plant ecology and soil science contributed 46 to 57 per cent of the subject matter at all six Congresses. Animal nutrition and systems of animal production arising from study of the animal-plant-soil interface were the other key preoccupations of grassland scientists, whilst environmental science, systems theory and socio-economic perspectives emerged with more force in recent Congresses.

#### The 1937-1952 period

The general theme of the first subject in Table 2, which was designated as styles of grassland development, included the papers with general or integrative themes which were insufficiently specific to be allocated elsewhere and whose main interest was regional or local. These constituted 19% of papers in 1937 and mainly dealt with humid or sub-humid temperate grasslands; in 1952 this category decreased to 12% with a predominance of non-specific tropical papers. The balance of content focused on intensity of land use, tree crops with pastures, leys and turf.

The plant genetic basis for grassland development in 1937 was oriented to evaluation of and selection within improved species; in 1952 there were more papers on hybridisation, induced polyploidy, disease resistance and certification of seed for varietal purity. Edaphic constraints on grassland development in 1952 were defined less in terms of general fertiliser needs and responses and more in terms of specific nutrients, including sulphur, and soil toxicities; soil conservation and watershed management became significant emphases. More interest in the physiology of flowering and seed production emerged, whilst in plant succession, the control of weed and shrub encroachment and the production of inventories of grassland resources were of significant interest in grassland ecology.

In the 1952 Proceedings studies of selective grazing and foraging strategy, stocking rate and forage allowance, and the methodology of grazing experiments appeared. More sophisticated approaches to nutritive value of forage were evident in the attention to energy value, digestibility and intake, mineral content, and anti-quality factors. Continuity of forage supply was addressed through irrigation and techniques of crop processing, which were especially dependent upon innovations in agricultural engineering. Characterisation of climate emerged as a topic, as did the transfer of technology to farmers.

**The 1966 Congress**

The trend to fewer general papers of regional interest continued, especially at this Finnish venue with respect to tropical grasslands. Papers dealing with specialist techniques of plant breeding such as induced polyploidy were again presented. The intensive use of fertiliser N was a new emphasis and there were 19 papers on this topic. Plant physiology was accorded greater importance through papers on growth analysis, tillering, plant response to defoliation, and the role of carbohydrate "reserves", but there were fewer papers on plant ecology.

Stocking method, stocking rate and forage allowance were further addressed, together with the spatial transfer of nutrients under grazing. Mixed grazing and the innovative choice of animal species were canvassed. Nutritive value received increased attention relative to 1952, especially in relation to forage intake, digestibility and anti-quality factors. Animal responses to systems of forage conservation were described and systems modelling in grassland research appeared as a topic (Table 2).

**The 1981 Congress**

This Congress was marked by considerable advances in tropical pasture science, and 133 of the 480 papers presented bore directly on grassland development in the tropics and subtropics, mainly in specialist areas. Styles of grassland development embraced interest in the intensity of land use, integration of land classes, deforestation and woodland management, long-term trends in production, the use of shrub legumes and intercropping.

Wide approaches to the improvement of the plant genetic base were enunciated which displayed increased emphasis on species evaluation, the conservation of germplasm, and the identification of elite material, whilst *in vitro* embryo culture signalled the nascency of molecular biology.

**Table 2** Themes represented at International Grassland Congresses (per cent papers with main theme)

| Year of Congress | 1937 | 1952 | 1966 | 1981 | 1993 | 2001 | Mean |
|---|---|---|---|---|---|---|---|
| Congress number | IV | VI | X | XIV | XVII | XIX | |
| Subject theme | | | | | | | |
| Styles of grassland improvement; regional themes | 23 | 18 | 10 | 9 | 16 | 8 | 14 |
| Plant genetic base | 23 | 20 | 19 | 21 | 25 | 17 | 21 |
| Edaphic constraints | 19 | 13 | 14 | 14 | 11 | 12 | 14 |
| Perspectives from plant physiology | 9 | 9 | 17 | 15 | 14 | 11 | 13 |
| Ecology of grasslands | 6 | 10 | 4 | 6 | 7 | 6 | 7 |
| Grazing systems | 4 | 4 | 8 | 8 | 8 | 16 | 8 |
| Nutritive value | 4 | 7 | 15 | 10 | 7 | 13 | 9 |
| Continuity of forage supply | 7 | 11 | 8 | 10 | 5 | 11 | 9 |
| Systems approach | - | 0.4 | 1 | 3 | 3 | 3 | 2 |
| Socio-economic perspectives | 1 | 3 | 3 | 4 | 4 | 3 | 2 |
| Miscellaneous | 3 | 6 | 3 | 1 | 2 | 1 | 3 |
| Number entries | 69 | 256 | 220 | 480 | 943 | 499 | |



Scientists at all si
production; associa
with nutrient cycli
from plant physiol
radiation, moisture
establishment. Th
encroachment figu
improvement of nat

The influence of gr
1981 Congress. Th
materials were can
emerged as strong
grassland science w

**The 1993 Congres**

A wider series of
Environmental scie
was explored in its
pastures, alley farm
pollution and globa
agenda, whilst a rec

Studies of the gene
merit and of disease
research resources
1981, with more att
the dynamics of ch
sensing in producin

The perennial them
of continuity of for
theory.

The socio-economi
equity in grassland
institutional policies

**The 2001 Congress**

A return to Brazil, 3
the countries of Sou
from 67 countries in

The traditional IG
complemented by
supply and fodder c
efficient animal pro
environmental resou
increasing sophistic
elsewhere, sometim

At this Congress m
with grasslands, es
degradation, the ma
growth and legume
with speculation ab
constraining effects
information and an

Scientists at all six Congresses emphasised the role of legumes and of biological N fixation in grassland production; associative mechanisms of N fixation were mentioned at the 1981 Congress, and soil N, together with nutrient cycling, stream pollution, soil toxicities and salinity received increased attention. Perspectives from plant physiology incorporated more interest in pathways of photosynthesis, efficiency of conversion of radiation, moisture use, stress resistance, growth regulators and the understanding of constraints to pasture establishment. The dynamics of change in plant communities, the role of fire and the control of shrub encroachment figured in grassland ecology, and some 91 papers were directed to the conservation and improvement of natural grasslands.

The influence of grazing on the balance of legumes and grasses and studies of foraging strategies figured in the 1981 Congress. The effects of endophytes, the potential of growth regulators and of chemical processing of crop materials were canvassed. Modelling of grassland systems and the development of decision support systems emerged as strong emphases, whilst technology transfer and the development of the human skills base in grassland science were accorded more significance.

**The 1993 Congress**

A wider series of topics was structured in depth at the 1993 Congress than had occurred previously. Environmental science was a strong feature of the Congress and the fashionable term `sustainable development' was explored in its various facets: the properties of systems of land use of varying intensity, tree crops with pastures, alley farming, the role of leys, relict areas, deforestation and woodland management. Atmospheric pollution and global warming, stream pollution, nutrient leaching and nutrient cycling were components of the agenda, whilst a recurrence of interest in organic matter and soil biological activity reinforced these trends.

Studies of the genetic basis of grassland improvement included more attention to the definition of criteria of merit and of disease resistance, and the rise of genetic engineering and of molecular biology in the allocation of research resources was evident. Many of the themes previously attacked in plant physiology continued from 1981, with more attention to the control of flowering and the processes of seed production. In grassland ecology the dynamics of change in plant communities, the utility of state and transition models and the use of remote sensing in producing inventories and current assessments of grassland resources figured strongly.

The perennial themes within the concepts of nutritive value, the devising of grazing systems and the maintenance of continuity of forage supply were elaborated further but in a new context of this description within systems theory.

The socio-economic perspectives which emerged at the 1981 Congress were enlarged by reference to social equity in grassland development, the participation of farmers in grassland research, and to the larger canvases of institutional policies with respect to resource transfer and international trade.

**The 2001 Congress**

A return to Brazil, 36 years after the IX Congress, revealed a much increased investment in grassland research in the countries of South America. The expense of travel was one factor limiting attendance, and c.700 scientists from 67 countries met in congenial social and intellectual circumstances at São Pedro, São Paulo.

The traditional IGC themes of plant improvement, ecophysiology, soil fertility and plant nutrition were complemented by studies of grazing ecology and management, forage nutritive value, continuity of forage supply and fodder conservation. However the trend at recent Congresses to reduce the emphasis on maximising efficient animal production from grassland and to pay greater attention to the sustainable use of grassland as an environmental resource continued. There were fewer general papers on regional themes (Table 2), reflecting an increasing sophistication and specialisation of grassland research and perhaps the growth of regional meetings elsewhere, sometimes stimulated under the aegis of the International Grassland Congress.

At this Congress many topics concerned with the wider aspects of land use were canvassed: de-intensification with grasslands, especially in relation to the policies of the European Community, deforestation, grassland degradation, the maintenance of biodiversity and the role of agro-silvipastoral systems. Increases in grassland growth and legume nitrogen fixation due to atmospheric carbon dioxide enrichment were quantified, together with speculation about the associated changes in climate. Socio-economics of pastoral development and the constraining effects of trade policies on grassland production were examined. The development of pragmatic information and analytical systems were central both to the efficient use of research resources and to the adoption of grassland improvement, whilst the dynamics of technology transfer and its basis in interactive education were recognised.

These trends will be intensified at the XX Congress in 2005 when only about a third of invited papers will deal with themes of grassland production and the overall title of 'Grasslands – a Global Resource' will embrace many environmental topics such as biodiversity, carbon sequestration and the best uses of water. The basic targets of food security, reduction of rural poverty and better livelihoods arising from improved grassland management and altered socio-economic policies will be discussed.

A central experience of grassland scientists over the decades under review is that the International Grassland Congresses have helped people working in specialist areas to conceptualise their work in wider contexts. The great world movement of International Grassland Congresses has delivered better managed ecosystems, greater equanimity in rural communities and more efficient production of food and fibre.

**Acknowledgements**

I am indebted to Roger Wilkins, Vivien Allen and Tom Nolan for assistance. Permission from Cambridge University Press to reprint the main body of this paper from Humphreys (1997) is gratefully acknowledged; the statistics in the paper are drawn from the Proceedings of the 19 International Grassland Congresses. The support of the School of Land and Food Sciences, University of Queensland, is acknowledged.

**Reference**

Humphreys, L.R. (1997). The Evolving Science of Grassland Improvement. Cambridge University Press, Cambridge, U.K., 202-209.



**Appendix**

**Office bearers o**

**Appendix Table**

| Congress | |
|---|---|
| I | Leipzig. |
| II | Sweden |
| III | Switzerl |
| IV | Aberyst |
| V | Netherl |
| VI | Pennsyl |
| VII | New Ze |
| VIII | Reading |
| IX | São Pau |
| X | Finland |
| XI | Australi |
| XII | Moscow |
| XIII | Leipzig, |
| XIV | Kentuck |
| XV | Kyoto, J |
| XVI | Nice, Fr |
| XVII | Australi |
| XVIII | Canada |
| XIX | São Ped |
| XX | Ireland/U |

*Presidents were
the Congress prec

**Appendix Table**

| Region |
|---|
| North America |
| Central America |
| Oceania |
| Southern Asia |
| East Asia |
| Mediterranean, Near East |
| Europe |
| Africa |
| Host Country Representative |

# ANEXO N° 4

## Libro: Utilization of Grass in Temperate Animal Systems
(solo portada y  capítulos iniciales)

# Utilisation of grazed grass in temperate animal systems

edited by
J.J. Murphy

Leading authorities from wide geographical regions of the globe will review the most up-to-date information in relation to temperate grasslands. Topics covered are:

- nutritive value of pasture;
- plant characteristics conducive to high animal intake and performance;
- modelling of both grass growth and animal production and intake in grazing systems;
- optimising financial returns from grazing;
- decision support systems;
- optimal animal breeds and traits for grazing systems;
- challenges and opportunities for animal production in the immediate future.

In addition, short papers will present the most recent research on the above mentioned topics. One paper will present a comprehensive overview of animal production from pasture in Ireland.

This book will be of interest to grassland and ruminant production scientists, mathematical modellers working on grazing systems, extension workers, students of agriculture and animal production and progressive livestock farmers.

Other publications related to the International Grassland Congress:

- Grassland - a global resource 907699871X
- International Grassland Congress offered papers 9076998817
- Optimisation of nutrient cycling and soil quality for sustainable grasslands 9076998728
- Molecular breeding for the genetic improvement of forage crops and turf 9076998736
- Pastoral systems in marginal environments 9076998744
- Silage production and utilisation 9076998752

ISBN 9076998760

Wageningen Academic Publishers

XX IGC 2005
IRELAND & UNITED KINGDOM

# Overview of animal production from pastures in Ireland

M.J. Drennan[1], A.F. Carson[2] and S. Crosse[3]
[1]*Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland*
*Email: mdrennan@grange.teagasc.ie*
[2]*Agricultural Research Institute of Northern Ireland Hillsborough, Co. Down BT26 6DR*
[3]*Teagasc, Oak Park, Co. Carlow*

## Key points

The importance of grassland to agriculture in Ireland is indicated by the fact that:

1. Sixty percent of agricultural output is from grassland as cattle, milk and sheep products.
2. Over 90% of the total farmed area is in grass.
3. Livestock are almost entirely dependent on grazed grass for 200 to 235 days of the year.
4. Grass conserved as silage is the main source of fodder in winter.
5. To improve competitiveness changes are continuously taking place, which include:
   - increased suckler herd size and a movement to late maturing continental cattle breeds;
   - movement in the dairy herd towards Holstein with increased production per animal;
   - increased importance, post CAP reform, of technical efficiency to maintain competitiveness in a more market-orientated era, and
   - greater influence on future livestock systems of agri-environmental support schemes and environmental legislation.

**Keywords:** grassland, animal production, systems

## Introduction

Animal production from pasture accounted for over 60% of the total Agricultural output on the island of Ireland in 2003 (€4,975 million) (Table 1). Beef cattle, milk and dairy products and sheep accounted for 34%, 25% and 5% of output, respectively. There are over 130,000 farmers in the Republic of Ireland (ROI) and 34,000 in Northern Ireland (NI). Of this total in the ROI, 27% are involved in dairying, 51% mainly in beef, 17% in sheep and less than 6% mainly in tillage (Connolly *et al.*, 2004) (Table 2). Average family farm income varies from €7,337 for those mainly involved in cattle rearing to €30,138 for those exclusively in dairying. Corresponding Utilisable Agricultural Areas (UAA) for these two groups are 26.4 and 40.1 ha. The number of livestock units (LU) per holding varies from 27.7 on cattle rearing farms to 86.4 on farms with dairying and other enterprises. The overall stocking density was shown to be 1.53 livestock units per ha devoted to livestock but varies considerably between the different enterprises. Figures for NI show a similar trend.

## Land use

Ireland has a total land area of 8.24 million ha with 6.89 million ha in ROI and 1.35 million ha in NI (Table 3). Over 90% of the land area is grassland in both ROI (91%) and NI (96%), while the figure for Great Britain (GB) is 71%.

**Table 1** Output value (million €) in agriculture, 2003

| | Gross output at producer prices | | Direct* payments | | Total | | % of total | |
|---|---|---|---|---|---|---|---|---|
| | ROI | NI | ROI | NI | ROI | NI | ROI | NI |
| Milk | 1,445 | 494 | - | - | 1,445 | 494 | 25 | 24 |
| Cattle and Calves | 1,23 | 291 | 850 | 276 | 2,079 | 567 | 36 | 27 |
| Sheep and Lambs | 193 | 58 | 109 | 29 | 303 | 87 | 5 | 4 |
| Pigs and Poultry | 434 | 283 | - | | 434 | 283 | 8 | 14 |
| Other | 1,429 | 604 | 134 | 13 | 1,563 | 617 | 27 | 30 |
| Total | 4,731 | 1,229 | 1,093 | 245 | 5,824 | 2,048 | 100 | 100 |

*Various EU premiums; Source: CSO (2004); DARD (2004)

**Table 2** National farm survey data by farming system - all farms, 2003

| Farm system | Dairying | Dairying and other | Cattle rearing | Cattle other | Mainly sheep | Mainly tillage | All systems |
|---|---|---|---|---|---|---|---|
| % of Population | 16.2 | 10.7 | 27.5 | 23.3 | 16.8 | 5.7 | 100.0 |
| Mean FFI (€) | 30,138 | 24,656 | 7,337 | 8,106 | 13 | | 15,054 |
| UAA (ha) | 40.1 | 53.0 | 26.4 | 29.4 | 37.3 | 63.7 | 36.1 |
| Total LU | 74.3 | 86.4 | 27.7 | 40.3 | 48.4 | 40.8 | 48.6 |
| LU/UAA | 1.91 | 1.85 | 1.06 | 1.41 | 1.32 | 1.46 | 1.53 |

FFI = Family Farm Income; UAA = Utilisable Agricultural Area; LU = Livestock Units

**Table 3** Land use in Ireland and GB

| | Ireland | | GB |
|---|---|---|---|
| | ROI | NI | |
| Total land area (m.ha) | 6.89 | 1.35 | NA |
| Forestry (m.ha) | 0.60 | 0.08 | NA |
| Total farmed (m.ha) | 4.42 | 1.07 | 16.5 |
| Total crops (%) | 9 | 5 | 30 |
| Grassland (%) | 81 | 80 | 36 |
| Rough grazing (%) | 10 | 15 | 35 |

Source: DAF (2004), DARD (2003), Hopkins (2000)

### Farm size

The average UAA per holding in the ROI and NI is 31.4 and 38.0 ha, respectively (Table 4). The average UAA for the EU15 is 18.7 ha per holding with the UK being at the top end of the scale (67.7 ha) and Italy at the lower end (6.1 ha). As an indicator of change, average farm size in ROI has increased gradually from 22.3 to 32.0 ha/holding between 1975 and 2002.

**Table 4** Utilised agricultural area (UAA) per holding

| | UAA (m.ha) 2002 | No. of holding ('000) 2000 | UAA per holding 2000 |
|---|---|---|---|
| EU15 | 130.1 | 6,771 | 18.7 |
| France | 29.6 | 664 | 42.0 |
| Ireland: (ROI) | 4.4 | 142 | 31.4 |
| (NI) | 1.1 | 28 | 38.0 |
| Italy | 15.3 | 2,154 | 6.1 |
| Netherlands | 1.9 | 102 | 20.0 |
| UK | 15.7 | 233 | 67.7 |

Source: Eurostat (2002)

## Climate

Rainfall, temperature and radiation are the most important climatic components affecting grass production. Ireland is suited to grassland farming. Located between 51°N and 55°N latitude it has a temperate, humid climate, influenced by the prevailing westerly winds and the proximity of the ocean and the gulf stream. Annual average rainfall in lowland areas (elevation less than 100 metres) varies from about 750 mm in parts of the east and northeast to greater than 1,200 mm in the west, northwest and south-west. While there are no well defined dry and wet seasons, the year may be divided into a relatively dry half, February to July, and a relatively wet half, August to January. There is considerable year-to-year variability in total annual rainfall.

The mean annual temperature over Ireland has a distinct north-northeast to south-southwest gradient. For example, at Hillsborough in the north-east, the mean annual temperature is 8.6°C, whilst in the south, at Moorepark, the mean temperature stands at 9.8°C (Table 5). Monthly mean temperature decreases by approximately 1°C for each 150 metres increase in altitude. Grass growth is considered to be continuous at temperatures over about 6°C in Irish conditions. Year-to-year fluctuations are comparatively small.

**Table 5** Monthly mean temperature (°C) and rainfall (mm) at [1]Hillsborough (north-east) and [2]Moorepark (south) averaged over a 30 (1961-90) or 20 (1982-2001) year period

| | J | F | M | A | M | J | J | A | S | O | N | D | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | | | | | | | | | | | | | |
| N | 4.0 | 3.9 | 5.3 | 7.1 | 9.7 | 12.6 | 14.2 | 14.0 | 12.2 | 9.7 | 6.0 | 4.8 | 8.6 |
| S | 5.2 | 5.6 | 7.1 | 8.2 | 11.0 | 13.6 | 15.7 | 15.2 | 12.9 | 10.2 | 7.3 | 6.0 | 9.8 |
| Rainfall | | | | | | | | | | | | | |
| N | 87 | 60 | 70 | 57 | 62 | 64 | 57 | 83 | 85 | 94 | 82 | 84 | 885 |
| S | 109 | 92 | 81 | 66 | 61 | 68 | 54 | 92 | 78 | 114 | 101 | 109 | 1025 |

N = north-east; S = South — Source: [1]Cruickshank (1997); [2]Shalloo *et al.* (2004)

## Grassland

Grassland in Ireland is composed predominantly of long-term permanent pastures with only about 3 percent reseeded yearly. With such a high proportion of land in grass, it is not surprising that cattle and sheep largely rely on grazed and conserved grass as sources of feed. A typical grass growth curve for Ireland shows that growth commences in March, reaches a peak of about 80 kg of dry matter per ha per day in late May, with a second lower peak of about 65 kg in early August followed by a rapid decline until growth almost ceases in November (Figure 1).

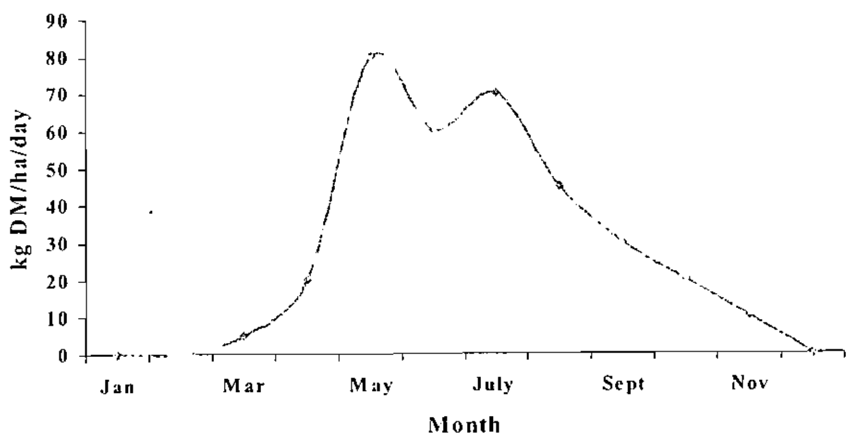



**Figure 1** Typical grass growth curve for Ireland

Total annual grass dry matter production varies from about 15 t/ha in the southwest to 11 t/ ha in the northeast in an average year (Figure 2) (Brereton, 1995). The length of the grass growing season varies from about 8 months in the north-east of the island up to 11 months in the extreme south-west (Keane 1992). The estimated starting dates of the grazing season vary from March 25 in the southwest to April 20 in the northeast (Brereton, 1995) (Figure 3). Thus, the grazing season varies from about 235 days (mid March to early November) in the south and southwest to about 200 days (mid April to late October) in the midlands and north. Soil type has a major effect as poorly drained soils have a shorter grazing season due to utilisation problems and have a correspondingly longer winter feeding period. Moisture deficit is generally not a problem in relation to grass production in Ireland with only small losses in production potential which (<1.5 tonnes DM/ha) are confined to a narrow coastal strip in the east and southeast (Brereton and Keane, 1982).




**Figure 2** Mode
matter grass pro

**Provision of wi**

Grass silage is th
of farms that ma
(O'Kiely *et al.*,
million ha provi
silage harvested
It is estimated th
baled silage, ar
additives. It is
trends in the pr
grassland now h
2004). Althoug
ROI amounted t

**Table 6** Trends

Dairying
Beef
Sheep
All systems

Source: O'Kiely

**Fertiliser use**

Recent data fro
areas used for s
nitrogen (N) w
respectively. W
for beef cattle o

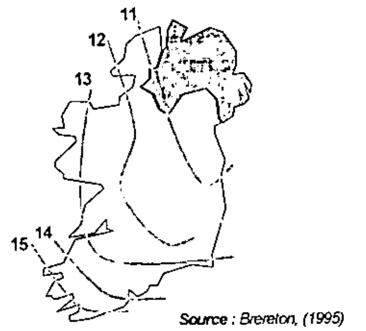



Figure 2 Model estimates of annual dry matter grass production (t $ha^{-1}$)

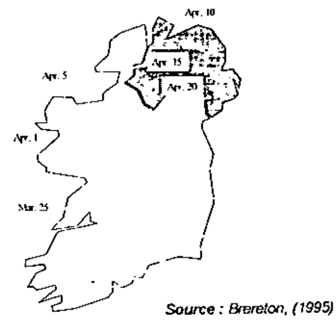



Figure 3 Estimated starting dates of the grazing season in Ireland

## Provision of winter feed

Grass silage is the principal source of winter feed for livestock in Ireland. Indeed the proportion of farms that make silage continues to increase, now standing at 86% of all farms in the ROI (O'Kiely *et al.*, 2000) (Table 6). The total area harvested for grass silage in 1999 was 1.24 million ha providing 4.6 million t. of edible silage DM. First cut accounts for over 70% of the silage harvested with second harvests from the same area accounting for most of the remainder. It is estimated that baled silage accounts for 35% of the area harvested for silage. Virtually all baled silage, and almost 75% of conventional silage, is made without the application of additives. It is estimated that 0.2 million ha of grass is harvested for hay each year. Similar trends in the provision of winter feed are seen in NI with an estimated 0.32 million ha of grassland now harvested for silage yearly producing 1.2 million t of edible silage DM (DARD, 2004). Although increasing in recent years, the total quantity of maize silage harvested in the ROI amounted to only 19,600 ha in 2003 or about 3% of conserved forage DM.

**Table 6** Trends in the percentage of farms that make silage within the main farming enterprises

| | 1991/92 | 1999 |
|---|---|---|
| Dairying | 91 | 99 |
| Beef | 52 | 86 |
| Sheep | 50 | 76 |
| All systems | 65 | 86 |

Source: O'Kiely *et al.* (2000)

## Fertiliser use

Recent data from the ROI (Coulter *et al.*, 2002) show that fertiliser use is greater on grassland areas used for silage than for grazing or hay areas (Table 7). Application rates of fertiliser nitrogen (N) were shown to be 109, 133 and 53 kg/ha on grazing, silage and hay areas, respectively. Within farming systems, fertiliser use was shown to be greater for dairying than for beef cattle or sheep systems (Table 7).

**Table 7** Estimated nitrogen, phosphorus and potassium fertilizer applied (kg/ha) to grassland for grazing, silage and hay and for different farming systems

| | Nitrogen | Phosphorus | Potassium |
|---|---|---|---|
| Grazing | 109 | 9 | 21 |
| Silage | 133 | 15 | 49 |
| Hay | 53 | 11 | 27 |
| Dairying | 176 | 12 | 26 |
| Cattle | 48 | 8 | 17 |
| Sheep | 48 | 6 | 13 |

Source: Coulter *et al.* (2002)

**National cow herd**

There have been substantial changes in the composition of the cow herd over the last twenty years. In the early 1980's total cow numbers in the ROI were just over 2 million, of which 80% were dairy cows and 20% suckler cows (Figure 4, CSO publications). The introduction by the European Union (EU) of milk quotas in 1984 and increased milk production per cow has resulted in a gradual decline in dairy cow numbers from 1.65 million in 1984 to 1.16 million in 2004. The corresponding change from 1984 to 2004 in suckler cow numbers was from 0.44 to 1.21 million. The average number of cows in dairy and suckler herds is 37 and 15 respectively (CSO, 2001). In NI, significant quantities of milk quota have been imported from GB, leading to an expansion in overall milk output (37% increase in milk quota held by NI producers over the last 10-years). Whilst overall numbers of dairy cows in NI have remained relatively unchanged (0.28 million), average milk yield has increased from 4,639 to 6,290 litres per cow over the period from 1984 to 2003, with average herd size now standing at 61 (DARD, 2004). The milk yield increase in the ROI was from 5,080 l. in 1985 to 6,166 l. in 2003 (ICBF 2003).

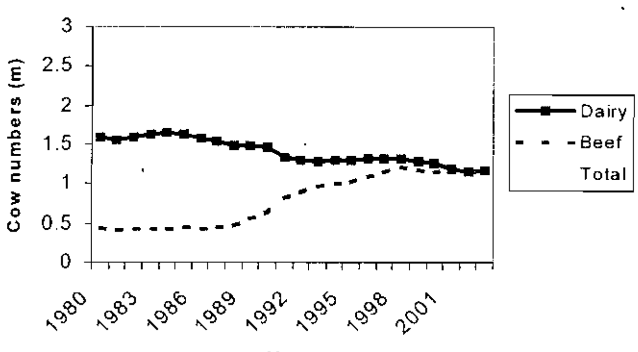



**Figure 4** Trend in cow numbers (million) in the ROI

*Breed composition of the cattle herd*

The dairy cow herd in the ROI is predominantly Holstein-Friesian (98%) and has changed little over recent years (Drennan, 1999a). Fifty percent of dairy cows in the ROI are bred to Holstein-Friesian sires, about 28% to late maturing beef breeds (e.g. Charolais) and 22% to early maturing breed sires (Hereford and Aberdeen Angus).



There has been r
side in both the F
of late maturing l
also evident on tl
breed sires, of wl

**Table 8** Breed c
(%) on beef dams

Aberdeen Angus
Hereford
Friesian
Simmental
Limousin
Belgian Blue
Charolais
Other breeds

Source: Drennan (

Calving pattern

In the ROI, both
the dependence o
43% in March-A
(Figure 5). The c
marginally earlie
systems are main
earlier grass grow

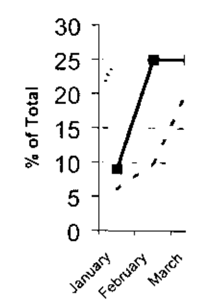



**Figure 5** Calf bir

There has been major changes in the composition of the beef herd, on both the dam and sire side in both the ROI and NI. Between 1992 and 2003 the proportion of beef cows comprised of late maturing breeds increased from 40 to 71%. Increasing usage of late maturing breeds is also evident on the sire side. Approximately 85% of suckler cows are now bred to continental breed sires, of which over 40% are bred to Charolais sires (Table 8).

**Table 8** Breed composition (%) of the beef cow herd in 1992 and 2003 and breed of sire used (%) on beef dams in 2003

| | Beef Cow Herd | | | | Sire Breed | |
|---|---|---|---|---|---|---|
| | 1992 | | 2003 | | 2003 | |
| | ROI | NI | ROI | NI | ROI | NI |
| Aberdeen Angus | 9 | 23 | 12 | 16 | 6 | 10 |
| Hereford | 35 | 12 | 20 | 6 | 5 | 5 |
| Friesian | 20 | 11 | - | 1 | - | - |
| Simmental | 9 | 23 | 17 | 18 | 8 | 7 |
| Limousin | 8 | 12 | 19 | 33 | 25 | 25 |
| Belgian Blue | - | - | - | - | 7 | 6 |
| Charolais | 7 | 7 | 21 | 12 | 44 | 40 |
| Other breeds | 12 | 2 | 11 | 11 | 5 | 8 |

Source: Drennan (1999a), ICBF (2003), DARD (2004), Kirkland *et al.* (2004)

Calving pattern

In the ROI, both the beef and dairy herds are predominately spring calving, which indicates the dependence on grazed grass. In the beef herd, 16% of calvings are in January-February, 43% in March-April, 22% in May-June with only 19% in the remaining 6 months of the year (Figure 5). The corresponding percentage figures for the dairy herd are 34, 41, 12 & 13. The marginally earlier calving in the dairy than in the beef herd reflects the fact that dairying systems are mainly in the southern part of the country, which as discussed previously, has earlier grass growth than northern areas.

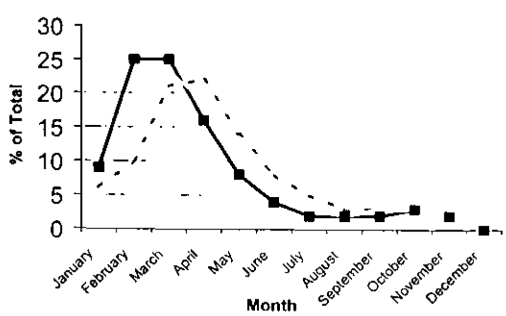



**Figure 5** Calf birth by month in beef and dairy herds in the ROI 2003

In NI, the majority of dairy cows calve over the autumn-winter period with only 18% calving in the January to April period (CAFRE, 2003). This is mainly a result of the higher output systems practised in NI along with the shorter growing season and more difficult ground conditions early and late in the season.

**Cattle slaughterings**

For orderly marketing, an even supply of beef throughout the year is desirable. However, in contrast with most other EU countries, beef production in Ireland, because it is based on grazed grass, has tended in the past to have a pronounced seasonality in production (Figure 6). In 1990, 40% of prime cattle slaughterings in ROI were in the final quarter of the year. This has changed in recent years and the corresponding figures for 2003 were 28% for ROI and 26% for NI. Various EU schemes including the eligibility to meet premium payments have contributed to this change, which may again be altered following the decoupling of subsidy payments from production systems. Average carcass weights in 2003 for steers, young bulls, heifers and cows in ROI were 341, 327, 273 and 294 kg respectively. Corresponding percentages with carcass conformation classes of EUR were 59, 82, 67 and 12%. Similar carcass weights and carcass quality were recorded in the NI beef industry.

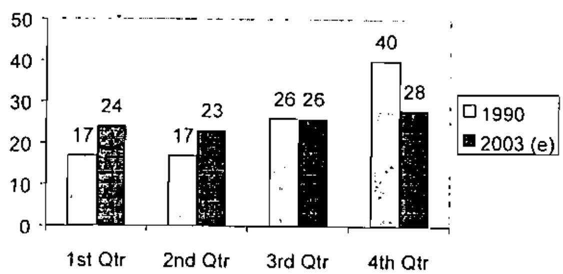



**Figure 6** Seasonality of prime cattle supplies in the ROI (%)

**Cattle and beef production and exports**

In the ROI, total cattle disposals in 2003 were 2.08 million, of which 1.86 million were slaughtered and 0.22 million were exported live (Bord Bia 2004). Total beef availability was 583,000 t carcass weight equivalent (includes 20,000 t imported) of which 14% was used for the home market, with the remainder exported. The home market is supplied almost entirely by heifer beef. Live cattle exports have varied widely from year to year. Between 1995 and 2003 exports varied from 57,000 head in 1997 to peaks of over 400,000 head per year in 1999 and 2000 (*Appendix Table 1*). In the peak export years, three-quarters were to continental EU countries (Spain, followed by Italy and Holland being the main markets) with minimal numbers to non-EU markets. In contrast, non-EU markets accounted for 71 and 73% of total live exports in 1995 and 1996, respectively with Egypt and Libya accounting for practically all exports in these years. Between 1995 and 2003 beef carcass exports varied from 345,000 t in 2001 to 554,000 t in 1999 (*Appendix Table 2*). While non-EU markets accounted for 40 to over 60% of exports in the period up to 2000 most have been exported to EU countries in recent years. In 2003, 53, 30 and 17% of total meat exports were to the UK, continental EU and non-EU markets, respectively.

In NI, cattle disposals in 2003 were 408,000 head all of which were slaughtered (DARD 2004). BSE (Bovine Spongiform Encephalopathy) export restrictions on beef have changed markets considerably over the past decade. In 1995, 52% of prime beef production in NI was exported outside the UK, chiefly to continental Europe. In 2003, of the 0.41 million of prime beef cattle slaughtered, 80% were exported to GB with the remainder used largely for home consumption (LMC, 2004).

**Beef production systems**

The data outlined shows that the climate in Ireland is ideal to grow grass and thus a suitable feed source is available which is the major cost factor in animal production. Beef, dairy and sheep production systems were designed to make optimum use of grass. As indicated earlier grass growth is confined, on average, to 7 to 8 months of the year when grass can be grazed cheaply *in situ*. For the remainder of the year it is necessary to conserve the grass from the time of most rapid growth (spring) to use in the period when grass growth is negligible in winter. In the past, grass conservation was as hay, which because of our wet climate was not ideal. Conservation of grass as silage was first introduced in the 1950's and has since continued to increase. It has the advantage over hay of being less dependent on weather conditions, allowing somewhat greater scope for mechanisation and permitting harvest at an earlier stage of grass maturity thereby allowing the production of higher quality conserved feed. In general, the systems are based on spring calving/lambing thereby ensuring that animal feed requirements are lowest when feed costs are greatest. When feed requirements are greatest in lactation the animals are at pasture and the management systems are designed to provide high quality leafy pasture throughout the grazing season. Compensatory growth is also availed of in that growing cattle are fed for moderate rates of gain in winter and subsequently high growth rates are attained at pasture. The grassland management practice results in beef cows being in good body condition at the start of winter and studies have shown that these cows can tolerate substantial losses in body reserves over the winter period without ill effects on subsequent cow or calf performance.

There is practically no veal production in Ireland with young bull beef production accounting for only 6% of male slaughterings in the ROI (Bord Bia 2004) and 18% in NI (LMC, 2004). Although declining, slaughter age of steers is generally between 24 and 30 months of age, while heifers are slaughtered 4 to 6 months earlier than steers. Most animals are housed in winter. Animal housing includes slatted floor sheds, straw-bedded courts, and cubicle accommodation.

Although numerous production systems are operated at farm level, the majority in the ROI involve spring born calves. Target weights at different stages of growth for these systems, based on studies at Grange Research Centre, are presented in the following sections for calves from suckler (Drennan 1999b, 2004, Drennan and Keane 2001) and dairy (Keane 2001, Drennan and Keane, 2001) herds.

*Suckling systems*

In studies of beef systems at Grange Research Centre, Limousin x Friesian and Simmental x (Limousin x Friesian) cows are used. Mature cows are bred to Charolais sires of high beef merit or Simmental sires for breeding herd replacements. Heifers are managed to calve at 2 years of age and are bred to easy calving Limousin sires.

Average calving date is mid March with the cows and calves turned out to pasture in April. Calves are weaned in October-November, when all animals are housed. Weaned calves are offered grass silage plus 1 kg of concentrates daily, normally over a 5-month winter period, following which they are put to pasture for a second grazing season. Heifer progeny are slaughtered in November at 20 months of age having received 3 kg of concentrates daily with grass (or silage) for the final 3 months. Steers are housed in mid October and offered silage plus 4 to 5 kg concentrates daily until slaughter in early March at two years of age.

Both semi-intensive and more extensive systems have been examined (Table 9). In the semi-intensive system 0.81 ha of grassland is allowed per cow unit, (cow, progeny and 25% replacements) with 225 kg of fertiliser N applied per ha and two silage harvests taken yearly. Fifty-five percent of the area is harvested for silage in late May (good quality for progeny with a dry matter digestibility (DMD) of about 740 g/kg) with a further 30% harvested in July (for cows with a DMD of about 650 g/kg). The extensive system has a lower stocking rate (1.0 ha /cow unit), less than half the level of fertiliser N applied (100 kg/ha) with one silage harvest half of which is in May (high DMD for progeny) and the remainder in June (lower DMD for cows). As no second silage cut is planned in the extensive system, although some may be harvested to maintain grass quality, there is an opportunity to accumulate sufficient grass as autumn approaches to allow the heifers to be finished outdoors. In both systems, flexible paddock rotational grazing programmes are operated with the objective of providing adequate supplies of leafy pasture throughout the season. Similar animal performance levels were obtained on both systems and the mean weights achieved by steers and heifers at different stages are shown in Table 10. With the same concentrate inputs per animal similar high animal performance levels can be obtained from semi-intensive or extensive grassland management systems. Consequently, beef output per ha is greater on the semi-intensive system (510 versus 410 kg/ha) but, due to lower costs in the extensive system, margins per ha were shown to be similar for the two systems.

**Table 9** Details and performance of semi-intensive and extensive sucking systems

| | System | |
|---|---|---|
| | Semi-intensive | Extensive |
| Stocking rate: ha/cow unit* | 0.81 | 1.0 |
| Nitrogen: kg/ha | 225 | 100 |
| Number of silage cuts | 2 | 1 |
| Percent of area harvested | 85 | 55 |
| Silage tonnes/cow unit | 14.5 | 13.5 |
| Heifers finished with concentrates on | Silage | Grass |
| Concentrates/cow unit (kg) | 700 | 700 |

*Cow plus progeny to slaughter plus 25% replacements

**Table 10** Animal weights (kg) and age at slaughter (days)

| | Steer | Heifer |
|---|---|---|
| Weaning weight | 316 | 288 |
| Yearling weight | 404 | 373 |
| Slaughter weight | 700 | 565 |
| Carcass weight | 396 | 309 |
| Age at slaughter | 725 | 606 |

*Dairy calf to beef systems*

Calves are born in February-March and are at pasture from May to November. Calves are rotationally grazed ahead of the yearling cattle. At a fertiliser N application rate of 114 kg/ha, the grassland area required for late maturing beef breed x Friesian and Friesian steers taken to slaughter is 0.55 ha. To provide adequate winter feed (total of 1.5t of silage DM consumed per animal) 55% of the total area is harvested in late May. Total lifetime concentrate inputs are 1000 kg (130 kg in calf stage and end of first grazing season, 120 kg during the first winter and 750 kg (5 kg/day) during finishing). Because of their earlier slaughter, the concentrate requirements of early maturing breed crosses are about 300 kg less than for Friesians and continental crosses. Lifetime live weight targets for both Holstein-Friesian and continental x Holstein-Friesian steers slaughtered at 2 years of age are shown in Table 11. The weights for Friesians also apply to early maturing breed crosses but the latter would have a shorter finishing winter and a lighter slaughter weight (carcass weight 295 kg).

**Table 11** Target weights and gains for Holstein/Friesian (FR) and Continental x Friesian (CT) steers slaughtered at 2 years of age

| Date | System event | No. days | Weight (kg) | | Age (weeks) |
|---|---|---|---|---|---|
| | | | FR | CT | |
| Mid March | Purchase | | 45 | 50 | |
| Mid May | To pasture | 58 | 80 | 90 | 8 |
| Mid November | To house | 189 | 230 | 240 | 35 |
| Late March | To pasture | 126 | 300 | 320 | 53 |
| Mid October | To house | 210 | 490 | 510 | 83 |
| Mid March | Slaughter | 147 | 620 | 650 | 104 |
| Overall | | 730 | 620 | 650 | |
| Kill-out (g/kg) | | | 520 | 538 | |
| Carcass wt (kg) | | | 320 | 350 | |

## Dairying

In 2003 the volume of milk sold off farms in Ireland totalled 6,972 million litres (Table 12). Close to 90% of this milk output was manufactured into butter, cheese, cream, and whole milk powder, with 10% produced for the liquid milk market. In the ROI, 57% of the milk used in manufacture was for butter and 20% for cheese. In NI, the main milk products are milk powder and cheese, using an estimated 20 and 50% of milk produced, respectively.

**Table 12** Milk output and disposal[1], 2003 (m.l whole milk only unless otherwise stated)

| Manner of disposal | ROI | NI |
|---|---|---|
| Milk sold off farms | 5,200 | 1772 |
| Milk used in farm households[2] | 45 | |
| Imported milk Intake | 349 | 9 |
| Total milk available | 5,594 | 1782 |
| Of which | | |
| Used for liquid consumption | 505 | 213 |
| Used in the manufacture of: | | |
| Butter | 3,216 | 34 cream |
| Cheese | 1,106 | 200 + 64 cream |
| Cream[3] | 220 | 587 + 270 cream |
| Whole Milk Powder | 247 | 587 +270 skim milk |
| Chocolate Crumb | 129 | |
| Miscellaneous Products | 717 | |

[1]Milk output and disposal will not reconcile due to the existence of different production processes in the production of milk based products
[2]Including milk used for the production of farm butter, cream and cheese and milk given as payment in kind to agricultural employees
[3]Includes milk used for the manufacture of cream by creameries and pasteuries
Source: DAF (2004), DARD (2004)

*Spring-calving systems*

Milk production in the ROI is predominantly based on spring-calving systems. Thus grazed grass, makes a major contribution to the feed budget of dairy cows. The Blueprint (Dillon and Stakelum 1999) for efficient dairying based on calving at the start of grazing in spring sets a target of 6,000 litres of milk per cow with an average fat content of 3.9% and a protein content of 3.4%. This level of performance is achievable at a stocking rate of 2.5 cows/ha, a N input of 325 kg/ha and a mean calving date in mid February-early March. The inputs per cow include 500 kg of concentrates, 3.6 t (DM) of grazed grass and 1.4 t (DM) of silage. The blueprint is applicable for dry land in the south and it will change to reflect differences in soil type and location within Ireland.

The objective over the main grazing season (May to September) is to achieve high cow performance from an almost complete grass diet. This is achieved by allocating an adequate daily supply of high quality grass. The provision of adequate silage for the winter is also important over this period. The aim of autumn grazing management (September to November) is to maximise the amount of grass utilised while at the same time finish the grazing season with the desired farm grass cover so as to set up the farm for early spring grass. The timing of autumn supplementation depends on grass growing conditions, stocking rate, calving pattern and milk yield.

It is recommended that, on dry land, all of the farm should be grazed initially, starting in early-March if grass supply and weather conditions permit. This may not be possible in all years. Early grazing is facilitated by early applications of N fertiliser and the correct timing of final autumn defoliation. However, due to the low growth rate in early spring, grass supply will not be adequate to meet the dairy cow's demand when first turned out to grass. With compact spring-calving and stocking rates of 2.5 cows/ha, daily grass growth will not be adequate to meet the cows demand until mid to late April. Therefore, up to that date and depending on turnout date, supplementary concentrates and silage will be provided with grass. It is important that the first rotation should not finish before mid to late April. At a stocking rate of 2.5 cows per hectare, 45 to 50% of the total area can be closed for silage on the first week of April.

During the early part of the grazing season (late April to June), tight grazing (residual sward height of 6 cm) is critical. First cut silage is taken during mid to late May with a second silage crop (35% of farm closed) cut 7 to 8 weeks later (mid to late July). The two cuts will provide a total of 7 t of silage (20% DM) per cow. From mid to late August onwards, the total farm is available for grazing. During this period (July to September), grazing pressure may be relaxed to allow a post-grazing sward surface height of 7-8 cm in order to increase milk yield per cow without resulting in deterioration in sward quality afterwards.

*Autumn calving systems*

Research at the Agricultural Research Institute of Northern Ireland has examined systems to allow high nutrient intake to support milk production from high genetic merit Holstein-Friesian cows which are widespread in the NI dairy industry (Ferris *et al.*, 2004). Systems examined incorporated the following broad approaches to increasing nutrient intakes:

- improving the feed value of the silage offered or increasing concentrate feed level during the winter.
- offering a high allowance of high quality pasture without supplementation or tighter grazing regimes combined with concentrate supplementation during the summer.

Although total milk outputs were similar with each of the four systems (7,900 litres/cow), milk protein contents were higher with systems involving high concentrate inputs during the winter. System had only minor effects on the degree of tissue loss/gain during lactation and on the fertility of the cows involved. However, the land requirement associated with each of the systems was very different ranging from 2.3 to 3.3 cows/ha. Consequently gross margin per ha increased with increasing stocking rate, while gross margin per cow and gross margin per litre of milk produced were relatively unaffected by system. Thus the profitability of different grassland production systems for autumn calving cows is to a large extent influenced by the fixed costs which arise on the individual farm,

**Sheep production**

The ewe population is 3.9 million in ROI and 1.1 million in NI. Corresponding average flock sizes are 113 and 126 ewes (CSO, 2004; DARD, 2004). Over the past 10 years, total ewe numbers have fallen by approximately 25% in both the ROI and NI. In the ROI, most of the decline in ewe numbers has been in hill areas, whereas in NI hill ewe numbers have remained relatively unchanged with the decline being more evident in the lowland sector.

Sheep production in 2003 amounted to around 4 million lambs in the ROI and 0.8 million lambs in NI. In the ROI, 70% of lambs were exported, mainly to France (70% of exports). In NI, 39% of lambs were exported to the ROI for processing. Of the lambs slaughtered in NI the majority were exported to GB (63%), with 22% to continental Europe (mainly France) and 15% marketed for home consumption (LMC, 2004).

Hill sheep systems are predominately based on Scottish Blackface and Cheviot ewes either bred pure or crossed with prolific breeds (e.g. Belclare, Blue-Faced Liecester) to produce crossbred female replacements for the lowland sector. Typical levels of performance in hill sheep systems are presented in Table 13. In most hill sheep systems lambs are mainly sold at weaning for finishing in the lowland sector or housed and finished off on concentrate diets.

**Table 13** Output from Scottish Blackface and Cheviot ewes on hill farms across Northern Ireland (Carson *et al.*, 2001)

| | Scottish Blackface | Wicklow Cheviot |
|---|---|---|
| No. lambs born per ewe mated | 1.29 | 1.29 |
| No. lambs weaned per ewe mated | 1.14 | 1.20 |
| Lamb live weight at weaning (kg) | 30.5 | 31.5 |
| Age at slaughter (months) | 9.7 | 8.5 |
| Carcass weight (kg) | 17.8 | 18.3 |

The dominant system of lowland sheep production is grass-based. The great majority of ewes lamb in spring and are managed in an integrated grazing/silage/housing system, often mix-stocked with cattle or in association with tillage enterprises.

Developments in recent years have seen the emergence of a significant core of specialist lowland sheep producers who have invested in relatively large flocks ranging from 400 to 800 ewes for economy of scale and labour efficiency. Research in sheep production has been focussed in particular on two major determinants of production efficiency, namely, the number of lambs reared per ewe joined (Hanrahan, 1997; Dawson and Carson, 2002) and the number of ewes stocked per ha of pasture. The set target for ewe productivity is 1.7 lambs reared per ewe mated (Flanagan 2003, 2004).

The significance of ewe productivity and stocking rate, was evident in the comparative performance of flocks managed in intensive and extensive systems at Knockbeg (Flanagan, 2003) (Table 14). Lamb output per ha in the intensive and extensive systems were 450 and 342 kg of carcass per ha, respectively.

**Table 14** Flock performance and output at Knockbeg Sheep Unit, Carlow: Pooled results for 1999 and 2000

| System | | Grazing/silage/housing | Extended grazing |
|---|---|---|---|
| No. ewes per ha | | 14 | 10 |
| Ewes lambing (%) | | 95 | 96 |
| No. lambs reared/ewe joined | | 1.76 | 1.78 |
| Carcass wt. (kg) | | 18.8 | 19.3 |
| Age at slaughter (days) | | 160 | 146 |
| Lamb output: | kg/ewe | 33.3 | 34.1 |
| | kg/ha | 450 | 342 |



**Environmenta**

In NI over 11,0
a quarter of the
Development F
through the po:
lakes by nutrie
Practice; and t
management im

European Unio
Nitrates Directi
Ireland. NI ha
produce a legall
spreading perio
for organic man

The Council of
direct agricultu
environment, an
to observe certa
which post-refc
production.

In the ROI, the
now almost 44,(
and inorganic
pollution avoida
introduced in the
farmers expecte
to the Nitrates D

**Appendix table**

**Appendix Table**

| | |
|---|---|
| Total | |
| of which to: | |
| International mar | |
| Continental EU | |
| United Kingdom | |

Source: Bord Bi

## Environmental issues

In NI over 11,000 farmers participate in voluntary agri-environmental schemes, covering over a quarter of the farmland area. The schemes, which have been developed under the EU Rural Development Regulation (EC 99/1257), focus on maintaining and improving biodiversity through the positive management of wildlife habitats, improving water quality of rivers and lakes by nutrient management planning and the adoption of the Codes of Good Agricultural Practice; and the maintenance of landscape and heritage features by integration of their management into farming system.

European Union legislation including the Water Framework Directive (EC 2000/60) and the Nitrates Directive (EC 91/676) will have implications for grassland production systems in Ireland. NI has adopted a 'total territory' approach within the Nitrates Directive, and will produce a legally binding action programme during 2005. This will impose restrictions on the spreading periods for both organic and inorganic manures, define a minimum storage period for organic manure, and set maximum limits on phosphorus balances on individual farms.

The Council of Ministers of the European Union has recognised that farmers in receipt of direct agricultural support have important responsibilities towards the protection of the environment, animal health and welfare, and public health. Farmers will therefore be required to observe certain conditions in these areas in return for receipt of direct agricultural support, which post-reform of the Common Agricultural Policy (CAP), is now decoupled from production.

In the ROI, the Rural Environment Protection Scheme (REPS) was introduced in 1994 and now almost 44,000 farmers participate in the scheme. In this scheme inputs of both organic and inorganic N on grassland are limited, a nutrient management plan developed and pollution avoidance is critical. In the third version of the REPS scheme, which has been introduced in the last year, there is greater emphasis on broader environmental objectives with farmers expected to be managers of the natural heritage. The action programme with regard to the Nitrates Directive is presently being finalised with the ROI.

## Appendix tables

**Appendix Table 1** Irish live cattle exports from the ROI, 1992-2003 ('000 head)

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|
| Total | 370 | 190 | 57 | 171 | 416 | 401 | 101 | 147 | 220 |
| of which to: | | | | | | | | | |
| International markets | 263 | 139 | 7 | 29 | 74 | 65 | 11 | 32 | 37 |
| Continental EU | 89 | 41 | 23 | 137 | 324 | 311 | 40 | 73 | 143 |
| United Kingdom | 18 | 10 | 27 | 5 | 18 | 27 | 50 | 42 | 40 |

Source: Bord Bia

**Appendix Table 2** Destination of beef exports from the ROI, 1995-2003 ('000 tonnes cwe)

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|
| Total | 440 | 425 | 450 | 510 | 554 | 495 | 345 | 460 | 500 |
| of which to: | | | | | | | | | |
| UK | 100 | 60 | 95 | 85 | 95 | 110 | 220 | 255 | 265 |
| Continental EU | 158 | 100 | 90 | 130 | 150 | 135 | 72 | 116 | 150 |
| International markets | 183 | 265 | 265 | 295 | 309 | 250 | 50 | 89 | 85 |

Source: Bord Bia

## Acknowledgements

The authors thank Miss D. Hennessy for assistance in data assembly and Ms. M. Weldon and Miss S. Caffrey for typing the manuscript.

## References

Brereton, A.J. & T. Keane (1982). The effect of water on grassland productivity in Ireland. *Irish Journal of Agricultural Research*, 21, 227-248.

Brereton, A. J. (1995). Regional and year to year variation in production. In: Jeffrey, D.W., Jones, M.B. & J.H McAdam (eds.) 1995 Irish grasslands – their biology and management: *Dublin Royal Irish Academy*, 12-22.

Bord Bia (2004). Irish Food Board. *Meat and Livestock Review and Outlook 2003/04*, 80pp.

Carson, A.F., B.W. Moss, L.E.R. Dawson & D.J. Kilpatrick (2001). Effects of genotype and dietary forage to concentrate ratio during the finishing period on carcass characteristics and meat quality of lambs from the hill sector. *Journal of Agricultural Science, Cambridge*, 137, 205-220.

Central Statistics Office (CSO) (2001) Publications.

Central Statistics Office (CSO) (2004) Publications.

College of Agriculture, Food and Ruaral Enterprise (CAFRE) (2003). *Greenmount Dairy Benchmarking Report*

Connolly, L., A. Kinsella & G. Quinlan (2004). *National Farm Survey 2003*, 16pp.

Coulter, B.S., W.E. Murphy, N. Culleton, E. Finnerty & L. Connolly (2002). A survey of fertiliser use in 2000 for grassland and arable crops. *Teagasc, End of project report*, 34pp.

Cruickshank, J.G. (1997). Soil and Environment: Northern Ireland. Published by the Agricultural and Environmental Sciences Division, DANI and the Environmental Science Department, The Queen's University of Belfast.

Dawson, L.E.R & A.F. Carson (2002). Options for genetic improvement within the NorthernIreland sheep industry. In: *75th Annual Report of the Agricultural Research Instituteof Northern Ireland*, 58-68.

Department of Agriculture and Food (DAF) (2004). Annual Review and Outlook for Agriculture and Food.

Department of Agriculture and Rural Development for Northern Ireland (DARD) (2003). The Agricultural Census in Northern Ireland – Results for 2003. *A National Statistical Publication.*

Department of Agriculture and Rural Development for Northern Ireland (DARD) (2004). Statistical Review of Northern Ireland Agriculture 2003. *A National Statistical Publication.*

Dillon, P. & G. Stakelum (1999). Spring Milk Production. In: J. Murphy (ed.) A new agenda for dairying, 3-7.

Drennan, M.J. (1999a). Breed composition of the Irish Cattle Herd. *Teagasc, Beef Production, Series*, No. 22, 26pp.

Drennan, M.J. (1999b). Development of a competitive suckler beef production system *Teagasc, Beef Production Series* No. 18, 32pp.

Drennan, M.J. (2004). Quality suckler beef from low and high input grassland management systems. *Teagasc, Beef Production Series* No. 48, 15pp.

Drennan, M.J. & M.G. Keane (2001). Producing cattle in the current policy and market environment. R and H Hall *Technical Bulletin*, 12pp.

Eurostat (2002). Farm Structure 1999/2000 Survey.

Ferris, C.P., D.C. Patterson & J. Murphy (2002). Grassland-based systems of milk production for autumn calving dairy cows: a three-year comparison. In: 75th Annual Report of the Agricultural Research Institute of Northern Ireland, 44-57.

# ANEXO N° 5

## Libro: Grassland: a Global resource

(solo portada y capítulos iniciales)

# Grassland: a global resource

edited by
**D.A. McGilloway**

The concept of grasslands as a global resource is not new. Indeed many recognised authorities have been canvassing for a global approach to understanding, managing and exploiting this resource for many years. This is the first book that gathers together leading experts from around the world to outline our current understanding of this complex ecosystem, the ways in which it can be enhanced and utilised and where the research challenges are for the future. The following themes unite the book:

- Efficient production from grassland.
- Grassland and the environment.
- Delivering the benefits from grassland.

The reader is given an in depth understanding of the biology of the system and how grasslands are crucial for soil stabilisation and water quality. Secondly, much attention is given to how grasslands offer the possibility of increasing food supply and income generation, which is a hugely important but often ignored facet in today's climate of extensification and biodiversity. Current advances in the grassland sciences have a proven potential to promote the economic development and environmental stability of regions, nations and peoples, particularly in some of the most resource-limited areas of the world. Approaches for achieving the most effective development and adoption of new technology are reviewed.

Other publications related to the XX International Grassland Congress:

- XX International Grassland Conference - Offered papers 9076998817
- Optimisation of nutrient cycling and soil quality for sustainable grasslands 9076998728
- Molecular breeding for the genetic improvement of forage crops and turf 9076998736
- Pastoral systems in marginal environments 9076998744
- Silage production and utilization 9076998752
- Utilisation of grazed grass in temperate animal systems 9076998760

ISBN 907699871X

Wageningen Academic Publishers

XX IGC 2005
IRELAND & UNITED KINGDOM

# Grassland in Ireland and the UK

M. Rath[1] and S. Peel[2]
[1]*University College Dublin, Department of Animal Science, Belfield, Dublin 4, Ireland, Email: myles.rath@ucd.ie*
[2]*Rural Development Service, Department for Environment Food and Rural Affairs, Otley Road, Lawnswood, Leeds LS16 5QT, UK*

## Key points

1. Grassland is the dominant land use option in Ireland and the UK, and is characterised by a long growing season.
2. Dynamic, interactive systems of grassland management have been developed which combine high grass dry matter intakes with good sward quality. In the better grassland areas, milk yields in excess of 7000 kg/cow are attainable with low levels of concentrate supplementation.
3. In the times to come, measures to protect the environment will constrain stocking rates, and fertiliser and manure use on intensive grassland enterprises.
4. A high proportion of beef and sheep farms participate in voluntary, EU-funded agri-environmental schemes that promote less intensive production systems and high standards of environmental protection.
5. Access for the public to, and conservation by farmers of, the countryside have become increasingly important in the last 20 years. In the future, grasslands will have to meet a variety of demands and be truly multifunctional.

**Keywords:** intensive, dairy, pollution, biodiversity, multifunctional

## Introduction: background and context

Irish agriculture is overwhelmingly grass based, and concerned with the conversion of grass to milk, beef or sheep-meat. Agriculture in the UK is similar except that cereal production also assumes importance. Details on land use, livestock numbers and farm structure and type are given in Tables 1 and 2. Permanent grassland is by far the largest land use option for agricultural land in Ireland, accounting for almost 80% of the land area. This is almost twice the proportion in the EU-15 as a whole. Grassland also dominates in the UK, though cereal production accounts for 18% of the land area. This compares to 7% and 26% for Ireland and the EU-15 respectively. While grassland and rough grazing are the major land use options, it is worth noting that many dairy farms in the UK (and Ireland to a lesser extent) also use maize silage or whole-crop cereal silage in addition to grass silage.

The vast majority of farms in Ireland are owned and operated by farmers. Historically most farmland in the UK was tenanted, but today 66% of farms are owned by the occupying farmer. A large proportion of farm households in both countries also have a source of off-farm income. Dairy herds, usually concentrated on the more productive land, account for 19% and 11% of farms in Ireland and the UK respectively. However the most common farm type in Ireland is the beef cattle farm, while in the UK it is the sheep farm. Many of the beef cattle and sheep farms in both countries are in areas classified under EU regulations as Less Favoured Areas (LFA). There are relatively high numbers of beef cows in both countries. Sheep production is also an important enterprise in both Ireland and the UK.

**Table 1** Land use and livestock numbers

| | Ireland | UK |
|---|---|---|
| Total agricultural area (000 ha) | 4,370 | 18,449 |
| Grassland | 3,466 | 6,884 |
| Rough grazing | 468 | 5,565 |
| Forage maize | 16 | 119 |
| Arable silage (mainly wholecrop cereals)[1] | 29 | 38 |
| Other forages (roots, green crops) | 5 | 55 |
| Breeding livestock (000) | | |
| Dairy cows | 1,156 | 2,192 |
| Beef cows | 1,187 | 1,700 |
| Ewes | 3,615 | 14,926 |

Data for 2003 from: Ireland - Central Statistics Office; UK - Defra.
[1](Wilkinson & Toivonen, 2003)

**Table 2** Structure of agricultural holdings in Ireland and the UK (Charlier, 2003)

| | Ireland | UK |
|---|---|---|
| Size of farm (ha) | 31 | 68 |
| Proportion of farms by type (%) | | |
| Specialist dairy | 19 | 11 |
| Specialist cattle – rearing and fattening | 51 | 14 |
| Sheep and other grazing livestock | 20 | 38 |
| Specialist cereals, general cropping or horticulture | 4 | 22 |
| Proportion of organic farms | 1 | 1 |

The role of grassland in Ireland and the UK is greatly influenced by the Common Agricultural Policy (CAP) of the European Union. Following entry in 1973 the rapid expansion of both milk and meat production continued, and sheep numbers rose dramatically, encouraged by CAP headage payments. However, the growth of intervention stocks of many agricultural products created difficulties, and measures to limit production began in 1984 with milk quotas, which are still in place today. Milk quotas reversed the growth in dairy cow numbers. Under the McSharry reforms in 1992 there was a shift from support for market prices, to headage payments for both sheep and beef. The growth in animal numbers contributed to overgrazing of grassland and resulted in damage to some environmentally sensitive areas. In 2003 a radical reform of the CAP was agreed, resulting in complete decoupling of income support from production in both Ireland and the UK. The many headage payments for livestock (and area payments for crops) have been discontinued. Income support for farmers, now known as the 'Single Farm Payment', is not dependent on the production of any specific crop or livestock. The introduction of decoupling may lead to profound changes in grassland usage within the EU in the years ahead.

Through the 1970s and 1980s, evidence began accumulating of the impact of the intensification and specialisation of agriculture on both surface water and groundwater. Agriculture was also found to be impacting on soil and air quality, and on the landscape and biodiversity. A number of statutory and voluntary schemes have been introduced to promote less intensive and more environmentally friendly systems of animal production. The most recent EU reform of the CAP includes a clause that makes all direct payments conditional on cross-compliance by farmers with a range of food safety, animal welfare and environmental measures. In Ireland farmers must follow the Code of Good Farming Practice and in the UK the land must be kept in Good Agricultural and Environmental Condition.

Two other major EU Directives, the Water Framework Directive and the Nitrate Directive, also have major implications for livestock production and for grassland management. It is likely that on intensive grassland farms, mainly in the dairy sector, farmers may have to reduce stocking rates, or export animal manures to neighbouring farms. In addition to requiring farmers to avoid air and water pollution the public, especially in the UK, are also seeking access to a countryside that exhibits attractive landscapes, ecological balance and biodiversity. These pressures will all impinge on the use of grassland in the future, and the mix of animal enterprises and management practices may therefore change significantly in years ahead.

## Effects of location and climate on grass production

Ireland and the UK are located on the northwest edge of Europe. Dublin, at 53°N latitude, is further north than Calgary (Canada) or Irkutsk (Siberia). The most southern point of the UK lies further north than the 49°N parallel, which forms much of the border between Canada and the United States. Ireland and the UK benefit greatly from the moderating influence of the Atlantic, and particularly with the warming effects of the Gulf Stream. The maritime climate is mild and moist which is good for growing grass and is especially important in giving a long growing season. Likewise the length of the grazing season in the most favourable areas in Ireland and the UK is a major advantage relative to many parts of Europe. However, one commonly overlooked disadvantage arising from the location and climate in both countries is that the intensity of radiation during the summer may be sub-optimal for grass growth and, more particularly, for some other high output forage crops. A comparison of the Irish climate with some selected regions is given in Table 3 (Keane & Sheridan, 2004).

Taking into account the altitude and distance from the sea, the January temperatures illustrate the mildness of the winters in Ireland and in many areas of England and Wales. However, the July temperatures show why Ireland is disadvantaged in relation to forage maize production compared to the other sites. The July rainfall values are also noteworthy – rainfall in Ireland and the UK is similar to the other sites, but tends to fall in prolonged, relatively light showers rather than in heavy 'downpours' which are more common on continental Europe. The favourable climatic conditions of Christchurch are also apparent. (Christchurch is located on the South Island in New Zealand which has much less favourable growing conditions than the North Island where most of the dairy cows in New Zealand are located.)

## Regional and annual variation within Ireland and the UK

While the climate in Ireland and the UK is, in general, very suitable for grass production, it is also suitable for growing a range of other crops including cereals and potatoes. This is particularly so in the eastern half of Britain and in more limited areas in the eastern and southern parts of Ireland. Such crops compete with grassland as land use options for some of the best land, and tend to dominate in the low rainfall areas, especially in eastern England (Hopkins, 2000). Grassland is the predominant land use option in all other areas, especially in the hills and in areas where wetter soils make the growing and harvesting of arable crops more difficult. In these areas the less intensive use of grassland is the norm, with sheep production and suckler cows more common than milk production.

**Table 3** Temperature, precipitation and sunshine at selected met stations, 1961-90 (Keane & Sheridan, 2004)

| Country | | Ireland | England | France | Netherlands | N. Zealand | Poland |
|---|---|---|---|---|---|---|---|
| Station | | Birr | Lyneham | Nantes | De Bilt | Christchurch | Poznan |
| Altitude (m) | | 73 | 147 | 27 | 3 | 37 | 84 |
| Mean | Jan | 4.8 | 3.4 | 5.2 | 2.2 | 17.2 | -2.0 |
| Temperature | April | 7.9 | 7.7 | 10.3 | 8.0 | 12.2 | 7.6 |
| (°C) | July | 15.0 | 16.0 | 19.0 | 16.8 | 5.8 | 18.0 |
| | Oct | 10.2 | 10.4 | 12.7 | 10.5 | 11.8 | 8.8 |
| Precipitation | Jan | 76 | 64 | 87 | 69 | 46 | 30 |
| (mm) | April | 53 | 45 | 50 | 53 | 53 | 36 |
| | July | 59 | 55 | 46 | 76 | 68 | 69 |
| | Oct | 84 | 64 | 79 | 75 | 44 | 39 |
| Sunshine | Jan | 50 | 53 | 72 | 47 | 215 | 40 |
| (hr) | April | 139 | 153 | 187 | 153 | 143 | 152 |
| | July | 131 | 205 | 267 | 187 | 126 | 218 |
| | Oct | 83 | 101 | 141 | 103 | 187 | 102 |

Hopkins (2000), outlined the variation in grass growing days in the UK based on temperature, adjusted for drought and altitude. The variation was from less than 200 days to in excess of 300 days. In Ireland a large area of the country has a growing season of between 270 and 300 days (Burke *et al.*, 2004). This is an area devoted to intensive grassland enterprises, mainly dairying. Peel & Matkin (1982) described 7 climatic zones in relation to grass productivity in England and Wales. They used a calculated 'drought factor' and noted that even in areas with high concentrations of dairy cows, that summer rainfall was significantly less than the potential evapotranspiration, so that soil moisture deficits were not uncommon.

Collins *et al.* (2004), reviewed climate and soil management in Ireland, whilst the relationship between soil type and grassland productivity have been summarised by Ryan (1972). Soils described as either dry and light, or dry and loamy, predominate in the main agricultural areas. With the exception of some restrictions on summer growth due to low rainfall these soils have few limitations for grass production. Soils described as wet and heavy, or wet and peaty have serious restrictions on both the production, and utilisation of grass for periods of the year. Intensive dairying is mainly based on dry loamy land, with some also on wet heavy land in the southern part of the country. Two thirds of the dairy cows in Ireland are located in Munster (1 of 4 provinces). Beef production in Ireland is distributed across all areas, with some based on intensive grassland located on good land across the country.

Shalloo *et al.* (2004a) compared the profitability of a typical dairy enterprise on free draining, or on badly drained soil in southern Ireland using the most suitable technology on both sites. Very large differences in annual profitability (*circa* €28,000) were observed, such that, even with relatively high milk prices, milk production was hardly viable on the badly drained site. The difference in profitability was due to a variety of factors arising mainly from the longer overwintering period, but also from interruption to grazing due to soil conditions following rainfall. Additional concentrate feeding and silage making costs accounted for almost half the difference in profitability. Capital charges arising from higher infrastructure costs plus land charges accounted for most of the rest (L. Shalloo, *pers. comm.*). If the expected drop in EU milk price occurs, milk production in the less favoured areas (even in Ireland) can only be viewed as a transition phase, probably to non-intensive part-time farming, combined with off-farm employment. This is a situation that is likely to be repeated in many areas across Europe.

Variation from year to year is of great significance for the management of intensive, grass-based animal production enterprises. In spring-calving dairy herds, poor grass growth in the critical early lactation period due to a 'slow' spring can have serious consequences for the rest of the lactation. Likewise an unexpected period of high growth can lead to a rapid deterioration in sward quality. This unpredictable variation in grass growth has provided the impetus in recent years for the development of dynamic interactive systems of grassland management to replace more static, date-based guidelines. Burke *et al.* (2004) presented Irish data on the variation in expected growth between regions, and between years for a 10-year period. In the January to April (winter-spring) period and also in the May to August (summer) period, the difference between the best and the worst years was in excess of 1000 kg DM/ha. In the September to December (autumn-winter) period the variation was little more than half the variation in the other two periods. Since the overall growth in winter-spring was much less than in summer, the relative variation in growth rates in the spring is much higher.

Again, as in the UK, soil moisture deficits are a continuing feature affecting grass growth in parts of Ireland. Burke *et al.* (2004) present data for a 20-year period from 1956 to 1975. The average losses in growth were relatively low, but in the eastern regions the average losses were in excess of 10% of annual growth. In the 5 driest years, a loss of at least 20% of annual output occurred in most areas, while the losses in the low rainfall areas were in excess of 30% of annual dry matter output.

The evidence that the climate is changing seems to be quite strong - four of the five warmest years recorded in central England since records began in 1772 have occurred since 1990. Rainfall in the last 30 years has been higher in winter but lower in summer compared to the 150-year historical data (Defra, 2004). It is expected that weather will also become more variable with more extremes occurring. In future, therefore, it is likely that soil moisture deficits during the summer months will become more serious in the main agricultural areas in Ireland and the UK, and grass growth during the summer months will be adversely affected. Temperature and rainfall are expected to increase in winter. Grass growth over the winter months will increase but the wetter soils will make grazing difficult. If these changes transpire, it is likely that forage maize for silage will become more important and that grass may be devoted almost entirely to grazing, with a small amount of surplus grass made into silage in the early part of the grazing season. It is also possible that there will be greater interest in *Medicago sativa* (lucerne ) and other drought-resistant forages.

## Forage species, fertilizers and conservation: the basic framework

### *Forage species*

The forage area in Ireland and the UK is overwhelmingly devoted to permanent grassland, along with a substantial area that can be described as rough grazing. A relatively small proportion of the total grassland area forms part of a regular rotation with arable crops – amounting to about 10% in England and Wales, with substantially less in Ireland. However, at least half of all enclosed grassland has been sown since the mid 20[th] century – often reseeded directly from grass to grass. Hopkins (2000) estimated that 70% of swards over 20 years old in the UK could be classified as first or second grade *Lolium perenne* L. (perennial ryegrass) pastures. By far the most widely sown grass species is *L. perenne*, accounting for some 80% of agricultural grass seed sold in the UK (Defra, 2003a). Most of the remainder is either *Lolium multiflorum* Lam. (Italian ryegrass) or *Lolium hybridum* (hybrid ryegrass) for use in 2 - 4 year grass leys. The only other significant sown species is *Phleum pratense* L. (Timothy), which is often included in long-term mixtures as a minor component. The position in Ireland is similar but with *L. perenne* in an even more dominant position.

Of the legumes, *Trifolium repens* (white clover) is the only widely used species, and is a component of most long-term mixtures. In recent times, there has been increased research interest in *Trifolium pratense* (red clover), but this has only made a major impact on organic farms. *Lotus* spp. (Trefoils) have been shown to be suitable legumes on more difficult soils, but uptake has been very small. *M. sativa* is scarcely used.

The context for the choice of forage species is that Ireland and the UK are very suitable for ryegrass species, and ryegrass is suitable for both grazing and silage.. Fertiliser nitrogen has been relatively inexpensive, and was heavily promoted from the 1960's to the 1980's. Robust and productive legume varieties have been bred, and legume-based systems have been extensively researched, but they have only been widely adopted on organic farms.

*Fertilisers*

Average fertiliser applications on grassland in Ireland, and particularly in the UK, are high by European standards, though they are much lower than the recommended economically optimum rates for intensive grassland enterprises. Data for enclosed grassland in Britain (Defra & SEERAD, 2004) shows that the proportion of grassland receiving the different elements is 73% for nitrogen, 60% for phosphate, 59% for potash and 6% for sulphate with average rates of application of 89, 20, 25 and 44 kg/ha respectively (Figure 1). Areas cut for silage receive much higher rates (133 kg/ha of N) than areas for grazing. Also much higher rates are applied on dairy farms than on beef and sheep farms.

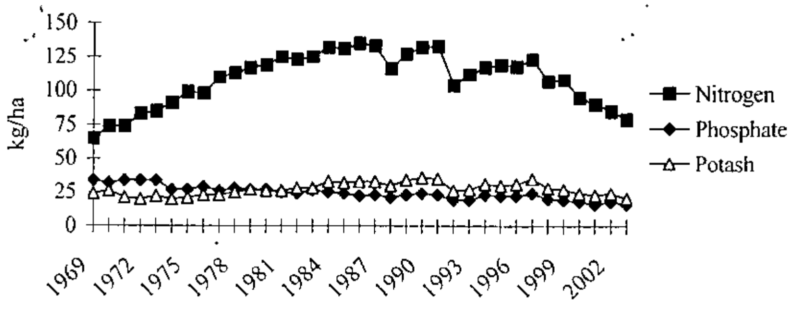



**Figure 1** Overall fertiliser use on grassland in England and Wales

In recent years application rates in the UK are falling. The annual dataset for England and Wales (Figure 1) goes back to 1969, when overall rates were 65 kg/ha N, 34 kg/ha phosphate and 22 kg/ha potash. Nitrogen use peaked in the mid 1980's at 130 kg/ha. The recent trend reflects a number of factors including lower farming profits, recommendations for lower levels of N application, a reduction in the amount of grass ensiled and an increased participation by farmers in agri-environmental schemes.

*Forage conservation*

Silage is the dominant means of grass conservation. Wilkinson & Toivonen (2003) summarised the silage making practices in the UK and Ireland. Grass silage accounts for 83% and 70% of the forage conserved in Ireland and the UK respectively, with only 16% and 18% as hay. Most of the grass silage in Ireland, and in the western part of the UK is low dry matter silage, either direct cut or subjected to only a brief wilt. Additives are widely used - bacterial inoculants and enzyme products now more popular than acids and salts. A large silage cut taken in late May or early June is the norm on dairy and cattle farms. A smaller second cut is also common. Machinery contractors with high capacity systems carry out a high proportion of silage making - 60% in the UK, a higher proportion in Ireland. Big-bale silage has been widely adopted on smaller farms, and also on larger farms for supplementary cuts, and as an aid to the management of sward quality - 35% of grass silage in the UK is made as big bale silage.

The area of forage conserved in the UK is falling - from 2.7 million ha in 1994 to 2.2 million ha in 2000. This may reflect the fall in cattle numbers, and perhaps also recognition that grass silage is expensive compared with grazing. As yield of dry matter for individual cuts of grass silage are low relative to the yield of forage maize or whole crop cereal, costs of ensiling are high. When dry matter yields of grass silage are low, the total cost per ton of dry matter for grass silage are similar to the cost of cereals purchased at harvest and stored on farm.

There has been a substantial increase in the use of whole crop cereals for silage in the UK and in the use of *Zea mays* (maize) for silage in both Ireland and the UK. The major limitations of grass silage, especially low dry matter silage, arise from its low intake characteristics. The higher intakes achieved with *Z. mays* silage make it a valuable alternative in the feeding of high yielding dairy cows, and in the intensive fattening of beef cattle. Keady (2003) reviewed the use of *Z. mays* silage in Northern Ireland. He concluded that *Z. mays* silage had a role to play even under the rather unfavourable climatic conditions in Northern Ireland using the complete cover plastic mulch system, which improved both dry matter yields and feeding value.

## Intensive grassland production systems

*Targets for milk output*

The development of efficient grassland-based systems of milk production, which rely heavily on grazed grass, has been the subject of much research in Ireland over the last decade. This work has mainly focused on assessing the suitability of such feeding systems for Holstein-Friesian dairy cows with high genetic potential for milk production. The suitability of different strains of Holstein-Friesian, of alternative dairy breeds and, more recently, of crossbred animals has also been assessed. The emphasis in Ireland has been on spring calving dairy cows (Buckley *et al.*, 2000; Kennedy *et al.*, 2002; Horan *et al.*, 2005) while work in Northern Ireland has focused on autumn-calving herds (Ferris *et al.*, 2002).

The challenge of achieving high milk yields per cow from grazing systems has been reviewed by Mayne *et al.* (2000), and by Peyraud *et al.* (2004), who stated that the gap between the potential (or expected) milk yield and the actual milk yield achieved on grass increases progressively as the potential milk yield increases. The gap is substantial at potential milk yields of 40 kg/day, which is well within the capability of modern dairy cows. The limitation of grass as a feed is probably the major reason why the average milk yield per cow in both Ireland and New Zealand is low by international standards. In addition, seasonal-calving dairy herds must maintain a 365-day calving interval, combined with low levels of involuntary culling, which may be a much more challenging target than achieving high milk yields *per se*.

The milk output achieved by Kennedy *et al.* (2002) in southern Ireland is a benchmark in Western Europe for high genetic merit Holstein-Friesian dairy cows in spring-calving systems, under favourable grassland conditions. Average annual milk yields per cow were 7389 and 8461 kg for low concentrate (377 kg) and high concentrate (1540 kg) groups respectively (with some groups producing in excess of 9000 kg per annum). These yields correspond to levels of *milk from forage*[1] of approximately 6500 and 5000 kg. (*Milk from forage* will normally be reduced as a result of additional concentrate feeding, due to the phenomenon of substitution of the additional concentrates for the basal forage intake). Likewise, Ferris *et al.* (2002) achieved benchmark levels of milk output from autumn-calving dairy cows under slightly less favourable conditions for grass production and utilisation in Northern Ireland. Animals received 928 kg concentrate dry matter (DM) in a system based on top quality grass silage combined with generous allowances of high quality grass for grazing. Cows consumed 1895 kg grass silage DM, and 3119 kg grass DM, and achieved an annual milk yield of 7868 kg per cow corresponding to a *milk from forage* value of almost 5500 kg. Results from commercial dairy farms in the UK show lower levels of *milk from forage – circa* 2700 kg on average, but with important regional variations (Simpson, 2004). Selected groups of dairy farmers were achieving a very efficient combination of milk yields of 7700 kg along with *milk from forage* values of more than 4000 kg per cow.

Feeding systems which achieve high milk yields per cow from animals receiving low levels of concentrates, require high grass DM intakes by the grazing animal and very high levels of technical and biological efficiency in the utilisation of grass (Kennedy *et al.*, 2003). However, such high levels of technical and biological efficiency are not necessarily synonymous with optimum economic efficiency. Analysis of the data from Kennedy *et al.* (2002) by Shalloo *et al.* (2004b), found that high levels of concentrate feeding were economically justified in certain circumstances with very high genetic merit animals, even though *milk from forage* and grass utilisation were reduced somewhat. Also, when rigid quantitative limits on milk output were imposed, as in the operation of the EU milk quota regime in Ireland, dairy cow genotypes which produced somewhat lower levels of milk output from low levels of concentrate input were economically very efficient. The data of Ferris *et al.* (2002) also showed that maximising milk output from forage was not necessarily the most economic in all circumstances. Nevertheless, achieving high levels of *milk from forage*, especially from grazed grass, on a per cow basis as well as on a per unit area basis, will probably remain a key objective in the profitable production of milk in temperate grassland regions for the foreseeable future.

---

[1] *Milk from forage* is calculated by first estimating the milk yield equivalent of the concentrates fed per cow using nutrient requirement tables. This is then deducted from the total yield per cow to obtain *milk from forage*.

While very high milk yields have been achieved with Holstein-Friesian cows, there have been problems with reproductive performance and with maintaining body condition. Limitations on grass DM intake may contribute to these problems, but it is important to note that feeding high levels of concentrate did not overcome poor reproductive performance. However, there have been promising results with some strains of Holstein-Friesian cows, which have slightly lower milk yields, and also with alternative breeds and crossbred dairy cows (B. Horan, *pers. comm.*). In the future the focus may be on animal genotypes and feeding systems that combine slightly lower milk yields with good reproductive performance. However, even in such systems, a target for milk from forage in excess of 5000 kg per cow should be realistic, arising from a total milk yield per cow of between 6000 and 7000 kg combined with a moderate levels of supplementary concentrate feeding.

**Evolution of grassland management to optimise milk production**

Until the establishment of milk quotas within the EU in 1984, the emphasis was on increasing output per unit area, mainly through increasing stocking rate. This focus will become important again if milk quotas are removed. However, since 1984 the emphasis has switched to reducing the costs of production - large differences in costs per unit dry matter has led to attempts to replace concentrates by forages, and especially by grazed grass. The cost of ground, pelleted concentrates is relatively high, and in Ireland and parts of the UK total mixed ration systems are not common, due to small herd size. Grass silage is also a relatively expensive feed source. Optimising the use of grazed grass has therefore been a high priority.

Post-grazing residual sward surface height and herbage allowance

Mayne *et al.* (1987, 1988) and Stakelum (1993), emphasised the importance of post-grazing residual sward surface height (PGRSSH) and its relationship to dry matter intake and milk yield, and to sward morphology and digestibility in subsequent grazings. Previously grassland management systems tended to be inflexible, with fixed proportions devoted to grazing and to conservation at various times during the year. This resulted in a serious deterioration in sward quality when grass growth was higher than normal during the first half of the grazing season. Guidelines for PGRSSH, and the need to adjust grazing plans for changing sward conditions are important components of current recommendations for optimum grassland management.

The effects of daily herbage allowance (DHA) on milk yield and milk composition have been addressed by Maher *et al.* (1999). O'Donovan *et al.* (1998, 2000) established that the inclusion of DHA along with PGRSSH considerably improved the management of grass DM intake at farm level. Selection of the appropriate level of DHA is important in the development of grassland management plans for high yielding dairy cows. Guidelines for DHA, in addition to PGSSH guidelines, are now considered to be critical components of current recommendations for the optimum management of grazing animals.

Feed budgeting and average pasture cover

Clark and Jans (1995) refer to the concepts of feed profiling, feed budgeting and grazing plans, and to the development of decision support models for pasture management in New Zealand. Stakelum, (1996) refers to annual, intermediate and short term feed budgeting, and to the concept of average pasture cover. This refers to the amount of grass dry matter per hectare, averaged across all paddocks within the grazing area. This was further developed by O'Donovan *et al.* (1997, 1998), who also addressed the problem of estimating herbage mass at farm level. Targets were developed for average pasture cover, expressed on either a per hectare or a per cow basis. The latter is probably more functional across a range of grassland situations. Likewise it may be easier to communicate the concept to farmers, if pasture covers were expressed as the number of cow grazing days ahead of the herd rather, than as kg DM/ha.

Average pasture cover is important because it allows short term feed budgets to be constructed based on the feed requirements of the animals when it is combined with expected grass growth for the period ahead. Any deviation from the target cover signals that the overall strategic plan for the grassland area requires tactical adjustments to the short term and/or intermediate term feed budgets. This is important because grass growth is variable during spring, mainly due to variations in temperature, while soil moisture deficits lead to variation in growth in summer in regions with low rainfall.

Feed budgeting is one of the most important concepts to have been introduced into grassland management for dairying in Ireland and the UK in the last decade. It has been critically important in enabling farmers to exploit the benefits of early turnout to pasture in spring (Dillon & Crosse, 1994; Sayers & Mayne, 2001), and of extended grazing in the late autumn – early winter period. Progressive dairy farmers have, in general, adopted dynamic interactive systems of grassland management that involve the setting of targets for various milk output and pasture parameters. Continuous monitoring of these parameters, and adjustment of the grassland and feeding programme is required. Comprehensive guidelines for dynamic interactive systems of grassland management are now available (O'Donovan *et al.*, 1998; Mayne, 2000; MDC, 2003; Teagasc, 2004b).

Other issues

The suitability of various cultivars of perennial ryegrass has been investigated (Gilliland *et al.*, 2002; Gowen *et al.*, 2002; Wilkins & Humphreys, 2003). The impact of sward factors on dry matter intake and milk output, and the impact of the quantity and the composition of supplementary feeding for the grazing animal are under consideration (McGilloway & O'Riordan, 1999; Mayne & Laidlaw, 1999; Mayne *et al.*, 2000b; Peyraud *et al.*, 2004). The preceeding discussion of developments in intensive grassland management has focused almost entirely on dairying, but similar concepts have been developed or are being developed in relation to beef and sheep production (Mayne *et al.*, 2000a; Steen, 1998; Teagasc 2004a).

*Environmental aspects of intensive grass and forage systems*

Statutory measures to reduce nitrate pollution of surface waters and groundwater began to be introduced in the 1990s. Nitrate Vulnerable Zones (NVZs) were designated in all areas where the existing or predicted concentration of nitrate N was greater than 50 mg/l. Nitrate Vulnerable Zones currently cover about 55% of England and a small proportion of the rest of the UK. The position in Ireland is under review at the time of writing, but it is likely that the entire country will be designated as a NVZ. In these zones farmers are required to keep records of fertiliser and manure applications. Fertiliser N must not be applied in excess of crop or grassland requirements, and a limit is set on the maximum loading of organic N in animal excreta. For grassland this was initially set at 250 kg/ha, but is now expected to be reduced to 170 kg/ha. This means that on intensive grassland farms (mainly the dairy sector), farmers may have to reduce stocking rates, or export animal manures to neighbouring farms.
Other environmental problems addressed by the EU Water Framework Directive include pollution of surface waters by phosphorus and soil runoff, and atmospheric pollution by ammonia, nitrous oxide and other gaseous emissions including methane. In Ireland, where

the Kyoto targets will be very difficult to meet, the national greenhouse gas abatement strategy requires a significant contribution from agriculture, which may increase the pressure to reduce the total number of ruminant animals in the country.

**Extensive grassland: a multifunctional resource**

Farmers have traditionally grazed sheep and beef (including suckler cows), on non-intensive grassland and rough grazing. However, increasing public interest in access to the countryside, may in time impact on such grassland farmers. As well as an intensive network of public footpaths, there is now a 'right to roam' on most open grazing land in Britain, and it is recognised that in many rural parts of Ireland and the UK, that tourism now has a higher economic value than agriculture. Whilst it can be difficult to reconcile public access with farming, it does present farmers with commercial opportunities – with farmers paid from public funds to care for and maintain extensive grassland as part of a multifunctional resource.

*Landscape, environmental features and farm types*

In most of Scotland and Wales and in parts of Ireland and northern England, the landscape is dominated by hills and rugged terrain that is typically between 300m and 1000m altitude. It has a combination of difficulties including steep slopes, rocky outcrops, and acid soils, some of which are permanently waterlogged. Most of it is unenclosed moorland characterised by heather and other dwarf shrubs, and has traditionally served the dual function of rough grazing for sheep or beef cattle, and hunting of wild deer and birds, particularly the red grouse. In nature conservation terms it is valued highly. The UK contains a substantial proportion of the world's resource of this habitat. Heather and other shrubs can only tolerate limited grazing – about 40% of each year's growth. Increased sheep numbers have contributed to a major decline in heather cover, particularly in England and Wales, and have led to its replacement by grasses such as *Nardus stricta*.

In the lowlands, particularly in the UK, the landscape has a characteristic 'patchwork quilt' appearance of fields enclosed by walls or hedgerows. Some of these are of great antiquity, and many more were constructed in the $18^{th}$ and $19^{th}$ centuries following government land reforms. Until the widespread use of inorganic fertilisers in the 1960s, the hay meadows, pastures and grazing marshes within this landscape were highly biodiverse. Since then such habitats have become rare.

The best of the historic environment and the richest examples of wildlife habitats, through the hills, uplands and lowlands, are now protected by European and national legislation. This includes the widespread network of 'Natura 2000' sites in the UK designated in response to the EU Birds and Habitats Directives. In addition to these high profile sites, many environmental features such as hedgerows and semi-natural grassland are also now protected through the use of cross-compliance. This was further extended on 1 January 2005 - from this date the Single Farm Payment can be partially or wholly withheld if such features are damaged.

The differentiation of the hill and upland sectors from the lowland sector is more distinct in the UK than in Ireland, and the descriptions that follow are more typical of the UK situation than the Irish situation.

Hill farms

Most of the land area is moorland rough grazing. Breeding sheep are the main or only enterprise, where hardy breeds such as the Scottish Blackface or Welsh Mountain produce on average only one lamb per ewe per year. They graze the moorland for most of the year and are brought down to lower ground to mate in the autumn and to lamb in the spring. The ewes may be mated with a ram of a larger and more prolific breed to produce female lambs, which can be sold to upland or lowland farmers. These females will then be mated with a ram such as a Suffolk or Texel to produce prime lamb for meat. This tradition of sheep moving from hills to uplands to lowlands is known as the 'stratification' of the sheep industry.

Hill farms often have very little 'in-bye' land from which to cut grass for hay or silage. They are unable to support large numbers of cattle since these usually have a much higher requirement for winter-feed. Farms that have more 'in-bye'' may have suckler cows, usually of a hardy breed such as Galloway or Welsh Black. Although cattle have been less profitable than sheep for several decades, cattle may in future be required for maintaining diverse moorland and grassland. In both hill sheep and cattle production there is a need for low-cost, 'easy-care' systems, which nevertheless have good animal welfare and are compatible with protection of the environment.

Upland farms

The convention in the UK is that those farms in hilly areas where the majority or all of the land area is enclosed grassland are known as upland farms. Some of these were created from moorland from the 1940s to 1980s. Its productivity was improved by the use of lime, fertilisers, cultivation and/or reseeding. The native grasses, typically *Festuca rubra* (Red fescue), *F. ovina* (Sheep's fescue) and *Agrostis capillaries* (Bent grass), were replaced with *L. perenne* and *T. repens*. More recently many of these swards have partially or wholly reverted to the native grass species as inputs have been reduced. These farms often have both sheep and cattle enterprises, and farmers may have invested heavily in silage pits and winter housing or hard-standing areas. This enabled the farmer to achieve higher stocking rates, have greater flexibility to breed animals out of season and fatten livestock.

Lowland farms

Grassland farms in the lowlands are often intensively managed for dairying or other enterprises. However, there are also extensive grassland-based enterprises that may occur for two main reasons. They may be farms with an area of existing permanent grassland that is difficult to manage intensively because of steepness, wetness, obstructions or accessibility. In many cases the farmer is eligible for agri-environment payments to maintain or restore this grassland. A second group may have income from another business or off-farm employment. Extensive grassland on lowland farms is often integrated with more intensive grassland, and/or arable crops. It can complement the other land such as providing summer grazing. The extensive livestock 'enterprises' found on lowland farms are hugely varied. In Ireland extensive systems of beef and sheep production are widely practiced on high quality soils in lowland areas. The main reason is probably historical in that the creameries that processed manufacturing milk were not distributed around the whole country but were concentrated in the southern region.

*Support for extensive grassland farming*

All hill land, most uplands and some lowlands with heavy wet soils, are classified within the EU as Less Favoured Areas (LFA). Forty four per cent of agricultural land in the UK, and

53% in Ireland, is classified as LFA. Until 2004 all beef and sheep, managed extensively or intensively, received support payable per head, with the payment being higher within the LFA. In future all headage for beef and sheep payments are consolidated into the Single Farm Payment, which is decoupled from production. This decoupling may lead to a substantial reduction in beef and sheep numbers, especially in the LFA. A recent survey of farmers in Ireland anticipates a reduction in sheep numbers, with an increase in the area devoted to forestry.

Since the mid 1980s a small but increasing proportion of government support for agriculture has been through voluntary Agri-Environment (AE) schemes. The first of a number of schemes in the UK was the 'Environmentally Sensitive Areas Scheme', which was introduced in 1986. These schemes offer annual and capital payments to farmers for restoring or recreating plant, bird or other wildlife habitats by reducing or ceasing fertiliser inputs to grassland. They were superseded in England in 2005 by the more ambitious 'Environmental Stewardship Scheme', which also includes soil and water protection as an objective. The aim is for the majority of all land in England to be in at least the lower tier of this scheme within the next few years.

In Ireland, the 'Rural Environment Protection Scheme' (REPS) was introduced in 1994 and initially covered 33% of farmland. The emphasis was on limiting the input of both organic and inorganic nitrogen on grassland, the development of nutrient management plans and the avoidance of pollution. In the third version of REPS (recently introduced) there is greater emphasis on broader environmental objectives with farmers expected to be managers of the natural heritage. These schemes are popular with farmers, and also have the support of the public.

## Conclusions

Conditions in the more favourable areas in Ireland and the UK are very suitable for grass production over a long growing season. Intensive systems of milk production, and to a lesser extent beef and sheep production, using high inputs of fertiliser nitrogen, have been developed and are widely used by farmers. Guidelines for dynamic interactive systems of grassland management that rely heavily on grazed grass have been developed. Very high levels of biological and economic efficiency in both seasonal and non-seasonal systems of milk production can be achieved.

Changes in the EU income support system for beef and sheep farmers agreed in 2003, may lead to significant reductions in the numbers of beef and sheep in Ireland and the UK. Intensive grass-based systems of animal production create risks of pollution to surface- and ground- water. A high proportion of beef and sheep farms participate in voluntary, EU-funded agri-environmental schemes. All EU direct income support payments are dependant on cross compliance with a range of food safety, animal welfare and environmental measures. Grassland farmers in particular, are regarded as custodians of the countryside. However the public, especially in the UK increasingly require access to the countryside which must not be polluted and which demonstrates ecological balance and attractive landscapes.

## References

Buckley, F., P. Dillon, S. Crosse, F. Flynn & M. Rath (2000). The performance of Holstein Friesian dairy cows of high and medium genetic merit for milk production on grass-based feeding systems. *Livestock Production Science*, 64, 107-119.

# ANEXO N° 6

## Libro: Silage Production

(solo portada y capítulos iniciales)

# Silage production and utilisation

edited by:
**R.S. Park**
**M.D. Stronge**

This book is essential reading for all those involved in forage conservation and provides a fascinating insight into current practices and the science underpinning forage conservation. Key subject areas include opportunities to enhance the fermentation process through crop manipulation prior to ensiling and the use of bacterial additives applied during ensiling. Latest developments in techniques for chemical and biological characterisation of silages are reviewed, including grass silage, alternative forages (whole crop wheat and maize silage) and tropical forages. The book also focuses on current developments in feeding of beef and dairy cattle with conserved forage with particular emphasis on factors influencing intake, digestion and animal performance.

Overall this is an important reference book, which provides an excellent overview of current developments in forage conservation and utilization of conserved forage in animal production systems.

Other publications related to the International Grassland Congress:

- Grassland - a global resource 907699[illegible]
- International Grassland Conference - Offered papers 907699[illegible]
- Optimisation of nutrient cycling and soil quality for sustainable grasslands 9076998728
- Molecular br[illegible] improvement of forage crops 9076998736
- Pastor[illegible] 9076998744
- [illegible] [illegible]76998760

ISBN 907699[illegible]

Wageningen Academic Publishers

XX IGC 2005 IRELAND & UNITED KINGDOM

# An overview of silage production and utilisation in Ireland (1950-2005)

C.S. Mayne[1] and P. O'Kiely[2]

[1]*Agricultural Research Institute of Northern Ireland, Hillsborough, Co Down BT26 6DR*
*Email: sinclair.mayne@dardni.gov.uk*
[2]*Teagasc, Grange Research Centre, Co Meath, Ireland*

## Key Points

1. The seasonal nature of grass growth in Ireland necessitates effective integration of grazing and grass conservation to fully manage and utilise grass within meat and milk production systems.
2. Silage now accounts for 87% of the total grass conserved in Ireland.
3. The rapid expansion of silage making in Ireland between 1950 and 2000 was facilitated by significant advances in mechanisation (forage harvesters, mower conditioners and stretch film wrapping of big bales) and by improved understanding of the preservation process. The expansion was required to support the major increase in livestock numbers.
4. Excellent silage-making practices can result in grass silages with similar nutritive values to those of the grasses from which they were made and these silages can sustain high levels of performance in cattle and sheep.
5. Key challenges for the future include: the development of lower cost, reduced labour harvesting systems; the improved prediction of silage feeding value based on analysis of the standing crop; the development of feeding strategies to improve the efficiency of nutrient capture in silage-based systems; and the production of meat and milk of enhanced nutritional value.

**Keywords:** grass silage, forage conservation systems, feeding value, silage feeding systems

## Introduction

Conservation of grass as hay or silage has been a feature of grassland management in Ireland for centuries. This reflects the fact that the grass growing season varies from less than 280 days to approximately 320 days (depending on geographical location) and in addition, the utilisation of grass by grazing may not be feasible for up to 5 months in some wetter areas. Furthermore, the highly seasonal nature of grass growth in Ireland (Figure 1) means that it is often difficult to manage grass growth early in the season using grazing animals.

Effective integration of grazing and grass conservation enables conservation of grass surpluses as hay or silage, facilitating improved management and utilisation of grass during the grazing season, whilst also providing high quality forage for winter feeding of livestock.

The aim of this paper is to review developments in silage production and utilisation in Ireland, particularly in relation to advances in science and technology from 1950 to the present day, and to illustrate how these advances have assisted the development of efficient silage production systems.

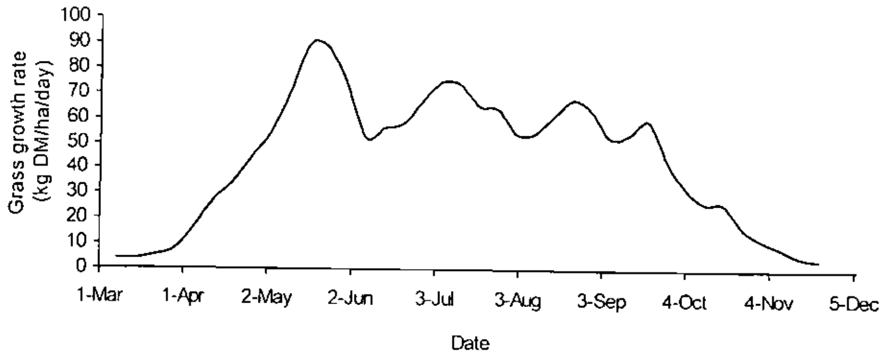



**Figure 1.** Average growth curve for perennial ryegrass (1999-2003) - Northern Ireland (AgriSearch Grass Check)

**Trends in forage conservation in Ireland (1950-2005)**

Data presented in Figure 2 illustrate the major change in emphasis in conserved forage production in Ireland since 1950. In addition to a 64% increase in the total area of land used for conserved forage production between 1950 and 2000, there has also been a continuous increase in the area conserved as silage and a concurrent decline in the area conserved as hay. The area conserved as grass silage, and the total area conserved, reached their respective peaks in 2000. The small reduction since 2000 reflects current concerns regarding the costs of silage production, particularly in the context of lower prices for animal products, and an increased emphasis on grazing and opportunities to extend the grazing season.

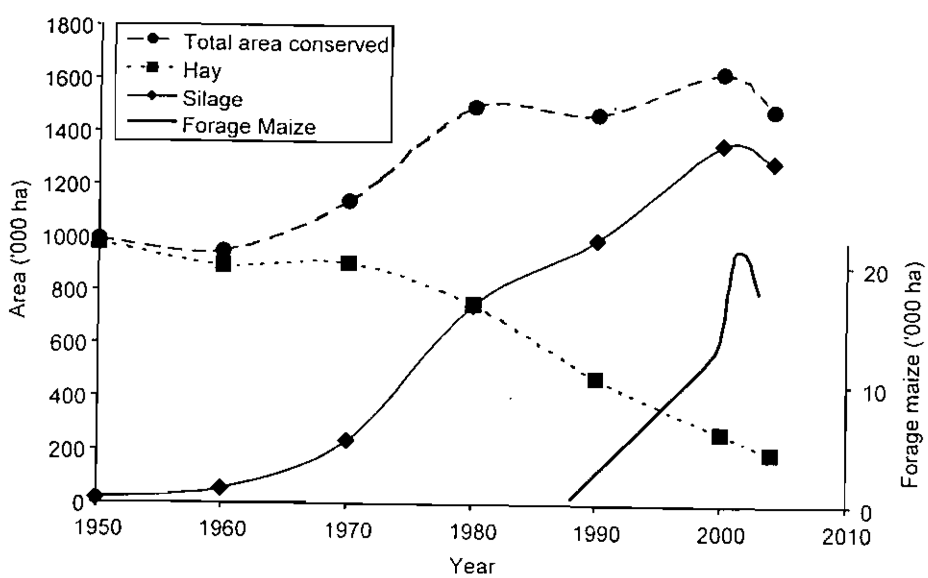



**Figure 2** Changes in areas of grassland conserved as hay or silage and in forage maize area, in Ireland 1950-2004
Source: Central Statistics Office (Eirestat) and Economics and Statistics Division, DARD



Alongside the cl
significant incre
increased by 65
numbers has nec

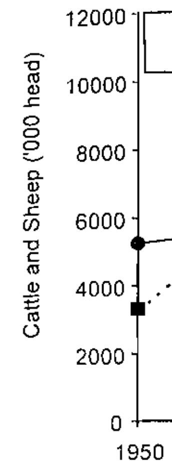



**Figure 3** Chang
Source: Central

The data preser
throughout Irelar
developments i
particularly the
increased the yie
communication)
starch contents
interest in forage
the reduced labo
predictability of

Keady *et al.* (2
forages in North
£85/t utilised DM
crop wheat cos
competitive cost
future is the nee
costs and improv

*Harvesting syste*

The increase in
changes in harv

Alongside the change in conservation practice over the last 50 years, there has been a very significant increase in livestock numbers (Figure 3). Between 1950 and 2000, cattle numbers increased by 65% while sheep numbers trebled over the same period. The increase in animal numbers has necessitated a drive towards more efficient grass conservation practices.

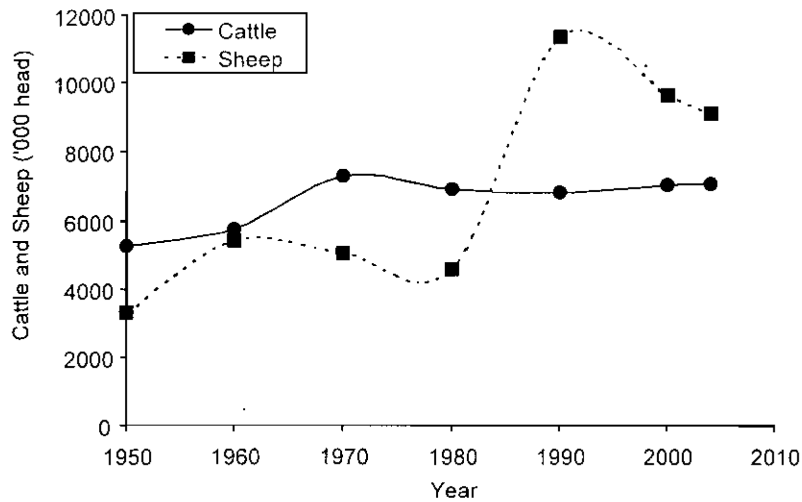



**Figure 3** Change in livestock numbers (cattle and sheep) in Ireland 1950-2004
Source: Central Statistics Office (Eirestat) and Economics and Statistics Division, DARD

The data presented in Figure 2 also highlights the rapid expansion of forage maize use throughout Ireland, with over 2000 ha of maize now being grown in Northern Ireland. Recent developments in plant breeding, coupled with improvements in agronomic practices - particularly the development of the complete-cover, plastic mulch system - have considerably increased the yield potential and feeding value of forage maize. For example, Easson (personal communication) has reported forage maize yields of up to 18 t DM/ha in Northern Ireland, with starch contents commonly in the range of 250-300 g/kg DM. Key drivers of the increased interest in forage maize and other alternative forage crops such as whole crop wheat, have been the reduced labour and expertise required in growing and harvesting the crop and the improved predictability of feeding value relative to that achievable with grass silage.

Keady *et al.* (2002), determined the cost of producing and feeding a range of conserved forages in Northern Ireland and concluded that, relative to a 3-cut grass silage system costing £85/t utilised DM and a 4-cut grass silage system costing £95/t utilised DM, fermented whole crop wheat cost £88/t and forage maize under plastic, £91/t utilised DM. Given the competitive costs of these alternative forage crops, a major challenge for grass silage in the future is the need to develop harvesting systems that require less labour input, reduced overall costs and improved predictability of final product feeding value.

*Harvesting systems*

The increase in the area of grassland conserved as silage since 1950 was facilitated by major changes in harvesting systems used in silage making. In the early 1950's, virtually all silage made in Ireland was produced using tractor-mounted buckrakes or stationary green-crop loaders. Today, precision-chop harvesters dominate the scene. Survey data from the Republic of Ireland over the last 15 years (Table 1) highlights the increased reliance on precision chop harvesters and big bale systems and the demise of single and double chop harvesting systems. There are no comparable data for Northern Ireland but similar trends in harvesting system have been observed here. However, it is estimated that big bale silage accounts for less than 20% of the total silage produced in Northern Ireland.

**Table 1** Trends in choice of harvesting system for silage in the Republic of Ireland (% of silage conserved for each system)

| Year | Harvesting system | | |
|---|---|---|---|
| | Big bale | Single/Double chop | Precision chop |
| 1991 | 23 | 40 | 37 |
| 1996 | 32 | 17 | 51 |
| 1999 | 35 | 9 | 56 |
| 2002 | 32 | 8 | 59 |

Another significant change in silage-making in Ireland has been the move from on-farm harvesting using the farmer's own equipment to a greater reliance on specialised silage contractors. It is estimated that more than 80% of silage produced on Irish farms is now undertaken by specialist contractors, who have made a very significant investment in specialised machinery – mainly high-output, self-propelled, precision-chop harvesters. Whilst this innovation undoubtedly speeds up the rate of harvesting and can assist in controlling costs on small livestock farms, there are a number of disadvantages. Firstly, the high output of these machines can cause operational difficulties in effective filling and compaction of silos, particularly where silos are relatively small or have difficult access. Secondly, a reliance on contractors reduces the farmer's flexibility to harvest the crop at the optimum stage of plant growth or in appropriate weather conditions. As a result, some farmers are now considering investing in their own equipment, with recent interest in self-loading forage wagons or, in some cases, increased reliance on big bale silage production systems.

**Developments in mechanisation of silage production**

Silage-making in Ireland in the 1950's largely relied on tractor-powered reciprocating mowers to cut the grass crop and tractor-mounted buckrakes or stationary green-crop loaders to collect the cut grass. Most grass was ensiled in small bunker silos, with tower silos being used on only a few larger farms. Generally, the grass was relatively mature and of low to moderate digestibility at the time of harvest, but this assisted the fermentation process in the absence of chopping and/or additive use. Following the introduction of flail or single-chop harvesters in the USA in the early 1950's, these were rapidly introduced in Ireland during the 1960's and this innovation drove the rapid increase in silage-making in Ireland through the 1960's and 1970's. The main advantages of the flail harvester were the saving in labour and the increased liberation of plant cell contents which accelerated the fermentation process in the silo, as demonstrated by Murdoch *et al.* (1955) in a series of classical experiments (Table 2). Chopping reduced silage pH and increased lactic acid content and amino acid N content.

These research findings were followed by further research studies throughout Europe which highlighted the important factors associated with the production of high quality silage.

One of the major advantages of conserving grass as silage rather than as hay is the ability to cut grass for silage at an earlier stage of growth and it was soon recognised that the most important factor affecting the nutritive value of silage was the stage of maturity of herbage at harvest (McIlmoyle & Steen, 1979).

**Table 2** Effect of chopping grass prior to ensiling on fermentation quality (Murdoch *et al.* 1955)

| | Unchopped | Chopped |
|---|---|---|
| Herbage dry matter at harvest (g/kg) | 234 | 230 |
| Silage | | |
| pH | 5.4 | 4.7 |
| Lactic acid (g/kg DM) | 2.0 | 26.0 |
| Butyric acid (g/kg DM) | 46 | 24 |
| Amino acid N (g/kg N) | 188 | 296 |

Further developments in mechanisation resulted in the design of improved flail harvesters and these became commonplace on livestock farms throughout Ireland, and remain in use on some smaller farms to the present day. Research data demonstrating the beneficial effects of chopping grass prior to ensiling on silage preservation and feeding value led to the introduction of precision-chop forage harvesters in the early 1970's. These machines had a higher tractor power requirement but could also achieve high work rates whilst chopping grass to as little as 5-7 mm particle size. However, in an extensive review of the literature, Marsh (1978) concluded that there was little evidence of benefits from fine chopping on fermentation in farm scale silos, except where fine chopping improved the consolidation of heavily wilted silages. More recent research suggests little benefit of fine chopping on animal performance, except in sheep. Nevertheless, the higher harvesting rate of precision chop machines has resulted in these machines largely replacing the flail type harvester.

### Conservation efficiency

Irish research has always emphasised the importance of efficient forage conservation systems that minimise quantitative and qualitative losses during harvesting, storage and feeding out. The variable, but often damp, Irish weather has a major impact on the practice and efficiency of silage-making systems. Ultimately, weather, directly or indirectly, influences factors such as the choice of crop, the physical, chemical and microbiological characteristics of the crop at harvest, the harvesting and ensiling practices used, and the cumulative losses due to fermentation, effluent and aerobic deterioration. Weather and management practices interact in their effects on a range of factors. For example, yields of up to 40 tonnes of wet grass per hectare are not uncommon and are, in part, facilitated by relatively high inputs of inorganic and organic N. Grass dry matter (DM) and water soluble carbohydrate (WSC) concentrations (O'Kiely & Muck, 1998) and buffering capacities (Muck *et al.*, 1991) vary widely in Ireland, while counts of lactic acid bacteria are relatively high, with mean values in excess of 100,000 colony forming units/g herbage (Moran *et al.*, 1991).

Recent developments in silage-making equipment have included the introduction of mower conditioners which, when used optimally, can improve wilting efficiency by between 55 and 109% (Merry *et al.*, 2000) and this has led to renewed interest in the use of rapid wilting systems. However, wilting is not always compatible with contractor systems or suited to prevailing weather conditions.

Another major development in silage-making in Ireland was the arrival of big bale silage production systems in the late 1970's. This technique enabled silage production on small livestock farms, without a need for significant investment in silos or silage-making machinery. Whilst the initial approach to producing big bale silage involved placing individual bales in large plastic bags, this was soon superseded by the development of stretch-wrapping of bales in the mid 1980's. Irish machinery manufacturers were quick to adopt the new technology and continue to lead the market in terms of the manufacture of stretch-wrapped baled silage systems. An important feature of big bale silage is the potential to reduce DM losses compared to those from precision-chop silage ensiled in bunker silos (Kennedy, 1989). Further developments in the design of big balers led to the introduction of chopping mechanisms prior to the bale chamber. This has enabled the production of wrapped silage of higher density that is more appropriate for sheep production, given the importance of chop length on intake and performance in sheep.

*Crop growth and management*

The rate of reseeding of grassland in Ireland is quite low at less than 3% per annum. Perennial ryegrass is the main constituent of seed mixtures because it has the potential for superior yield, nutritive value and ensilability within the prevailing systems. Wilson & Collins (1980) compared a range of grasses found in permanent swards and concluded that perennial and Italian ryegrasses were considerably easier to preserve successfully compared to other grasses, mainly due to their higher concentration of available water-soluble carbohydrates (WSC). Furthermore, when Keating & O'Kiely (2000) compared silages made from a perennial ryegrass sward and from a previously well-managed and agronomically productive old pasture of diverse botanical composition, the perennial ryegrass silages produced more beef carcass per hectare, mainly due to their inherently higher digestibility and their better preservation.

Farmers strive to maintain satisfactory soil P, K and pH statuses on land used for silage production, and then supply sufficient N to promote economically justifiable yields. Whereas P fertilisers (O'Kiely & Tunney, 1997) and K fertilisers (Keady & O'Kiely, 1998) do not negatively impact on grass ensilability, applied N can reduce grass DM and WSC contents and increase buffering capacity. These effects increase both with increasing rates of N addition and as the interval after N application decreases (O'Kiely & Muck, 1998). Advice to farmers therefore seeks to recommend total rates of N application that will promote superior yields without unduly compromising the ensilability of the crop. Manures recycled from housed livestock are an important source of crop nutrients and, on integrated grassland farms, they are recycled mainly onto fields managed for silage production. Clearly, it is essential that they are applied in a manner that prevents contamination of the herbage. Research has demonstrated that where slurry is judiciously applied in an even and timely manner, at an appropriate rate and with the inorganic fertiliser input modified to take account of the estimated N contribution from slurry, then silage fermentation and environmental criteria need not be compromised (O'Kiely *et al.*, 1994; Frost & Stevens, 2000).

*Controlling fermentation and reducing effluent loss*

Early studies confirmed that warm fermentation, which was favoured in the early 1950's (Brown & Kerr, 1965a), incurred greater losses during ensilage than cold fermentation (Brown & Kerr, 1965b). The importance of adequately sealing ensiled forage against contact with air was demonstrated by Brown & Kerr (1965c), while Jackson (1969) showed that it was not necessary to physically evacuate the air trapped in a sealed silo. The ready availability of suitable plastic sheeting for horizontal silos (Brown & Kerr, 1965c) and of stretch-film for baled silage (Forristal *et al.*, 1999) made achieving anaerobic conditions economically feasible. Similarly, the move to most grass being harvested by well-equipped contractors operating high-output machinery greatly facilitated the rapid achievement of anaerobic storage conditions.

Flynn (1981), Cushnahan & Mayne (1995) and Keady & Murphy (1995) each showed that excellent silage-making practices could result in silages with nutritive values quite similar to those of the grasses from which they were made. This highlighted the importance of limiting all sources of conservation losses.

In order to remain relatively independent of frequently wet weather conditions, silage-making in Ireland has tended to rely on direct-harvesting or minimal wilting of grass. In experiments where wilted silage was compared with a poorly-preserved unwilted control silage, successful wilting reduced losses (Kormos & Chestnutt, 1966) and improved preservation (Wilson & Flynn, 1979). However, where the unwilted silage was well preserved - sometimes due to the application of formic acid - then traditional wilting techniques did little to improve the conservation (Jackson & Anderson, 1968). Under conditions where wet weather prevented a mown crop from drying effectively, the wilting process caused a significant increase in losses (Kormos & Chestnutt, 1968) and produced a poorer silage preservation (Wilson & Flynn, 1979). Overall, Mayne & Gordon (1986a, b) concluded that both unwilted and wilted silage systems were capable of conserving forage effectively provided that satisfactory meteorological and management conditions prevailed.

A key issue when ensiling low dry matter herbage is the production of silage effluent, and Irish farmers have always had to be very careful to ensure they managed silage effluent appropriately. Stewart (1980) and Binnie & Frost (1995) developed protocols for safely spreading silage effluent on grassland to capitalise on its fertiliser value for the growing crop but without scorching the new grass regrowth. Patterson & Walker (1982) and Steen (1986) quantified the nutritive value that could be obtained if effluent were cleanly collected and fed to farm livestock, while Ferris & Mayne (1994) and O'Kiely (1992) demonstrated that the co-ensilage of dry concentrate feedstuffs with wet grass could significantly reduce effluent output and enhance the value of the resultant silage. Finally, O'Donnell *et al.* (1995a, b) established guidelines to limit the corrosion of concrete silos by acidic silage effluent.

*Silage additives and their use*

Silage additives have elicited much interest through the years. Molasses was the focus of early attention due to its perceived palatability attributes and the relative ease with which it could be applied to wet grass of low WSC content, at the silo, in low-output harvesting systems. Under conditions where unwilted silage, made without additive, usually preserves badly, the addition of molasses, at 10 to 20 litres per tonne of herbage, can improve the fermentation and reduce in-silo losses. In contrast, the response to molasses was minimal when the control silage was well preserved (McCarrick, 1963). With the advent of direct-cut harvesting systems and the introduction of on-harvester application of additives, the use of formic acid became possible. Research by McCarrick (1963) and Flynn (1981) showed the potential of formic acid to aid preservation under a range of difficult ensiling conditions.

A wide variety of additives were evaluated for their efficacy as preservatives but none surpassed those mentioned above. During the 1980's, sulphuric acid was used as a low cost alternative to formic acid but, from the early 1990's onwards, the market rapidly became resistant to acid additives which were considered corrosive to machinery and concrete and dangerous to farm operatives who had to use them. Bacterial inoculants were topical during the 1990's, and their potential to improve animal productivity was widely demonstrated (Gordon, 1989a; Mayne, 1990, O'Kiely, 1996). However, since most dairy and beef cows calve in spring, with cows grazing grass from early lactation, the scope to obtain an economic return is often limited. In more recent years, the use of additives has decreased considerably as farmers seek to reduce costs and contractors seek to operate high throughput systems unimpeded by the delays associated with additive application. A reduction in additive use was also made possible by the significant improvement in overall silage-making standards that has occurred over the years.

Great improvements have been made also in the management of the exposed silage face in opened silos. Considerable differences exist among silages in their susceptibility to aerobic deterioration (O'Kiely, 1989) and the most important consideration in reducing aerobic losses at feeding out is minimising the duration of exposure of the silage to air. Some problems with mould growth on baled silage continue on many farms (O'Brien *et al.*, 2005), indicating that improvements in the application of technology are still required.

## Factors influencing the potential feeding value of silage

### *Feeding value for dairy cattle*

The key factors influencing the feeding value of grass silage for dairy cattle include the stage of development of the crop at ensiling, the mechanical treatment of the crop and the extent and type of fermentation achieved within the silo. In a comprehensive review, Gordon (1989b) concluded that, on average, a 10 g/kg reduction in D-value (digestible organic matter in the dry matter) resulted in a decline in milk yield of 0.37 kg/cow/day. Other studies (Givens *et al.*, 1989) have shown that herbage D-value in primary growth perennial ryegrass-based swards declines linearly from 1 May, with a mean decrease of 2.5 g/kg per day. Accordingly, each one-week delay in harvesting grass for silage after 1 May results in a depression in milk yield of approximately 0.65 kg/cow/day.

Developments in silage mechanisation over the last 50 years have been accompanied by major changes in the degree of laceration and/or chopping prior to ensiling. However, the effects of chop length on the performance of dairy cows are quite variable. Murphy (1983) showed no difference between forage wagon and precision-chop silages when both were easy fed, even though differences in chop length were very large (230 *vs* 52 mm). In contrast, Castle *et al.* (1979) compared three chop lengths and observed increases in both silage intake and milk yield with the shorter chop material. Whilst part of this response was due to improved silage fermentation with short chopped grass, particle length *per se* also had some effect. It is worth noting that the work of Castle *et al.* (1979) was undertaken with cows offered very low levels of supplement (2.0 kg DM/cow/day). Overall, it appears that chop length has a relatively limited effect on silage intake and animal performance providing the long chop material is well fermented and cows are offered moderate levels of concentrates.

The importance, for animal performance, of achieving good fermentation during ensilage has been well documented in many studies. For example, Baker *et al.* (1991) observed a 56% reduction in intake of a poorly-preserved silage compared to a well-preserved silage of similar digestibility. Given the relatively low DM content of grass in Ireland during the growing season, there is a high risk of poor preservation during ensilage, particularly in grasses with a WSC content of less than 30 g/kg fresh weight (O'Kiely *et al.*, 1986). A number of approaches have been adopted to improve the likelihood of achieving a good fermentation during ensilage. These include wilting, adding sugar to the crop, reducing pH by the addition of organic or inorganic acids, applying homofermentative lactic acid bacteria and/or enzymes to the crop and the addition of absorbents to increase crop DM content.

Formic acid was widely used as the main silage additive on dairy farms in Ireland from the early 1970's to the early 1990's and was applied directly into the delivery chute or chopping chamber of the forage harvester at rates of between 2.5 and 4.0 l per tonne of fresh crop. Steen (1991), in a review of 17 comparisons of untreated and formic acid-treated silages, observed significant improvements in silage fermentation, silage intake, milk yield and milk composition with formic acid treatment. The early 1990's saw renewed interest in the concept of restricting silage fermentation through the application of high levels (6 to 9.5 l/t grass) of either formic or mixed organic acids. Large responses in both silage intake and milk production were recorded, particularly with low dry matter crops (Chamberlain *et al.*, 1990), with milk production responses of up to 1.9 kg/day. However difficulties in applying high rates of additive and the increased cost of organic acids limited the commercial uptake of this approach in Ireland.

The increased cost of formic acid in the mid 1980's led to interest in the use of sulphuric acid as an alternative silage additive. Initial studies indicated that sulphuric acid compared well with formic acid in terms of effects on silage fermentation and animal performance (Murphy, 1986). However Steen (1991) concluded that the use of sulphuric acid resulted in poorer animal performance compared to untreated silage, possibly through detrimental effects on liver copper status.

The use of bacterial inoculants as silage additives came to the fore in the 1980's primarily because they were safer to handle and were less corrosive to machinery than the acids. Whilst some early inoculant additives produced disappointing results (Done, 1986), improved understanding of silage microbiology led to the development of more effective inoculants, most of which were based on *Lactobacillus plantarum*. Gordon (1989a) reported large increases in silage intake (+ 1.2 kg DM/day) and milk yield (2.0 kg/cow/day) with inoculant treatment, even though the inoculant had little effect on conventional measures of silage fermentation. This stimulated new research into the development of new laboratory procedures to evaluate the feeding value of silage.

The silage additive market in Ireland is now dominated by inoculants, with a wide range of products available. However, formic acid is still used on some farms, particularly where the grass being harvested has low DM and WSC contents.

Given the prevailing climatic conditions in Ireland, pre-wilting of grass prior to ensiling is a high risk venture. Results of the "Eurowilt" programme (Zimmer & Wilkins, 1984), which involved a co-ordinated programme of experiments throughout Western Europe, indicated little difference in animal performance between unwilted and wilted silage. Other work in Northern Ireland (Small & Gordon, 1988) reported lower milk output per hectare with wilted than with direct-cut material. Consequently, there was little Irish interest in field wilting until the early 1990's. At this stage, the development of improved high-output mower conditioners, coupled with the advent of self-propelled, precision-chop, forage harvesters, and increasing concerns over the environmental impact of silage effluent led to renewed interest in field wilting. Further research in the late 1990's demonstrated improved intake and performance of dairy cows offered wilted silage compared with those offered direct-cut material (Patterson *et al.*, 1996), with the extent of the increased intake positively correlated with the extent and rate of water loss in the field (Wright *et al.*, 2000).

Silage production systems on intensive dairy farms in Ireland are, today, largely characterised as follows:

- Grass is pre-cut at a leafy stage using a mower or mower conditioner and pre-wilted for a few hours (up to a maximum of 36-48 hours) depending on weather conditions.
- Herbage is collected by self-propelled precision chop harvester (average DM content of 230 g/kg).
- Additive is applied according to conditions:
  - Very wet, low sugar grass – formic acid.
  - Moderate DM grass with water soluble carbohydrate content greater than 20 g/kg fresh grass – either no additive (81% of farms), or inoculant.

## Supplementation of silage for milk production

Significant changes in the approach to supplementation of grass silage diets over the last 50 years primarily reflect changes in the economics of milk production and advances in mechanisation. Milk production systems in the 1970's were largely based on high digestibility direct-cut silage fed with concentrates in flat rate feeding systems (5-10 kg/day) twice daily during milking. In the mid to late 1980's, there was some interest in silage-only systems (Reeve, 1989), largely reflecting the growing constraints on milk production imposed by European Union milk quotas.

Recent trends have seen a significant increase in the feeding of total mixed rations in which grass silage is incorporated with other forages and relatively high levels of concentrate feeds. However, many dairy farms in Ireland continue to operate very successfully with grass silage easy-fed as the sole forage and with concentrate supplements fed through in-parlour or out-of-parlour feeders. The key issue in today's feeding systems is to formulate supplements incorporating ingredients which complement the nutrients supplied from silage and which minimise adverse effects on the environment, particularly with respect to nitrogen and phosphorus.

### *Feeding value for beef cattle*

Some of the earlier experiments on the feeding value of silage for beef cattle compared it to hay, which had previously been the standard conserved winter forage. McCarrick (1966) showed that despite higher intakes and liveweight gains with hay, carcase gains from comparable, well-preserved, grass silages were superior, and these effects were more evident for leafy, highly digestible crops (Table 3).



**Table 3** Intake and

Cutting date

Forage

Forage DM intake (
Liveweight gain (k
Carcase gain (kg/da
Carcase gain (kg)/t

Source: McCarrick

Flynn (1981) repor
increase in intake
that can occur whe
without supplemen
Steen *et al.* (2002)
silages of superi
supplementation an
increases and the p
have been generate
proportion of conce
(Drennan & Keane
(1989) that identifi
with silage of medi
guidelines to beef f

Each silage-makin
differs in the circur
cut, flail-harvested
chop silage were ea
carcass output per l
*al.* (1999) found th
levels of animal pe
silage saved from g
(Steen, 1985) could

In general, finishin
those fed silages
supplementation w
Keane, 1987) and i
a growth response
fermentation (O'Su
can also impact o
2002).

*Feeding value for s*

In common with th
as the principal for

**Table 3** Intake and growth performance by cattle fed hay or silage

| Cutting date | 27 May | | 10 June | |
|---|---|---|---|---|
| Forage | Silage | Hay | Silage | Hay |
| Forage DM intake (kg/day) | 6.32 | 7.60 | 5.58 | 7.24 |
| Liveweight gain (kg/day) | 0.61 | 0.73 | 0.32 | 0.50 |
| Carcase gain (kg/day) | 0.45 | 0.38 | 0.19 | 0.20 |
| Carcase gain (kg)/tonne DM intake | 71.2 | 50.0 | 24.1 | 27.6 |

Source: McCarrick (1966)

Flynn (1981) reported a series of regression equations that quantified the magnitude of the increase in intake and growth rate, and thus the improvement in feed conversion efficiency, that can occur when well-preserved, unwilted, silages of increasing digestibility are offered without supplementation to finishing beef cattle. Subsequently, Drennan & Keane (1987) and Steen *et al.* (2002) clearly showed that the benefits to animal growth from feeding cattle with silages of superior digestibility are most evident at lower levels of concentrate supplementation and that the scale of the benefits decrease as the level of concentrates offered increases and the proportion of silage in the diet therefore decreases. Regression equations have been generated to quantify total feed intake, carcass gain and carcass fat content as the proportion of concentrates in the diet increases with a silage of either high or low digestibility (Drennan & Keane, 1987; Steen, 1998). This information allied to previous data from Steen (1989) that identified the optimal crude protein concentrations for supplementary concentrates with silage of medium to high digestibility to finishing steers, heifers and bulls, provides solid guidelines to beef farmers seeking to optimise rations for finishing cattle.

Each silage-making system has its own advantages and disadvantages and thus each system differs in the circumstances to which it is more or less suited. Steen (1985) found that direct-cut, flail-harvested silage and pre-cut, unwilted, precision-chop silage and wilted, precision-chop silage were each capable of supporting similar levels of growth in beef cattle and similar carcass output per hectare provided each system was operated correctly. Similarly, O'Kiely *et al.* (1999) found that baled silages and precision-chop silages could support broadly similar levels of animal performance. In contrast, poorly preserved, unwilted silage (Flynn, 1981) or silage saved from grass that has laid for an extended period on the ground during field wilting (Steen, 1985) could depress animal performance.

In general, finishing cattle fed well-preserved silage or hay have fatter carcasses compared to those fed silages of lower dry matter content (McCarrick, 1966). Increasing levels of supplementation with energy-rich concentrates increases carcass fat content (Drennan & Keane, 1987) and increasing the protein content of the supplement beyond the level at which a growth response is obtained can also increase carcass fat content (Steen, 1996). Silage fermentation (O'Sullivan *et al.*, 2004) and wilting (Moloney *et al.*, 2004; Noci *et al.*, 2004) can also impact on meat quality, as can supplementation with concentrates (Steen *et al.*, 2002).

*Feeding value for sheep*

In common with the dairy and beef sectors in Ireland, grass silage has generally replaced hay as the principal forage for sheep during the winter feeding period. Key factors influencing the feeding value of silage for sheep include digestibility and fermentation characteristics. However, chop length effects are more important in sheep than in cattle (Apolant & Chestnutt, 1982). Well preserved, high digestibility silage of short chop-length can sustain high levels of sheep and lamb performance without the need for supplementation. A particular issue of concern in relation to silage quality for sheep is the carry over of soil and/or other contamination during ensilage, as this can result in listeriosis in sheep (Low & Donachie, 2000). In this context it is worth highlighting that current research on silage additives is examining the use of species and/or strains of lactic acid bacteria that produce anti-microbial agents such as bacteriocins, to inhibit pathogenic bacteria and spoilage (Merry *et al.*, 2000).

## Feeding systems for grass silage

The increased reliance on silage for winter feeding of livestock in Ireland, coupled with increases in the numbers of livestock per farm, has necessitated the development of improved lower labour systems of feeding. In the 1950's, most dairy cows were tethered individually in traditional cow byres with silage manually brought to the cows. As herd size increased, "self feeding" systems were introduced in which cows physically removed silage from the silo face, usually from behind a mechanical barrier or electric wire. These systems generally performed well and continue to be used on a number of dairy farms throughout Ireland. Many of the key management recommendations for self-feed silage were based on results of studies undertaken at Experimental Husbandry Farms in England (Phipps, 1986). Key recommendations included a maximum silo face height of 1.8 m, with a silage feed-face width of 150 mm/cow.

The development of silage shear grabs and block cutters in the early 1980's facilitated the introduction of easy-feed and total mixed ration (TMR) feeding systems. Use of shear grabs enabled removal of silage from the silo, with minimal disturbance to the silo face, and facilitate transport of silage to the feed manger. The development of easy-feed systems, in which silage is presented to animals behind a feed rail or barrier, provides considerable flexibility in developing management strategies to maximise forage intake. However, given the importance of this topic, surprisingly little detailed research has been undertaken to examine the effects of factors such as frequency of feeding, trough space per animal, feed barrier design etc on food intake and animal performance.

The results of a recent study by Ferris *et al.* (2002) indicates that forage intake and the performance of dairy cows offered forages in relatively simple easy-feed systems, with new blocks of forage offered twice weekly, was similar to that of cows offered a TMR once daily. Further research is needed to develop low cost feeding systems which enable livestock to maximise forage intake, whilst maintaining high levels of animal welfare and performance.

Finally, accurate prediction of silage feeding value is an important prerequisite if the full potential of silage is to be achieved in livestock feeding systems. Early silage analysis in Ireland involved the determination of fermentation parameters (pH, ammonia N and lactic acid) and fibre and protein fractions. Whilst these techniques provided a general indication of potential intake and nutritive value, they were laborious to undertake, prone to inter-laboratory variation and lacked precision. A series of studies at the Agricultural Research Institute of Northern Ireland in the early 1990's, involving intake potential and digestibility measurements on over 130 grass silages, resulted in the development of prediction equations for nutritive value and intake potential through near infrared spectroscopic (NIRS) analysis of fresh silage samples (Park *et al.*, 1998). This resulted in a rapid, cheap and reliable method



for predicting a wid
been developed at t
analysis in Ireland, v

**Present and future**

There have been ma
livestock in Ireland
particularly in relati
and by-product fee
feeding value of the
develop lower cost h
effect of chop lengt
chop length harvesti

The unpredictability
need to develop syst
impact of factors su
feeding value of the

Finally, a major chal
strategies which will
phosphorus - both w
to grazed swards po
there are opportunit
systems, through re
fermentation.

## References

Apolant, S.M. & D.M.B
*Annual Report, Agricu*
Baker, R.D., K. Aston, (
supplement on intake,
Binnie, R.C. & J.P. Frost
*Forage Science*, 50, 2
Brown, W.O. & J.A.M. K
Comparison of long a
*Science*, 64, 135-141.
Brown, W.O. & J.A.M. K
Comparison of lacerat
*Journal of Agricultura*
Brown, W.O. & J.A.M. K
film in lined trench sil
Castle, M.E., W.C. Retter,
of three different chop
Chamberlain, D.G., S. Ro
salts of methanoic and
production. *Proceedin*
Cushnahan, A. & C.S. M
dairy cattle. 1. Food in
Done, D. (1986). Silag
*Agriculture*, 3, 2, 83-8

for predicting a wide range of chemical and biological parameters. A commercial service has been developed at the Institute based on NIRS and this is now the main centre for silage analysis in Ireland, with over 14,000 farm silages analysed each year.

### Present and future challenges in silage production in Ireland

There have been major advances in the science and practice of silage making and feeding to livestock in Ireland over the last 55 years. However, a number of major challenges remain, particularly in relation to the increased cost of conserved forage relative to grazing and grain and by-product feeds, and the relative unpredictability of silage-making in relation to the feeding value of the final product. The key challenges for research and development are to develop lower cost harvesting systems with reduced labour and fuel requirement. The lack of effect of chop length on animal performance in cattle feeding systems indicates that longer chop length harvesting methods, including self-loading forage wagons, may have a role.

The unpredictability of silage feeding value also needs to be addressed. There is an urgent need to develop systems which will enable rapid prediction of silage feeding value, and the impact of factors such as delayed harvesting, effect of wilting and impact of additive on feeding value of the final product, based on the analysis of the cut herbage in the field.

Finally, a major challenge facing farmers throughout Europe at present is the need to develop strategies which will enable more effective utilisation of nutrients - particularly nitrogen and phosphorus - both within the animal and from slurry applied to grassland. Slurry application to grazed swards poses particular problems in terms of intake and animal performance, but there are opportunities to make more effective use of slurry nutrients in silage-making systems, through reductions in inorganic N applications, without compromising silage fermentation.

### References


Apolant, S.M. & D.M.B. Chestnutt (1982). An evaluation of silage and pregnant and lactating ewes. *55th Annual Report, Agricultural Research Institute of Northern Ireland*, pp. 30-37.

Baker, R.D., K. Aston, C. Thomas & S.R. Daley (1991). The effect of silage characteristics and level of supplement on intake, substitution rate and milk constituent output. *Animal Production*, 52, 586-587.

Binnie, R.C. & J.P. Frost (1995). Some effects of applying undiluted silage effluent to grassland. *Grass and Forage Science*, 50, 272-285.

Brown, W.O. & J.A.M. Kerr (1965a). Losses in the conservation of grassland herbage in lined trench silos. 1. Comparison of long and lacerated silages made by the warm fermentation process. *Journal of Agricultural Science*, 64, 135-141.

Brown, W.O. & J.A.M. Kerr (1965b). Losses in the conservation of grassland herbage in lined trench silos. 2. Comparison of lacerated silages of low and high dry-matter content made by the cold fermentation process. *Journal of Agricultural Science*, 64, 143-149.

Brown, W.O. & J.A.M. Kerr (1965c). Losses in the conservation of heavily-wilted herbage sealed in polythene film in lined trench silos. *Journal of the British Grassland Society*, 20, 227-232.

Castle, M.E., W.C. Retter, & J.N. Watson (1979). Silage and milk production : comparisons between grass silage of three different chop lengths. *Grass and Forage Science*, 34, 293-301.

Chamberlain, D.G., S. Robertson, P.A. Martin & D.A. Jackson (1990). Effects of the addition of ammonium salts of methanoic and propanoic acids and octanoic acid at ensiling on the nutritional value of silage for milk production. *Proceedings of the Ninth Silage Conference, University of Newcastle Upon Tyne*, 120-122.

Cushnahan, A. & C.S. Mayne (1995). Effects of ensilage of grass on performance and nutrient utilisation by dairy cattle. 1. Food intake and milk production. *Animal Science*, 60, 337-345.

Done, D. (1986). Silage inoculants – A review of experimental work. *Research and Development in Agriculture*, 3, 2, 83-87.

# ANEXO N° 7

## Libro: UCD Research Farm
(solo portada y capítulos iniciales)

# International Grassland Congress 2005

**Date: 29 June 2005**

Tour 4: UCD RESEARCH FARM (LYONS)

AND

DAIRY FARM VISIT

**Dairy Farm:** Padraig & Lucy Travers, Straffan, Co. Kildare
**Teagasc Adviser:** Fiona Doolin, Teagasc, Naas, Co. Kildare
**Lyons Farm Manager:** Mr Tony Harte

**Tour Guides:** Bus 1: Dr John O'Doherty
Bus 2: Mr Eddie Jordan

DAWN MEATS

## Full Dairy Herd Monitor
## (January 2004 – December 2004 with 2002 & 2003 comparisons)

| | | | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| **Cows:** | | | | | |
| Total number of dairy cows | | | 86 | 97 | 89 |
| Number of births | | | 93 | 85 | 89 |
| Calf mortality (% of total births) | | | 10% | 9% | 17% |
| Replacement rate (% of total cows) | | | 37% | 26% | 12% |
| Total forage Ha | | | 62 | 62 | 62 |
| Average total L.U. on farm | | | 133 | 130 | 155 |
| Stocking rate All Stock (L.U./Ha) | | | 2.15 | 2.10 | 2.51 |
| **Milk:** | | | | | |
| Milk sold (Litres) | | | 537,435 | 616,436 | 569,631 |
| Milk to calves and house (Litres) | | | 20,962 | 26,300 | 31,114 |
| Milk yield/cow (Litres) | | | 6,528 | 6,601 | 6,725 |
| Milk fat % | | | 3.64 | 3.66 | 3.77 |
| Milk protein % | | | 3.22 | 3.23 | 3.22 |
| **Feed and Fertiliser:** | | | | | |
| Std. Concentrates fed (tonnes) | | | 113.16 | 122.64 | 118.16 |
| Std. Concentrates fed (kg/cow) | | | 1,323 | 1,259 | 1,323 |
| Std. Concentrated cost (€/tonne) | | | 186 | 178 | 199 |
| Fertiliser cost (€/Ha) | | | 144 | 189 | 207 |
| **Grass:** | | | | | |
| Kg N used/Ha | | | 206 | 253 | 290 |
| Kg P used/Ha | | | 7 | 11 | 8 |
| Kg K used/Ha | | | 14 | 36 | 27 |
| Number days cows at grass Day Only | | | 56 | 71 | 81 |
| Number of days cows at grass full time | | | 199 | 206 | 189 |
| Milk from forage % | | | 79.7% | 80.9% | 80.3% |
| **Financial (total Cows)** | € | ¢/Litre | /Cow | /Cow | /Cow |
| **Milk sales (€)** | **177,587** | (29.6) | **1,988** | **1,996** | **1,988** |
| + calf sales | 3,277 | (0.5) | 91 | 44 | **37** |
| + calf transfers out | 6,900 | (1.1) | 99 | 139 | **77** |
| + cow sales | 2,078 | (0.3) | 43 | 135 | **23** |
| - cow purchases | 4,320 | (0.7) | 0 | 0 | **48** |
| - replacements transfers in | 11,000 | (1.8) | 337 | 257 | **123** |
| ± change in cow inventory | 2,800 | +(0.5) | 172 | -65 | **31** |
| **= Dairy Output** | **177,322** | **(29.5)** | 2,054 | 1,992 | **1,985** |
| - concentrates | 23,470 | (3.9) | 246 | 225 | **263** |
| - purchased forage | 0 | (0.0) | 0 | 6 | **0** |
| - fertiliser cost (Tot cow/Tot L.U.) | 7,128 | (1.2) | 64 | 91 | **80** |
| = **Output less feed and fertiliser** | **146,724** | **(24.4)** | **1,744** | **1,671** | **1,642** |
| **Average prices:** (a) Milk (¢/Litre) | | | 31.61 | 31.53 | 31.18 |
| (b) Cow sales (€/hd) | | | 410 | 410 | 346 |
| (c) Calf sales (€/hd) | | | 159 | 160 | 137 |
| **Labour** | | | | | |
| Hours worked as % of standard calculated hours | | | **157%** | **137%** | **134%** |

# UCD RESEARCH FARM (LYONS)

## Sheep 2004-2005

**Lyons (UCD) Ewe Premium Quota**: 659 (reference years 2000, 2001, 2002)
The old ewe premium subsidy now included in the Single farm Payment.

| Early lamb production: | Mean lambing date | Conception rate (CR) | Litter size |
|---|---|---|---|
| (a) 84 Good ewes put to ram | Wed January 12 | 65 - >80% | 1.8-1.9 |
| (b) 89 Cull ewes put to ram | Wed January 12 | - | 1.8-1.9 |
| (c) 43 Pedigree ewes (Suffolk, Texel, Dorset Horn, Charollais) | | | |

**Mid-season lamb production**:
(d) 308 ewes put to ram Wed. March 9; CR= 79% (257/325) 2.16 (1.8-2.2)

**Ewe breeds**: Mainly Suffolk crosses, grey-face, half-bred, Belclare and other mixed types

**Ram Breeds**: (a) Early lamb – good ewes > Suffolk, Dorset Horn rams
(b) Early lamb – cull ewes >Texel rams (leaner carcass and heavier weights)
(c) Mid-season lamb >Texel mainly, also some Suffolk and Charollais

**Lambing:** All ewes lamb indoors with 24 hours supervision (some student help)

**Wintering:** All cull ewes and all mid-season ewes housed for the full winter.
March lambing ewes go to grass within one week of lambing.

**Feeding:**

**(a) Good Early Lambing Ewes.**
Grass pre-lambing. After lambing put to cow fields at low Stocking Rate (2.5e/ha) or fed grass/maize silage indoors. All lambs are early weaned at 6 weeks when eating 0.25kg concentrates. Lambs left in cow fields at a SR of up to 80/ha and offered concentrates ad libitum.

**(b) Cull Ewes**
Pre-lambing: Silage + up to 1.2 kg concentrates/hd/day. Lambs weaned at 5-6 wks and finished at grass with ad libitum concentrates. First sales 12 weeks. 90% sold by 18 weeks.

**(c) Mid-season Lambing Ewes**
Grass/Maize silage pre-lambing. Silage diet supplemented with concentrates at the rate of 0.1-0.7 kg (or 0.4/0.5 flat) per ewe/day for twin bearing ewes but this also depends on silage quality. Post-lambing the suckling ewes graze silage ground and during March some concentrate supplementation, the amount depending on grass quantity. No concentrates fed after end of March. During the first week of April, the suckling ewes are moved to the permanent grazing area on the higher ground where a rotational paddock grazing system operates until weaning at the end of June. The permanent grazing are is naturally high in K and most is high in P -- so no K and very little P applied. N goes out in Feb/March and again after the first/second grazing depending on grass growth. In total about 120 kg N/ha applied.

**Sale:** Lambs sold when 35-43 kg live weight and kill out % is 46-48%, to give a 17-19 kg carcass.

**Lamb Price:** 2004: Early: €4.69/kg DW (€88.45/lamb; Mid-season: €3.56/kg DW (€69/lamb).

**Gross margin/ewe** (excluding support payments)

(a) Early lamb grass based €45/ewe
(b) Cull ewes/early weaned €64
(c) Mid-season lamb €43

**Sheep Research**: Recent research has concentrated in the areas of:

(a) Pregnant ewe nutrition (effects of forage, energy, protein on ewe performance)
(b) Factors affecting colostrum yield and quality
(c) Factors affecting IgG absorption by the lamb, especially as it relates to the level of dietary iodine.
(d) The use of Sel-Plex and Bio-Mos in sheep diets
(e) Intensive finishing of lambs and dietary/housing factors relating to copper toxicity
(f) Controlled breeding and artificial insemination

## Beef

**Nutrition Experiments:**

**Source:** Heifers/bullocks/weanling bulls purchased in autumn + some progeny from Lyons suckler cow herd

**Buying in wt.** Heifers 450-550 kg; Bullocks 550-650 kg; weanling bulls 320-360 kg.

**Breeds:** Continental types > crosses of Charolais, Simmental, Limousin, Belgian Blue
Some originate in the dairy herd and are half Friesian.

**Housing:** Two slatted sheds beside silage pits. Capacity to individually feed 40 cattle. New metabolism house for detailed nutrition/metabolism work.

**Feeding:** Usually grass silage based + conc. (3-4 kg/hd/day but depends on experiment)
At times maize silage fed with different types and levels of concentrates
Sometimes concentrates fed ad lib. + 1kg straw (i.e. to alter carcass fat colour)

**Current Experiments:** Examining the effect of the augmentation of animal diet with specific fatty acids to improve (a) the nutraceutical composition of beef and (b) the reproductive performance of beef and dairy cows

**Future Experiments:** (i) Examination of physiological and molecular markers of energetic efficiency in beef cattle
(ii) Improved oestrous synchronisation regimes for beef cattle

**Performance:** Heifers/steers: 0.9/1.0 kg/hd/day with grass silage and 3-4 kg of concentrates
Young bulls: 1.5 kg/hd/day with ad-libitum concentrate and 1 kg straw.

**Sale weight:** Heifers: 550-600 kg (20 months); K.O. 53-54%
Steers: 700-750 kg (24-26 mths), K.O. 54%; carcass weight 380-400 kg.
Young bulls: 480-550kg (12mths); KO 56-58%; carcass weight 280-320 kg.

**Current price:** Steers/Heifers: Good quality; €2.96/kg carcass.
Young beef bulls: €3.10/kg carcass.
Cull cows: Good quality; €2.52/kg carcass.

## Suckler cows

**Number:** 16 cows and calves. 25 replacement heifers to be bred and used in veterinary teaching.

**Breed:** Cows Continental cross/Friesian; Bull: Continental

**Wintering:** Cows housed on slats for first few months and then changed to straw bedded pens

**Feeding:** Cows fed grass silage only at housing and this may be restricted in the last 4-8 weeks of pregnancy if the cows are getting over fat or cows may be fed straw + 2 kg concentrates. Target body condition score at calving is 3.0 (scale 1-5)

**Calving:** Spring calving, bedded on straw. Cows go to grass after calving (mid to late March).

**Performance:** Target weights for calves at weaning > **Bulls 300 kg** and **Heifers 280 kg.**
LW gain during first grazing season: **Bulls 1.2 kg/day** and Heifers **1.1 kg/day**

**Disposal:** Bulls: either sold as weanlings or retained for experimentation.
Heifers: either sold as weanlings or retained for experimentation/herd replacements

## Dairy cows

**Number of Cows:** 90

[1]**EU Milk Quota:** 625,000 litres (13800 gals);

[2]**Milk Output per Cow:** 7500 litres; Fat % - 4.39; Protein % - 3.42; Fat kg – 328; Protein kg - 297

[3]**Herd Genetics:** The herd consists of Holstein-Friesian dairy cows based on the use of semen which was generally available through the local AI station and which would be available to all dairy farmers. A limited amount of semen has been purchased from outside sources. Herd genetics changed from traditional "British Friesian" type animals to more Holstein type animals over the last two decades. Semen selection is now based on the Irish Economic Breeding Index (EBI) with the emphasis currently on semen from high-quality "traditional" New Zealand bulls. All semen will normally be selected from bulls which have daughters progeny tested in Ireland and which have a high EBI value combined with good reliability.

**Milk Production System:** The UCD dairy herd supplies milk for the liquid milk trade (town milk, fresh milk) which only accounts for 10% of milk ouput in Ireland. Most milk in Ireland is produced for manufacturing into butter plus dried skim milk powder and casein or for long-life cheeses. The UCD herd produces milk all year round on a non-seasonal basis while most manufacturing milk is produced from 100% spring-calving herds on a seasonal

---

[1] Each dairy herd within the EU has a production limit (milk quota), which was established in 1984. Any milk produced in excess of this quota may be subject to a very severe penalty (super-levy). This system has been very effective in limiting milk output in the EU.

[2] Lactation yield, based on a calving interval in excess of 400 days.

[3] The selection index used for dairy bull evaluation in Ireland was based solely on milk traits until 2000. The Economic Breeding Index was then introduced and it contained information on Survivability and Calving Interval as well as on milk traits. More recently information on beef traits and on calving difficulty have also been added to the index.

basis from grazed grass. In the UCD herd 40% of the herd calves in the autumn period (September-November) with the remaindewr calving in the spring period. A substantial premium is paid for milk produced over the winter months for compensate for the higher costs (mainly extra concentrates plus higher quality silage and highrer labour charges).

**Feeding System:** The overall annual feed budget for the UCD herd consists of approximately 3 tonnes of grass dry matter, 1.5 tonnes of silage dry matter plus 1.25 tonnes of concentrate dry matter on a per cow basis. The silage consists of both grass silage and maize silage. The maize silage is grown with the aid of a plastic mulch to increase the dry matter yield and to increase crop maturity and the starch content of the maize at harvest. Feeding over the winter period is by complete diet feeding (TMR) supplemented by some in-parlour concentrate feeding.

**Grassland Management:** Overall stocking rate -- 2.5 LivestockUnits/hectare approx; nitrogen use - 300 + kg nitrogen/ha. Rotational grazing is practiced during the main part of the grazing season, with routine monitoring of average grass cover (kg grass DM per ha and per cow), post-grazing sward surface heights, grass quality and daily herbage allowances per cow. Topping of pastures is practiced on a routine basis.

The greatest difficulty in grassland management in the UCD dairy herd arises because of variability in grass growth in the summer period due to soil moisture deficits arising from the low and unpredictable summer rainfall in the eastern region in Ireland.

**Milk quality:** Very good - very low TBC (total bacterial count); medium SCC (somatic cell count); refrigerated bulk milk tank with every second day milk collection by dairy processor; automatic washing systems for both milking machine and refrigerated milk tank

**Milking Parlour:** Highly automated, computer controlled milking and feeding system (mainly for research purposes) incorporating (i) automatic cow identification on entry to milking parlour; (ii) automatic feeding from either of two concentrate in-parlour feeding systems; (iii) automatic milk recording; (iv) automatic diversion of milk from main bulk tank to alternative outlet; and (v) automatic cluster removal.

**Parlour and Yard Washings:** Disposal during summer by (low volume) mobile irrigator.

**Research Areas:** The dairy herd provides animals for research projects in a variety of areas – see also entries for Animal Physiology, Methane Research and Maize Research. The main emphasis has been on fertility and reproduction and on the interaction between nutrition and the environment, especially on limiting the output of methane and nitrogen excreta. In addition to the research carried out at the UCD Research Farm at Lyons many UCD postgraduate students are involved in aspects of dairy production research at a number of Teagasc Research Centres in Ireland