

TRANSMITTING RESEARCH FINDINGS INTO FARM PRACTICE

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SUMMARY

When adapted and applied to farm practice, scientific research findings are a valuable 'resource'. There are many methods of technology or knowledge transfer and farmers have to be selective in choosing which method or methods suit their particular circumstances. Clearly, personal contact with advisers or consultants and discussions with fellow farmers are effective and preferred methods. The written word, provided it is couched in non-scientific and simple language, is also effective. It is foreseen that the use of decision support models set up on the internet will expand as a computer literate generation of younger farmers take up the farming reins. In effect, the internet represents a revolution in communication. Nevertheless, personal contact will remain the acme (now expensive) of farming advice provision together with monitor farm discussion groups. Increasingly and rightly so, farmers are participating along with researchers and advisers in official development farms or in commercial pilot or monitor farms that demonstrate improved systems of management and production. National and local agricultural sector societies also play a major role in technology transfer through their meetings, publications and the interaction of their members drawn from various agricultural professions. Research institutes have had to incorporate a technology transfer component into their grant-aided research projects. Agriculture has become multifunctional, having had to graft on a host of legislated non-production-orientated activities involving improvement of the environment and the landscape for example. Thus research and development and associated knowledge transfer provision have had to be adapted to meet to the new circumstances.

Key words: Technology transfer methods, internet models, farm practice uptake.

INTRODUCTION

“In agriculture, as in every human activity, we seem to be passing into a new world. There never was a time when tremendous changes were more certain, when events were harder to forecast or when action was more difficult to plan.”

These prophetic words, written in 1933 by J.A. Thomas, a British Secretary of State, are particularly relevant for today's rapidly changing 'growing ever smaller' world in which competition for agricultural markets is intensifying. Precision of inputs, stringent containment of costs, predictability of outputs, and profitability, are key aims for farmers. In addition, there is need to complement these aims with an enlightened future investment approach. In many European countries a scenario exists of restrictions on output of agricultural products, demands for improvements in animal welfare, better product quality, the necessity for environmentally friendly production methods and the seamless integration of nature conservation and landscape enhancement. In the face of this plethora of pressures farmers have to make swift and flexible yet sensible responses and adaptations. While there are several arts in farming, those farmers who turn science into practice are taking advantage of what is a major 'resource' and so acquire a competitive edge. Coincidentally, the motto on the crest of my initial place of work, The West of Scotland Agricultural College, is 'Scientia Terram Fecundare', namely, 'Science Makes the Earth Fertile'. Now part of the amalgamated Scottish Agricultural College (SAC) with three campuses (North, West and East Scotland), each closely linked to a local University, the SAC has an integrated system of research and development (R&D), provision of advisory services, and education from diploma to postgraduate level. This system, which also has close links with other purely basic-research institutes, ensures that R & D findings are transferred to farm practice. This paper is largely based on my personal experience of technology transfer methodology in Scotland and the UK, with particular reference to grassland management, and not on general theoretical considerations or basic principles.

SAC ADVISORY SERVICES

There is a chain of advisory offices throughout Scotland wherein staff have a wide range of expertise in various agricultural disciplines plus there are some staff with sufficient all-round skills who focus on holistic farm systems. In the past, advice was free and impartial, and it was recognised that delivering change was best achieved by individual face-to-face, on-farm visits. Such advice is particularly effective when there is a good adviser-farmer client relationship with mutual trust and respect. The advice has to be

unbiased and in the best interests of the farmer client, and it is essential that the farmer sees and understands the economic benefits of introduced new technology since it usually requires some financial investment on his part.

In the recent past there has been a sea-change in government policy and farmers are now charged for technical advice; this is mainly done by offering different advisory 'packages', e.g. dairy, beef, sheep, that include limited farm visits plus limited telephone contact. Currently advice on agri-environmental matters is free. Organised day or evening meetings of farmer groups to discuss a particular subject area are also held and while efficient in terms of advisory manpower, they are not as effective as individual contact. Nevertheless, meetings held on official development or commercial monitor farms, where new systems and practices are demonstrated to farmer groups, are particularly effective since they tie in closely with commercial practice.

With the onset of charging for official advisory service advice, competition in advisory provision has increased, which arguably is a good thing, the competition being from commercial firms and private consultants. However, the official service has a competitive edge given the R&D resources backing them up. Nonetheless, some commercial firms have their own R&D facilities and they also fund investigative work at SAC, universities or basic-research institutes and so get first call on the benefits of the findings.

DEVELOPMENT FARMS

Agricultural research is only of practical benefit when farmers apply the findings, and the benefits, whether practical or financial, must always outweigh any disbenefits. Unsurprisingly, a salutary point is that market forces (demand and product price) can have a greater positive impact on the uptake of technological innovations or advances than technology *per se*. Official development farms, sometimes called demonstration or experimental husbandry farms, have played and are playing an important role in transferring technology to British farmers.

In essence, applied development is needed to integrate relevant findings or advances from basic or fundamental research into practical production systems. The development farm fulfils this function and researchers, development staff, advisers and farmers interact and are involved in the decision making as to which findings to synthesize and test in practical systems. Selected research findings are thus assessed under farm conditions, the findings from small scale trials are scaled up and evaluated, and successful systems demonstrated to farmers. It behoves the interacting team to choose carefully which variants to incorporate into large-scale trials since the number has to be restricted owing to the high input of resources needed for systems work, particularly for animal production systems.

The interaction among the participants has to be emphasised; for example, it has to be considered what farmers really want or why farmers may not wish to adopt a practice which seems to the researcher to be an advance. The input of advisers is also important since they have to translate R & D information into understandable advisory messages to farmers. Some advances, for example, higher yielding plant varieties, are easily incorporated into farm practice and usually require simple demonstration rather than development work. In contrast, some advances such as in grazing technology are more complex since they impinge on several components within the grazing system and so farmers need advice to understand and cope with the consequent interactions.

Essentially the approach on development farms is practical and involves multidisciplinary teams or task forces, an approach that contrasts with scientists doing basic research, often working in narrow subject areas – so-called component part research - sometimes in isolation and not always mindful of the ultimate agricultural objectives. Nonetheless the applied development work is underpinned by the fundamental and strategic research undertaken by staff at basic research institutes. The official development farm offers full control of management, facilities and objectives. It becomes a focus of visiting farmer groups, can offer practical training courses for advisers and farmers and is a valuable link between research and farm practice. Where it is not possible financially for a basic research institute to have a separate development farm it may be possible to create one within the institute provided there are sufficient staff, stock and land to undertake comparative systems work or at least demonstrate a new practical system.

It is also possible to utilise commercial farms as so-called pilot, focus, monitor or demonstration farms. Indeed as funding to official research centres in the UK has been ever-reducing in recent years, there has been a growth in the use of commercial farms for demonstration purposes. A good relationship with researchers and farmers is essential but there is always the risk that relationships break down or that farm staff may not appreciate the scientific rigour or meticulous recording that is necessary. The farmer receives advisory support and is recompensed for the additional practical and recording work necessary; he has also to be amenable to exhibiting the improved farm practices and farm accounts to visiting groups of farmers. It is important to establish the farm practice baseline inputs-outputs and profitability of the farm so that the effect of the introduced progressive practices can be compared with the baseline situation them and the end results validated. Close and continuous monitoring and a final evaluation are therefore essential.

A technology transfer project entitled 'Practice into Profit' provides an example of the use of demonstration farms (Moseley, 2002). The 3-year programme was sponsored by a group of bodies including government, product levy organisations, and commercial firms with agricultural interests. The overall aim was to promote good grassland practi-

ces that incorporated new and proven technology and in turn generated improved profitability. Seven demonstration dairy farms were located at agricultural college and institute sites in England and Wales. The farms were selected for their ability to demonstrate expertise in grassland farming and were in areas of high grassland dependency with potential for uptake of the results. The practices and management systems involved were devised and monitored by local groups of progressive farmers, staff and invited experts. All the facets of grassland management, e.g., seed mixtures, methods of reseeding, extending the grazing season, improved silage making and grazing technologies, were dealt with and amended as necessary, and their positive effects at the end of the project assessed, namely, a reduction in variable costs, in fixed costs, and in unit costs per litre of milk, leading to financial performance.

BRITISH GRASSLAND SOCIETY (BGS)

Full accounts of its history from its inception in 1945 to 1995 (Powell *et al.*, 1995) and from 1995 to 2005 (Davies, 2005) are available, (web site: www.britishgrassland.com).

The objects of the Society's constitution are:

- a) The advancement of methods of production and utilisation of grass and forage crops for the promotion of agriculture and the public benefit.
- b) The advancement of education and of research in grassland forage production and utilisation, and the publication of the results of any research.

In furtherance of these objectives, three powers out of the nine listed are closely related to technology transfer:

- a) To stimulate the incorporation into practice of advances resulting from research, experimental work and practical experience.
- b) To hold meetings, lectures, conferences and exhibitions.
- c) To collect information and to publish a Journal for the benefit of the public, together with such other periodicals, books or leaflets as may from time to time be desirable.

The Society has a unique blend of members – scientists, advisers, lecturers, technicians, students, farmers, farm managers and seed, fertiliser, feeding stuff and machinery representatives. Thus, the interactions among these members offer a unique opportunity for participatory exchange of information, ideas and research findings, and importantly a forum for debating current issues. Farmer members are often leading exponents of grassland farming and apart from being innovators of practical technology in their own right are able to identify problems worthy of investigative research and in many cases

collaborate in on-farm investigations and demonstrations. In a word the BGS is about communication. With the increased emphasis on the food chain it is incumbent on the Society to broaden its membership and get closer to retailers and consumers of food products, and also to landscape and wildlife conservation scientists; recruitment of young members is an ongoing aim.

Summer meetings

The society holds 3-day summer meetings in different regions of the UK each year during which participants visit several farms plus a research institute, development farm or agricultural college if present in the region. At each farm visit some system, technique, experience or finding is highlighted, demonstrated and discussed. Such meetings have proved very popular with farmer members though less so with researchers. Many commercial firms or banks provide sponsorship.

Winter meetings

Regular indoor winter meetings or symposia of varying lengths of time and with different formats are organised. These range from one-day to three-day events built around a particular theme, often one of topical interest, or one where there has been a recent accumulation of knowledge. In some cases, the meetings have been held jointly with related societies. However, unless the programme is specifically farm practice-orientated, the majority of attendees are scientists. To encourage more farmer participation, a recent initiative has been the introduction of one-day 'mobile' winter roadshows, i.e., meetings with mainly leading farmer speakers, which have taken place at venues in each of the four countries of the UK. Agriculture is undergoing a seismic change instigated by official policies, legislation and subsidies that are aimed at extensification, environmentally friendly systems, accredited food products, countryside enhancement and wildlife conservation. In many of its activities, the BGS is responding to these changes. For example a planned conference is entitled 'High value grassland: providing biodiversity, a clean environment and premium products', and is joint with the British Ecological Society and the British Society of Animal Science.

Another conference initiative is the biennial holding of a so-called research conference. This provides a platform for young scientists to present and vindicate their ongoing research to their peers. This transfer of technology is mainly among the research community though any significant advances soon filter through indirectly to farmers by various routes.

Scientific publications

These play a major role in the society's activities. The flagship is 'Grass and Forage Science' (print run of 1700 copies, four quarterly issues per annum. This publication is also the official Journal of the European Grassland Federation (web site www.european-grassland.org). The journal's aim as outlined by the editor, Milne (2006), is to publish high quality papers on all aspects of grassland and rangeland management, and to report the results of R&D in grass and forage production, and on its management and utilisation, taking an integrated view of grassland and related systems. Articles dealing with amenity and recreational uses of grassland and the environmental implications of grassland systems are also invited. All members receive a copy of the journal but obviously it is of more interest to the agricultural science community than to farmer members.

Proceedings of the formal conferences and symposia are published in an occasional symposium series, currently with 37 titles. Text books currently available are 'Grass: Its Production and Utilization', 'Sward Measurement Handbook' and 'Herbage Intake Handbook'. Papers presented at miscellaneous meetings and conferences are also published in a cheap folder format. Electronic publishing was commenced in 1999 when a first CD-ROM, which incorporated an Acrobat Search tool for a text search, was produced of four occasional symposia held in the recent past (Davies, 2005). Proceedings of the other types of meetings are also available on CD-Rom.

Practical publication

The Society also produces a practice-orientated publication 'Grass and Forage Farmer' thrice a year (print run, 4600 copies). Its aim is to provide information about new technology, outline current R&D at research centres, development farms, pilot farms and colleges, describe initiatives from innovative dairy, beef and sheep farmers that have made their enterprises more efficient and profitable, publicise current activities of local grassland societies, describe conference highlights and give accounts of various technology transfer initiatives of different special interest groups. A recent initiative is to feature a grassland clinic which deals with specific technical queries from members.

It is noteworthy that the BGS R&D committee which outlined priorities for R&D pinpointed the need to improve technology transfer, particularly with respect to food chain connections (British Grassland Society, 2005). It also noted that "the present knowledge base from research and from farmers is sufficient for marked improvements from the current general level of efficiency achieved on farms". Also, "value for money from research will be increased by increased participatory involvement of stakeholders at the start of research programmes and increased planning of exploitation routes at an early stage of research programmes". One current example of this latter concept is that EU-funded research projects normally have to have an ongoing technology transfer component.

Special interest groups

The BGS encourages the formation of these groups and at present there is a researcher/farmer orientated Forage Legumes group, a researcher-orientated Pasture Ecology group, a farmer-orientated Brassica group and a Horse group. Consideration is being given to a Grazing group (Davies, 2005). In a European initiative, a working group has been organised on 'Grassland re-sowing and grass-arable rotation'. The group meets during EGF meetings and its reports are part of the meeting programmes. Satellite working groups are being established in eastern and southern Europe (Taube and Conijn, 2004). A new working group on 'Dairy Farming Systems', involving scientists from nine different European countries, has also been established under the umbrella of the EGF.

Local Grassland Societies

The first was formed in 1954 and subsequently the movement grew rapidly either within individual counties, or groups of counties. A peak of 73 local societies was reached in 1992 with 10000 members (Powell *et al.*, 1995) but currently the numbers are 68 and circa 8000, respectively (Davies, 2005); membership is dominated by farmers, many of them representing leading grassland devotees and pioneers. Local societies are affiliated to the BGS which provides practical and financial assistance.

The local vibrant grassland society in south west Scotland (SWSGS) was formed in 1962. Its main activities are: organised visits to leading grassland farms; winter evening discussion meetings; circulation of grassland literature and information from the BGS; circulation of newsletters and advisory literature; details of competitions for members in connection with silage, hay, nature conservation and innovations. In conjunction with the Central Scotland Grassland Society (CSGS), it publishes a journal, 'Greensward' for members (47 issues to date). The popular SWSGS silage competition has been running since 1974. The local winner then competes against winners from other Scottish societies for the Scottish title. In 1977 the BGS started a National Silage Competition and local society winners from different British regions competed for the National Title. This competition changed to a BGS Grassland Management competition from 2002 onwards and is open to beef, sheep and dairy farmers; while silage making and utilisation are still featured, grazing strategy, general farm management, care for the environment, innovation and safety and welfare area all featured and judged. The diversity of farms is taken into account using a flexible scoring system to allow for differences in such factors as farming enterprise, geography, climate and soil. Undoubtedly, talks by competition winners, organised visits to their farms, including discussions of their techniques and methods, are powerful means of transferring technology to fellow farmers in a superbly practical way and thus complement the routine programmes of the local societies

RESEARCH STATION ADVISORY INITIATIVES

The Institute of Grassland and Environmental Research (IGER) employs dedicated staff specifically to disseminate information to farmers, land users and government policy makers, but also to receive feedback that could influence its research. It has a Grassland Development Centre, one of four in Wales, funded by the EU and the Welsh Assembly Government that supports farming and rural development in Wales. The Institute is also associated with 'Grassland Challenge' a joint venture between IGER, Duchy College and five Cornish Societies, (web site www.farm-management-sw.co.uk). New advances from grassland research and practice are tested and demonstrated on twelve commercial 'focus' farms for the benefit of other farmer participants in the scheme, currently over 550 in number. Forage crops and sources of home-grown protein are also dealt with. A team of extension officers is available to give technical advice and to seek out recent research findings worthy of transmission.

An outstanding example of stakeholder (farmer) involvement is the Australian Landcare movement which started in the late eighties with a main aim of soil and water resource management, (web site www.landcare.gov.au). It has recently been funded by the government for a National Landcare programme for 2005/2006 to encourage sustainable natural resource action. Grazing and livestock management for environmentally sustainable production systems is propagated through a programme, 'Prograze', which covers dairy, beef and sheep systems and includes business development. Essentially a training course devised in the early nineties by farmers for farmers, over 9000 livestock producers have since taken the programme and many have subsequently taken further specialised courses such as the so-called LambCheque and BeefCheque programmes (Martindale and Marriott, 2004). The courses are generally held on farms. To promote the Landcare concept worldwide, there is a non-profit Secretariat for International Landcare based in Australia, (web site: www.silc.com.au), and the concept has now spread to many countries including five regional projects in the UK.

FARMING SECTOR EVENTS

Many agricultural events are held at various locations throughout the UK. They may feature the dairy, beef or sheep sector and give farmers the chance to see and hear about the latest developments. A notable one is the 3-yearly 3-day multi-sector event held in central England and usually sponsored by commercial firms. It has working demonstrations of machinery, trade exhibits, targeted workshops and interactive computer demonstrations. These events, together with a host of local or national agricultural shows, provide a fairly informal strand of knowledge transfer and publicise various advisory organisations and the activities of R& D centres.

SPECIAL EXTENSION PROJECTS

In recent years what can be termed as 'hands-on' technology transfer projects have taken place in association with a diverse number of kindred bodies, including levy-gathering bodies such as the Milk Development Council (MDC), (web site: www.mdc.org.uk), and the Meat and Livestock Commission (MLC), (web site: www.mlc.org.uk). Basically the aim was to demonstrate to milk and meat producers, respectively, on how to make their enterprises more profitable. One BGS initiative was to create on-farm discussion groups led by specialist New Zealand consultants with the remit of promoting techniques to extend the grazing season at both ends. Eye-catching titles were devised for the projects, e.g. 'Grazed Grass Grows Profits', in order to attract farmer participation. A video was also produced. This initiative has been extended into the present, with the current MDC project entitled 'Grass +' up and running with *circa* 1000 farmers registered. The MDC has also produced 132 technical/advisory publications for dairy farmers.

Another farmer-orientated project supported with funding from the government Department for Environmental Food and Rural Affairs (DEFRA), (web site: www.defra.gov.uk), is the Forage Legume Network operating mainly in southern England. Its objective is to communicate research findings and to demonstrate the successful incorporation of forage legumes into farming systems via leading farm exponents sharing their experiences with fellow farmers. A disadvantage of special projects is that they have a limited time frame.

EUROPEAN GRASSLAND FEDERATION (EGF)

The EGF has general meetings somewhere in Europe every two years and symposia on specific subject areas in the years between the general meetings. One of its objectives is to promote the interchange of scientific and practical experience between grassland experts. As for the IGCs, it is mainly grassland researchers and advisers who attend, but much of the information disseminated can be expected to filter down to the advisory level when the delegates return to their individual countries. At the recent EGF meeting in Spain (Lloveras *et al.*, 2006), there were in excess of 300 delegates from over 30 countries.

INTERNATIONAL GRASSLAND CONFERENCE (IGC)

IGCs are held every four years and provide an international forum principally for the presentation and exchange of findings from R&D. However, normally there is a session on technology transfer. For example, at the recent IGC held in Ireland and the United

Kingdom in 2005, the Proceedings of the offered papers (O'Mara *et al.*, 2005a) included a section entitled 'The role of the IGC and grassland societies in technology interaction and influencing policy' In it there are 23 brief papers giving accounts of the activities of national and local societies, e.g. Tiley (2005) for west of Scotland, Selge *et al.*, 2005 for Estonia, Isselstein and Hochberg (2005) for Germany, San Miguel and Roig (2005), for Spain. Some national societies can be instrumental in influencing government policies.

SURVEY OF KNOWLEDGE TRANSFER METHODS

A consultation with the livestock agricultural industry identified the most pressing technical issues facing farm businesses (Anonymous, 2001). Grassland production and utilisation, animal production and nutrition, animal health and welfare, and marketing were notable through not exclusive issues. This consultation was followed by a general survey (800 respondents) to classify the ranking of thirteen methods of knowledge transfer; within the survey group 120 known technically innovative farmers were used as a group of 'benchmark' farmers (see Table 1).

TABLE 1

Preferred methods of knowledge transfer (1 = most preferred, 13 = least preferred).

Métodos preferidos para la transferencia de conocimientos

(1 = el más preferido, 13 = el menos preferido)

Method	Overall	Benchmark
Veterinarians	1	4
Farming press	2	2
Demonstration farms	3	6
Consultants / advisors	4	3
Neighbours / other farmers	5	8
Farmer discussion groups	6	1
Training courses	7	9
Research papers / journals	8	7
Agricultural shows	9	10
Conferences	10	5
Internet	11	11
Salesmen / representatives	12	12
Television / media	13	13

The overall results highlight how farmers prefer personal contact, with advisers and other farmers for example, while the benchmark farmers do likewise but also favour farmer discussion groups and conferences. The farming press proved popular with both groups. It is significant that modern methods of communication – internet, television/media – do not yet seem to be an effective means of knowledge transfer.

Undoubtedly in the long term, a younger generation of computer literate farmers will embrace the internet, which *inter alia* is a treasure trove of agricultural information.

There has been a growth of innovative decision support systems on internet web sites. A good example is the web site, (www.gruenland-online.de) from southern Germany (Elsaesser and ThuMM, 2006). Essentially it is a large database designed for use by farmers and advisers, firstly to identify grassland sward types and then outline action necessary to improve or renovate them if necessary and secondly, to present the latest information and potential courses of action for different aspects of grassland management.

Another example is the use of a web site and the farming press to provide information on actual and predicted grass growth rates in Northern Ireland so that farmers can draw up future feed budgets aligned to animal requirements. This partially-farmer funded service, 'Grass Check', which reports actual grass growth rate and quality on a weekly basis, together with forward predictions for two weeks, has been in operation in Northern Ireland for three years, (web site www.ruralni.gov.uk/livestock/grass). Another similar concept from Denmark provides information on current grass growth

rates and forecasts predicted grass production for the following week, but the information is sent to livestock farmer's mobile phones (Søegaard, 2005).

ADVISORY SERVICE CHANGES

The impetus to creating independent organisations such as some of those described above, e.g., MDC, resulted from the funding cuts in official advisory services. Advice on government policies, legislation and inspectorial duties is largely officially funded as is agri-environment-type advice. However official advisory services were privatised in England and Wales and had to become commercially viable and charge for technical advice on farm production matters. In Scotland, the advisory service is still run by SAC but advice is chargeable. Levy bodies such as MDC and MLC, which receive some funding from government and the EU, also stepped into the advisory breach, hence their dissemination of technical publications for example.

Another independent advisory body is the nationwide 'Farming and Wildlife Advisory Group' (FWAG), (web site: www.fwag.org.uk), which is mainly funded by members' subscriptions. It provides practical advice to farmers on farm wildlife conservation and biodiversity, landscape enhancement, habitat creation, management and other conservation issues that integrate with good commercial farming practice. It also advises on various governmental agri-environment grant schemes. In a UK-wide network, it has 66 local groups and 120 farm conservation advisers and project officers.

Yet another independent advisory body, mainly funded by members' subscriptions, is

Linking Environment and Farming' (LEAF). It aims to help farmers improve their environment and business performance, and create a better public understanding of farming through a nationwide network of demonstration farms, (web site: www.leafuk.org). Its objectives are to encourage farmers to adopt integrated farm management (IFM), that is, having a whole farm policy for efficient profitable farming which is economically viable and environmentally responsible.

As is evident, the end result of the changes is that advice to farmers is available from a host of different sources, more so than before. Farmers are faced with an almost bewildering array of sources and clearly have to be highly selective otherwise they will suffer from information overload. It is now more difficult to have long term face-to-face personal relationships with the same advisers as when advice and farm visits were non-chargeable and official advisory services were the norm. The growth in special extension projects is noteworthy but while intensive during their implementation, they usually have a limited time span. There has also been a welcome rise in farmer participation in R & D, whether as co-partners in the planning as providers of on farm facilities, and as active participants in that their farms can be pilot or monitor farms to groups of farmers. Jiggins (2003) examined six 'transfer of technology' models and rightly concluded that no one model suited all circumstances, clients and policy goals. However, *inter alia*, she emphasized the "efficiency and effectiveness of participatory approaches that engendered partnership among researchers, advisers and farmers".

Inevitably, in this electronic age, the internet is increasingly being used by researchers and advisers to provide both general information and decision support models for specific areas of farm management. At the recent IGC, there was a session on 'Decision support for grassland systems' which highlighted a number of innovative models from different countries (O'Mara *et al.*, 2005b) Many more models are likely to emerge in the future. There has also been a change in the types of advice sought by farmers. Technical advice needs to be allied to economic realities and so farm business advice has attained a greater importance than hitherto when economic constraints were less arduous. In addition, agriculture has had to become multi-functional, that is, food production has to be supplemented by Society's demands such as improved nature conservation, landscape management, environmental protection and animal welfare; thus R & D and resultant advice has increasingly had to take account of these demands and adjust their activities accordingly.

CONCLUSIONS

Agriculture in Europe is undergoing rapid changes, fuelled by government policies, which in turn are responding to Society's demands. There is an obligation to produce food, but simultaneously with sustainable environmentally friendly methods of production, including pollution avoidance, enhancement of the landscape and wildlife conservation, and improved animal welfare. Those farmers who make use of the fruits of the scientific R&D and incorporate them into their farm practice gain a significant competitive edge over those who ignore scientific findings.

The role of official development farms or commercial demonstration farms has expanded and increasingly, are farmer-led or else their role is planned in conjunction with interacting researchers, advisers and farmers; this differs from the past where technology transfer was 'linear' from researcher to adviser to farmer. Farmer adoption of the technology hinges largely on the economic benefits any new technology can bring since some investment will be necessary. The speed of adoption will vary from rapid for a simple new technology seen to be profitable, to slower more complex technology, which may impact on other sectors of the farm.

The role that national and local societies can play should not be gainsaid. Their blend of members from diverse professions provides a forum for interchange of knowledge and ideas. Their publications, conferences and farm open days provide a rich source of technological advances and encourage their uptake in farm practice. Participatory involvement of farmers in R&D, whether at the planning stage or even in its execution is increasingly common and scientists no longer 'live and work alone in ivory towers'. Grant-aided research projects now invariably have to have a technology transfer component built in. While most of the examples of knowledge transfer in this paper are drawn from the UK, some innovative examples from other countries have also been noted. Brief mention is made of the IGC and the EGF whose conferences are mainly supported by researchers but it is contended that findings do filter back and become available to farmers by various means, particularly by reports and word of mouth.

There are many methods of technology transfer but some form of personal contact is the most effective while farmer discussion group meetings are the more efficient in terms of advisory input. These methods, together with the farming press were highly preferred methods highlighted in a survey but of course changes in advisory services, particularly the introduction of charging, in several countries have downsized the on-farm, face-to-face role of advisers. Interestingly, this being the electronic age, the internet and TV/media were the least preferred methods identified by the survey results shown in Table 1. Yet there has been a continuing growth in innovative decision support models and key information on the internet. It is foreseen that the younger upcoming generation

of farmers will embrace these types of knowledge transfer as computer literacy becomes increasingly common. The provision of advice to farmers has many strands and farmers have to be highly selective as to their sources, otherwise information overload will result.

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TRANSFERENCIA A LAS EXPLOTACIONES DE LOS RESULTADOS DE INVESTIGACIÓN

RESUMEN

Los resultados de investigación son un 'recurso' valioso cuando se adaptan y se utilizan en las explotaciones. Hay muchos métodos de transferencia de conocimientos y los agricultores deben escoger el que mejor se ajusta a sus circunstancias particulares. El contacto personal con asesores o consultores y el análisis e intercambio de información con agricultores amigos son, sin duda, los métodos más eficientes y preferidos. La palabra escrita, si se formula en un lenguaje sencillo y no científico, es también eficiente. Se prevé que los modelos de apoyo a la toma de decisiones a través de internet aumentarán en cuanto la nueva generación de jóvenes agricultores, formados en informática, tomen las riendas de las explotaciones. De hecho, internet representa una revolución en las comunicaciones. Sin embargo, el contacto personal (ahora caro) seguirá siendo el mejor modo asesoramiento a los agricultores, junto con grupos dirigidos de análisis e intercambio de información. Está aumentando el número de agricultores que participan, junto con asesores e investigadores, en demostraciones de sistemas mejorados de producción y manejo, tanto en fincas oficiales como en fincas piloto comerciales. Las sociedades del sector agrario, nacionales y locales, juegan un papel importante en la transferencia de resultados a través de sus reuniones, publicaciones e interacción de sus miembros, provenientes de diversas profesiones agrarias. Los institutos de investigación han tenido que incorporar un componente de transferencia de tecnología a sus proyectos de investigación financiados con dinero público. La agricultura se ha convertido en una actividad multifuncional, que ha tenido que integrarse en actividades no productivas, orientadas a

la mejora del medio ambiente o del paisaje, por ejemplo. Por ello, la investigación, el desarrollo y las actividades de transferencia de conocimientos han tenido que adaptarse a las nuevas circunstancias.

Palabras clave: Métodos de transferencia de tecnología, modelos de internet.