IAgrE Journal

Landwards

Volume 52 No. 3 Autumn 1997

Agriculture • Forestry • Environment • Amenity

SECRETARY/COMPANY SECRETARY

Institution of Agricultural Engineers

SECRETARY/ COMPANY SECRETARY

The Institution of Agricultural Engineers is the professional body for engineers in land-based industries. It was founded in 1938 and is a nominated body of the Engineering Council, a registered company and a registered charity. Its aim is to promote the profession and the interests and careers of its members.

The Institution is now seeking to appoint a Secretary/Company Secretary to coordinate and direct the activities of a small secretariat based at Silsoe in Bedfordshire. The appointee will be responsible for most aspects of running the Institution including relations with the Engineering Council, finance, membership, staffing, committees, education, and information technology. The appointee will also endeavour to raise the profile of the Institution both inside and outside the industry. A good communicator and marketer is therefore required.

The successful candidate will almost certainly have an engineering background, preferably from the agricultural sector. Ideally he or she will be registered with the Engineering Council as a Chartered or Incorporated Engineer.

Salary will be in the range £20,000 to £23,000 depending on experience and qualifications.

Further information can be obtained from the address below. Applications in the form of a letter plus a detailed CV should be sent to:

The President
Institution of Agricultural Engineers
West End Road
Silsoe
Bedford
MK45 4DU

Closing date: 16 October 1997

INSTITUTION OF **AGRICULTURAL ENGINEERS**

CPD the conference...

continuing professional development

focus on the issues
explore the benefits
share experiences
guidance & recommendations

'Competence & CPD-
The Business Benefits'

DTI Conference Centre, London
November 26th, 1997

Sponsored by the Engineering Council, DTI & Institution of Incorporated Executive Engineers

Programme and registration details from
CRAC, Sheraton House, Castle Park,
Cambridge CB3 0AX
☎ 01223 460277 Fax 01223 311708
E-mail enquiries@CRAC.org.uk
http://www.crac.org.uk/crac

engineering council IIEXE dti

Technical equipment for disabled people

REMAP is a registered charity of 1,500 professional engineers and medical experts based throughout the UK.

Each member - who belongs to one of the 100 panels - voluntarily helps disabled people of all ages to be more independent by making one-off technical aids which cannot be bought commercially.

Much of what REMAP does could be unique: even the national headquarters are run by a part-time paid staff of three.

All the gadgets are provided for use free of-charge: in 1996, engineers turned out £2 million of aids that money just can't buy. A single £25 donation will enable equipment worth more than £500 to be produced for those who need it.

Practically speaking, REMAP welcomes the involvement of engineers, working or retired, who can spare time to help.

Contact the National Organiser: Eur. Ing. J. J. Wright, CEng, MIMechE, Hazeldene, Ightham, Sevenoaks, Kent TN15 9AD. Tel: 01732 883818.

Landwards

The Journal for Professional Engineers in Agriculture, Forestry, Environment and Amenity

Editor

Eur Ing Prof Brian D Witney
PhD CEng FIMechE HonFIAgrE MemASAE

Advertising Manager
Prof Brian D Witney
LAND TECHNOLOGY LTD,
33 South Barnton Avenue,
Edinburgh, EH4 6AN
Tel/Fax: 0131 336 3129
Email: landtec@ednet.co.uk

Origination King Design
Printing Barr Printers Ltd

Price £12.00 per copy
subscription £45.00 (post free in UK)

Publisher
Landwards is published quarterly by:
Institution of Agricultural Engineers,
West End Road, Silsoe,
Bedford, MK45 4DU
Tel: 01525 861096
Fax: 01525 861660
Email:secretary@iagre.demon.co.uk
Web site at
http: //www.cranfield.ac.uk/safe/iagre/

President
Michael J Dwyer
BSc MSc PhD CEng FIMechE FIAgrE

Secretary
Michael H Hurst
BSc MBA CEng MIEE MIMgt

Contents

Volume 52 No 3, Autumn1997

Feature articles

News and comment

Front cover: *Power driven discs to cultivate brash covered land prior to re-planting with young trees (photo: Forest Enterprise)*

The views and opinions expressed in individual contributions are not those necessarily of the Institution or the Editor.
Landwards is compiled from information received by the Institution of Agricultural Engineers but no responsibility can be accepted by the governing Council, the Publishers or the Editor in respect of any errors or omissions. The Editor reserves the right to edit any material sent to the journal.
Material from this publication may be quoted or reported on condition that full credit is given to ***Landwards*** and to the author, and that the date of publication and volume number are stated. In the interest of factual reporting, reference to trade names and proprietary products may be inevitable. No endorsement of the named products or manufacturers is intended and no adverse criticism is implied of similar products which are not mentioned.

© THE INSTITUTION OF AGRICULTURAL ENGINEERS

ISSN 1363 8300

Energy farming?

Alastair G M Hunter and Eric C Todd

Wind turbines carefully sited on a farm in Cornwall.

Summary

Renewable energy is receiving widespread publicity because of premium contracts to supply electricity to the grid. Biomass, solar, hydro and wind energies are all accessible on farms and collectively represent a huge resource. An increasing number of farmers are contracted to supply straw and chicken litter to power stations, to rent land for wind and hydro projects, and soon to grow energy crops. Straw and wood fuels are widely used and cost-effective on farms, and there are numerous uses for wind generators. New income earned from wind energy could help to sustain farming and rural communities in less-favoured areas.

What is energy?

Making energy out of farm resources is not new: wood fuel, watermills, and windpumps are centuries old, and were once central to farming and rural activity. With modern technology, the same energy resources are staging a comeback and are now collectively called renewable energy. High oil prices first created interest in straw-fired boilers; vehicle exhaust pollution in city centres brought out the benefits of biodiesel; greenhouse gas emissions and acid rain from central power stations have again pushed renewables forward, as environmentally friendly alternatives to fossil fuels.

Power stations are running on chicken

Alastair Hunter FIAgrE is Renewable Energy Consultant, Resource Engineering Department and Eric Todd was formerly Rural Enterprise Consultant, Rural Resource Management Department, SAC Edinburgh. This paper was presented at the annual SAC Outlook for Agriculture Conference held in the Royal Highland Centre, Ingliston, near Edinburgh, Scotland, on 8 November 1995.

Table 1 Status in the UK of selected renewable energy technologies (Source: ETSU R82).

	Research & development	Demonstration projects	Commercially available
Hydro small-scale			>>>>>>>>>>>
Active solar			>>>>>
Onshore wind energy	>>	>>>>>>>>>>>>>>>	>>>>>
Photovotaics	>>>>	>>>>>>>>>>>>>>>>	
Agricultural and forestry wastes	>>>>	>>>>>>	
Energy crops	>>>>>>>>	>>>>>>	

litter, pig farms are powered by wind generators, and a dairy farm has been converted into a windfarm; biogas is produced by slurry digestion, and willow coppice or miscanthus may come to be grown on set-aside land. Opportunities for using farm resources to generate renewable energy are being publicised almost daily.

In the face of so much activity, it is worth considering renewable energy in relation to everyday farming. Will farmers at large become involved, or only a small number of pioneers; will the rural community feel any benefits; will the resources generate new income and perhaps help to sustain less-favoured areas?

This paper cannot answer all these questions but will aim to review some of the technologies briefly and put them in perspective, both from an energy point of view and a financial one. Opportunities for farmers will be presented in the context of the present UK market for renewable energy, with a future vision for the rural economy.

Table 2 Typical applications of wind energy on farms.

AC circuits	Hot water	Lighting
Grid supply	Heating	Electric fence
	Water pump	DC circuits
	Drainage pump	

The technologies

All the technologies are at different stages of development, *Table 1*: they will be described briefly.

Fuel from wood and wastes - willow coppice, forestry and woodland wastes, straw

Automatic feed boilers which burn woodchips fed from a hopper, and big bale straw boilers, are now highly efficient. At farm-scale, they may have heat outputs from 10 kW to 100 kW, and district heating boilers may have heat outputs of 10 MW; with a condensing flue, these can operate at 100% efficiency. Combined heat and power plant (CHP), and electricity power stations, can be designed to run entirely on wood and straw fuels using gasification technology; this is still at the pioneering stage but advancing rapidly. Stoves and boilers burning logs and other waste or low cost fuel are popular and well known, although relatively inefficient.

Transport fuels - biodiesel and bioethanol

Biodiesel produced from rape methyl ester (RME) can be run in conventional diesel engines with little or no modification; one hectare yields approximately enough fuel to run a tractor for a week. Bioethanol is produced by distillation from sugar beet or wheat and can be converted into a petrol blend.

Biogas - pig and cattle slurry

Biogas is produced from slurry by bacterial action in the process of anaerobic digestion. The resulting gas is rich in methane and can be used as a fuel for heat or to run a gas engine which in turn drives an electric generator; heat from the engine provides a secondary output, for a CHP system. Operating the digestion process at maximum efficiency also demands a supply of heat, and computerised control. The content of solids in the slurry is critical, so blending with other organic materials such as wastes from food processing factories is normal for centralised plant.

Waste fuel - poultry litter

Poultry litter is dry enough to be burned efficiently, either to heat the broiler house or to raise steam at a centralised power station. The plant at Eye in Suffolk has an electrical output of 13 MW and consumes 130,000 tonnes of poultry litter annually, a useful disposal method to overcome nitrate and odour problems; the ash is high in phosphate and potash.

Solar power - air heating, water heating, photovoltaics

Glasshouses are designed to capture maximum solar energy, requiring a minimum of supplementary heating in the sunny months, and the same principles are being incorporated into modern architecture. Solar barns are used in a number of countries in Europe to dry and store top quality hay. Active solar panels are a valuable means of supplementary water heating, and their efficiency is continually being improved. Photovoltaic panels convert solar energy directly into electricity: they are expensive but their cost is still falling. A demonstration dairy farm in Bavaria now runs entirely on solar electricity, and photovoltaic panels are often used at remote sites for low-power applications.

Hydro power

There is an abundance of sites in the UK with high rainfall and and a good head and flow of water, the essentials for hydro power. Water is powerful: microhydro systems are rated from 1 kW upwards, mini systems generate up to 100 kW, and sizes above this are still classed as small by hydro standards. An example of a new community development of hydro power is the Crofters' Trust project at Assynt in Sutherland which will have a rating of 230 kW. The equipment is thoroughly reliable, requires little maintenance, and has a long life. Small private hydro systems brought the first electricity supplies to many highland estates and villages.

Wind power

Modern wind turbines are efficient, highly developed and reliable. Capturing energy from the wind, they convert it directly into electricity and ratings vary from over 500 kW right down to only fifty watts. Depending on size and specification, wind electricity is suitable for a host of applications, both on the farm and connected to the electricity supply network, *Table 2*. At remote or off-mains sites, where there is no other supply, the cost of a wind system is often the lowest cost option. Combined systems take a number of forms: stand-alone wind generators have diesel or battery backup; wind/photovoltaics units are in use to supply communications units; hydro/wind generators have been installed on islands. Direct mechanical windpumps are also still available and effective.

The economics

With so many energy sources available, it is certainly confusing and perhaps a little puzzling why they have not had more of an impact on everyday farming. The economics can be considered from a simple financial point of view, to see how the technologies compare with each other and how they fit into the market-place, starting with the amount of energy produced.

Table 3 Estimates of annual electricity yield per hectare of land (MWh/ha).

Fuel/technology	Yield MWh/ha	Assumptions
Wind - single machine	130,000	Turbine 500 kW, wind speed 7 m/s, tower base 10 m x 10 m
Photovoltaics	1,100	Solar radiation 2.5 kWh/m²/d, conversion 15%
Wind - windfarm	860	As above, but spacing 390 m x 390 m per turbine (10 x rotor dia)
Wind coppice - high	33	Crop yield 21 odt/ha, calorific value 19 GJ/t, conversion 30%
Wind coppice - low	16	As above, but crop yield 10 odt/ha
Whole crop cereal	11	Crop yield 135 GJ/ha
Rape oil	4	Oil yield 50 GJ/ha

Note - Numerical conversion factor for one gigajoule: 1 GJ = 0.278 MWh

Energy yield

Several technologies will involve the use of land, land for growing energy crops and physical space for equipment. Land area can be used as a common basis for comparing energy outputs, looking at the theoretical yield from one hectare, *Table 3*. The yield from oilseed rape is very low, between one quarter and one eighth of the yield from willow coppice. Photovoltaic panels would generate one hundred times more electricity per year than is obtainable from a whole crop cereal harvest. Wind turbines generate electricity up to 120 times more intensively than photovoltaics. Needless to say, quite different types of land would be used to grow crops and to site wind turbines, but the energy comparison is still useful.

The average farm requires 21.7 MWh of electricity to supply the whole premises including the house for a year. To supply this amount of energy from one hectare of farm land, the yield would need to be 20 MWh/ha, ie similar to willow coppice. Thus, photovoltaics and wind systems are capable of supplying far in excess of a farm's electricity requirements, while it is impractical to think of whole crop cereals or oilseed rape being used for this purpose. Hydro systems are site-specific but frequently have the potential to generate ample energy supplies.

Prototype coppice harvester at Brahan Estate, Invernessshire.

Taking willow coppice as a benchmark, thirty-one tonnes of woodchips (wet weight) would convert into a farm's electricity requirements, or a similar quantity of wood from forest or woodland residues. Straw is much drier so only twenty-one tonnes would be required. Slurry, being mainly water, would require 289 tonnes to yield enough biogas for the same amount of electricity.

Generating Cost

For day to day use, the cost of harnessing renewable energy must be acceptable. Calculating the generating cost of electricity also helps to put all the technologies onto a common basis; this is the approach widely adopted by the renewables industry, reflecting the practice of the power generation industry. The cost of producing heat will be referred to later.

Generating cost is the annual cost of the system divided by the number of electricity units generated, annual cost being made up of capital interest payments, depreciation, operation and maintenance, fuel, etc. It is quite revealing to look at the prices paid per unit under NFFO, the Non-Fossil Fuel Order. This is the Government Order for England and Wales which encourages electricity generation from renewables by obliging Public Electricity Suppliers (PESs) to purchase electricity from certain projects at premium prices; the comparable Order for Scotland is known as the Scottish Renewables Order, SRO, and for Northern Ireland, NI-NFFO. The average prices awarded in 1994 under NFFO-3, the third round of the Order, are given in *Table 4*. Relative values for generating cost can be inferred from these prices, which include profit.

Most of the prices compare well with the retail price of electricity sold to farms,

Table 4 Electricity prices for technologies under NFFO-3 contracts (Source: REVIEW).

Technology	Price, p/kWh
Wind farm (over 8 wind turbines)	4.3
Wind (1-7 wind turbines)	5.3
Hydro	4.5
Straw, chicken litter, slurry	5.0
Woodchips	8.7

about 7 p/kWh, and it does appear that several technologies have arrived at the point where local generation may be profitable. Unfortunately, none of the technologies can hold the same generating costs when scaled right down to a size for supplying just the average farm: a five kilowatt stand-alone wind generator system might cost £17,500 to install and would generate electricity at 8.6 p/kWh; an on-farm anaerobic digester system might cost £65,000 to install and would generate electricity at 444 p/kWh

Heat systems

Heat systems are generally simpler than electricity systems, and always more efficient for converting biomass energy into a useful form, but heat is lower grade energy than electricity and less versatile so it is less expensive to supply from conventional fuels. Very approximately, three times more units of heat than electricity are available from fuels, and therefore heat is one third the price.

Straw boilers consume low cost fuel: the price of straw may be as high as £25 per tonne but the annual requirement for a farmhouse is thirteen tonnes or less, so the annual fuel cost will only be £325 at a maximum. Depending on the price of straw, this gives a fuel cost between 0.1 and 0.8 p/kWh compared with 2.3 p/kWh for oil. Straw boilers are competitive with conventional systems on the basis of fuel alone, and they are still competitive after accounting for capital charges, depreciation, and maintenance, being able to supply heat at less than 2.8 p/kWh; the figures for wood boilers are similar.

In practice, labour is required for stoking which may be costly and inconvenient, and the initial outlay is higher for alternative systems than conventional ones, regardless of low fuel costs. This is most apparent with wind heating systems where the fuel is entirely free but the capital outlay of £5,000 upwards brings the heating cost to 2.8 p/kWh as a minimum, not a maximum.

The future

Problems

At farm scale, renewable energy equipment is normally more costly to buy and install than the conventional mass-produced option. Biomass fuels are very variable in quality, while solar, hydro and wind energies are variable in quantity although quite predictable over extended periods. On a farm, the financial benefit of using renewable fuels is limited to cutting the cost of existing energy supplies, which average £3,104 for electricity per year on dairy farms and £971 on hill farms, and £800 for heating per year; there is only a small minority of users with annual electricity bills exceeding £9,000. It is doubtful whether the majority of farmers will wish to get involved in providing their own energy supplies, although it will always be worthwhile for some. Annual energy demands are given in *Table 5*.

Table 5 Mean annual energy demand on Scottish farms (Source: Graham and Owen).

Farm type	Electricity, MWh		Heating oil, MWh	
	Per farm	All farms	Per farm	All farms
Hill	14	0.13×10^6	46	0.41×10^6
Arable	26	0.11×10^6	65	0.27×10^6
Dairy	44	0.11×10^6	71	0.18×10^6

Note: Farmhouse included in these figures

At a centralised scale, viable contracts still depend on government stimulus even though the worldwide equipment market is growing and costs are falling. The number of NFFO and SRO contracts is relatively small and the competitive bidding process disposes of a much larger number of prospective projects. Development companies are the main bidders rather than individual farmers. The opportunity cost of dedicating land to grow energy crops over a fifteen year contract period may prove a strong disincentive to farmers. Electricity can be sold to an electricity company outside a NFFO/SRO contract but the price received may be as low as 1.3 p/kWh.

Opportunities

The immediate financial opportunities for supplying energy from renewable sources are:

i. to provide the most cost-effective option at remote and isolated sites,
ii. to provide a lower cost alternative to existing supplies on the farm,
iii. to become involved in a NFFO/SRO contract, and
iv. to become involved in other local initiatives.

The first of these has always provided niche opportunities for renewables and will continue. The second is opening up more widely as technology advances and as relative costs change; for example, metered water charges now run at 50 p per cubic metre of water, while a windmill pumping water from a borehole may cost as little as 1 p at some sites and is worth considering. The third opportunity has already become a reality: rent is paid for siting wind turbines on farm land, and for access to hydro sites; straw and chicken litter are purchased from farms, and contracts are being negotiated for growing and supplying willow coppice. The fourth includes pilot projects, for example, the energy system at Tweed Horizons, the Sustainable Technology Centre at St Boswells, Borders Region.

The next significant change will arrive in 1998 when the UK energy market becomes fully deregulated; it will then be possible to generate electricity for sale under licence to any customer or group of customers. Initially, this may have little impact on farming except for a wider choice of electricity suppliers with competitive prices. In the longer term, individual farmers, farmer cooperatives, and machinery rings may start to generate and sell electricity at a profit. Already, work is in progress to find mechanisms for this trading, funded by UK and EC programmes.

The vision

Trading in electricity is selling energy beyond the farm gate, in other words "energy farming". As a form of diversification, it is perhaps more unusual than growing and selling an energy crop such as arable coppice, but it is a potentially attractive way of turning resources into income, especially because of the high value of electricity. The practicable resource which can be converted into electricity in the UK, using only renewable

resources available on the land, is huge - energy crops 89 TWh, wind 32.5 TWh, hydro 8 TWh, agricultural and forestry wastes 5 TWh. The total of these figures, 124.5 TWh, is thirty-two times the electricity consumption in UK agriculture, and forty-four percent of the entire UK electricity consumption. While only a small fraction of this total will actually be realised in the near future, it is also true that farming processes will make the principal contribution to this new energy industry.

Wind energy is by far the largest of the resources that actually exist in the UK; it is about one half of the entire European wind resource. High average wind speeds greatly improve the economics of using wind turbines, and are found predominantly in less-favoured areas (LFAs). This suggests a possible route to generating income in LFAs, helping to sustain their farming and rural communities. A single 500 kW wind turbine generates between £90,000 and £150,000 of electricity a year, at 7 p/kWh, depending on the average wind speeds at the site. If there was the equivalent of just one of these machines for every 1,000 farms in the UK, they would generate a total exceeding £25 million new income within the rural economy, each and every year.

Conclusions

1. Renewable energy is staging a comeback with modern technology, driven by environmental concerns. Biomass, solar, hydro and wind resources are accessible on farms and are already being converted into electricity and heat at a centralised scale and at farm scale.
2. The intensity of electricity yield from farm resources varies widely, according to the resource. Crops and organic wastes are low yielding, while photovoltaic and wind systems are high yielding; hydro systems can be very powerful, even at farm scale.
3. The cost of generating electricity from farm resources is falling: for wind, hydro, and farm waste technologies it is now below 7 p/kWh, which is the typical price of farm electricity supplies. Generating electricity solely for farm use is not cost-effective because of the small operating scale, except at remote and isolated sites where mains supplies may be even more expensive. Providing heat for the farm is an efficient use of straw and wood fuel; it is competitive with using other fuels.
4. The potential for cutting energy costs by using renewables on farms is relatively small except for intensive energy users. The main initiatives at present are led by NFFO and SRO contracts to supply electricity to the grid. Increasingly, this will involve farmers whose land is rented or who are contracted to supply biomass fuels.
5. The estimated energy resource available from farming is huge, dominated by wind energy at present but projected to be overtaken by energy crops in the future. The wind resource in LFAs is so large that it presents a major opportunity for generating new income to help sustain farming and rural communities in these areas.

Acknowledgements

The material for this paper was drawn from studies funded by the Scottish Office Agriculture Environment and Fisheries Department, the Department of Trade and Industry, and the European Commission.

References

Graham R, Owen G M (1994). A farm energy survey. Dep. Note 70, Scott. Centre agric. Engng, SAC, Penicuik.

REVIEW Supplement (1995). NFFO-3/SRO-1 Results Announced. Renewable Energy Enquiries Bureau, ETSU, Harwell, Oxon, OX11 0RA.

ETSU (1994) An Assessment of Renewable Energy for the UK. ETSU R82, HMSO, London.

Safety Alert: LP gas for grain drying

A recent incident, described as a 'near miss', has raised concerns about the risk of a possible serious accident involving the use of liquefied petroleum gas (LP gas) for grain drying.

The incident occurred when a farmer decided to relocate a small bulk propane gas tank which was being used to fuel a grain dryer. The vessel, which still contained a quantity of propane, was severely damaged while being moved. Fortunately, there was no escape of gas and a serious incident was avoided.

The LP Gas Association says that all too often it gets reports of farmers moving propane storage vessels with unsuitable farm equipment such as fork lift trucks or dumper trucks, with the very real risk of an accident and the subsequent release of extremely flammable gas. The Association stresses that gas storage vessels should *only* be moved by the LP gas supplier or in a manner approved by the supplier.

LP gas is a very efficient and convenient fuel for grain drying and its use is widespread. The LP Gas Association has issued a Technical Memorandum (TM46: *Bulk LPG Installations for Grain Dryers)* which covers the safety aspects for the use of LP gas with both fixed and mobile dryers.

For copies of Technical Memorandum No. 46 or for further information, contact: **LP Gas Association, Alma House, Alma Road, Reigate, Surrey, RH2 OAZ. Tel: 01737-224700.**

National Sprayer Test Scheme comes to UK

The AEA, whose members include UK manufacturers and principal importers of agricultural sprayers, launched a voluntary, national sprayer test scheme at "Sprays and Sprayers" on 24 June for new and used machines. "We see this as a major initiative to sustain public confidence in British produce and crop protection practice", said John Castell (Lurmark Ltd), Chairman of the AEA Chemical Applications Committee. "Farmers, environmentalists, retailers and consumers will all benefit from improvements to traceability, reliability, improved maintenance and quality control."

The aim is to establish 20 test stations in the first year and to conduct 500 tests, on farms or at test centres, so providing the foundation for a faster expansion in the following, years. The test stations are affiliate members of the AEA, individually trained and examined by the Association. Set-up costs for the AEA Sprayer Test Scheme are being met by the Association and this will provide the scheme's administration and database, as well as the initial services of John Handbury of Mid Tech Europe who will vet the test stations and train the testers.

The scheme will provide not only a standardised test, but a national register of machines performing to that standard. Two distinctive decals, for new and used machines respectively, will indicate the sprayer's compliance. The tests are valid for two years.

The AEA voluntary test is endorsed by MAFF, HSE, BCPC, BAA and NFU.

For further details, contact: **R F Saunders, Technical Director, AEA, Samuelson House, Paxton Road, Orton Centre, Peterborough, PE2 5LT. Tel: 01733 371381.**

First AEA approved sprayer test centre

H L Hutchinson, East Anglia's leading agricultural distributor and agronomist company, has been named as the first AEA approved sprayer test centre, based at its machinery operation in Wisbech, Cambs.

'The AEA's national sprayer test initiative is a voluntary scheme which encourages owners of sprayers to put their machines through the equivalent of a regular MOT. We launched our Sprayercheck service last year, based on the AEA's protocol, and it has to date been used by many farmers in East Anglia,' commented David Hutchinson, Managing Director of H L Hutchinson. 'Being approved as the first test centre fully endorses our philosophy of providing a practically based service to our customers.'

'We believe sprayer tests will become an increasingly important aspect of the quality control of food production, particularly in response to ICM protocols. This national test scheme will enable equipment to perform consistently to the highest standards, so providing benefits to both farmers and their customers, and ultimately to consumers,' he added.

Contact: **Steve McCracken, H L Hutchinson Ltd, Weasenham Lane, Wisbech, Cambridgeshire, PE13 2RN. Tel: 01945 461177.**

Re-launch of the Certificate of Competence in the use of Pesticides

National Proficiency Tests Council (NPTC), the nationally recognized awarding body for pesticides, is relaunching its Pesticides Award. The Award, which has been running since 1987 has issued almost 100,000 Certificates of Competence to date.

The Award is primarily aimed at anyone who uses pesticide products approved for use in agriculture, horticulture (including amenity horticulture) and forestry. Some pesticides are also used outside these industries for example public utilities, green keepers and local government contractors. NPTC's Pesticides Award is a recognised Certificate of Competence for the purpose of Conditions 6 and 7 of the "consent to use pesticides" given by Ministers on the 6th October 1986 in exercise of the power in the Control of Pesticides Regulations 1986.

Certificates of Competence are issued to successful candidates who pass an assessment carried out by an approved NPTC or Scottish Skills Testing Service Assessor. Application forms are only available through the County Proficiency Tests Committees.

The revised Pesticides Scheme certificate is issued in two forms, one a printed paper certificate and the other a plastic ID card certificate, upon the successful completion of any module from PA2A to PA12. The new ID card is designed to aid detection of fraudulence out in the field and incorporates a signature strip and a photograph of the certificate holder. The card is credit card sized and multi-laminated to reduce the chance of forgery. This is NPTC's second Award to incorporate an ID card, the first being for the Certificate of Competence in Chain Saw and Related Operations, launched in September 1996.

The new scheme will commence on 1 September 1997, and is expected to prove even more successful than its predecessor.

Contact: **Julie Marsden, National Proficiency Tests Council, Avenue J, National Agricultural Centre, Stoneleigh, Kenilworth, Warwickshire CV8 2LG. Tel: 01203 696553.**

Improving the effectiveness of tertiary systems

Part II - Water supply, delivery and drainage

Erroll D Coles

Introduction

Two procedures may be used to supply water to a tertiary system and to reticulate water through it, either continuous supply or rotational supply.

If the supply of water from the main conveyance system is reliable and seldom falls below 75% of the full discharge, the procedure for continuous supply may be considered. The continuous supply to a tertiary/quaternary system has the advantage of requiring less management input but, for the system to work satisfactorily, larger canals and the greater number of proportional divisional controls are needed, thereby increasing the cost of the system. On the other hand, a simple single tertiary gate outlet leads to a head-ender/tail-ender conflict situation.

The water supply for most irrigation schemes is seldom available within the 75% limit and rotational water delivery is necessary. Where the main water supply fluctuates seasonally, then the rotational supply is preferred. The advantages of using a rotational water delivery procedure are:

- allowing earlier land preparation and planting with diminished water supplies early in the season;
- the lower cost of smaller canals and structures;
- greater flexibility in distributing available water supplies to each quaternary unit.

These three factors add up the economy of distributing water, more efficient water use and more flexible management of water.

Tertiary and quaternary canals are usually unlined earth canals and specific design considerations are required to prevent scouring and siltation of the canals. During the rainy season, irrigation water usually carries heavy sediment loads and channel velocities should be limited to 0.2 m/s to prevent deposition.

Where erosive soils are encountered, the Critical Tractive Force principle and appropriate Froude numbers (Lane, 1955) is the recommended procedure for canal design. Canal linings are used where the canals traverse unstable soils and filled sections, broken rock and gravel or where two canals run close to each other.

Although simple inexpensive gated outlets are often used, they are not satisfactory for regulating or measuring the supply of water. Proportional division boxes (PDB) are preferred for regulating water supplied to the quaternary units. Where the water supply seldom falls below $Q \geq 0.50\ Q_m$, ungated PDB boxes can be used but at lower discharges flap gates are required.

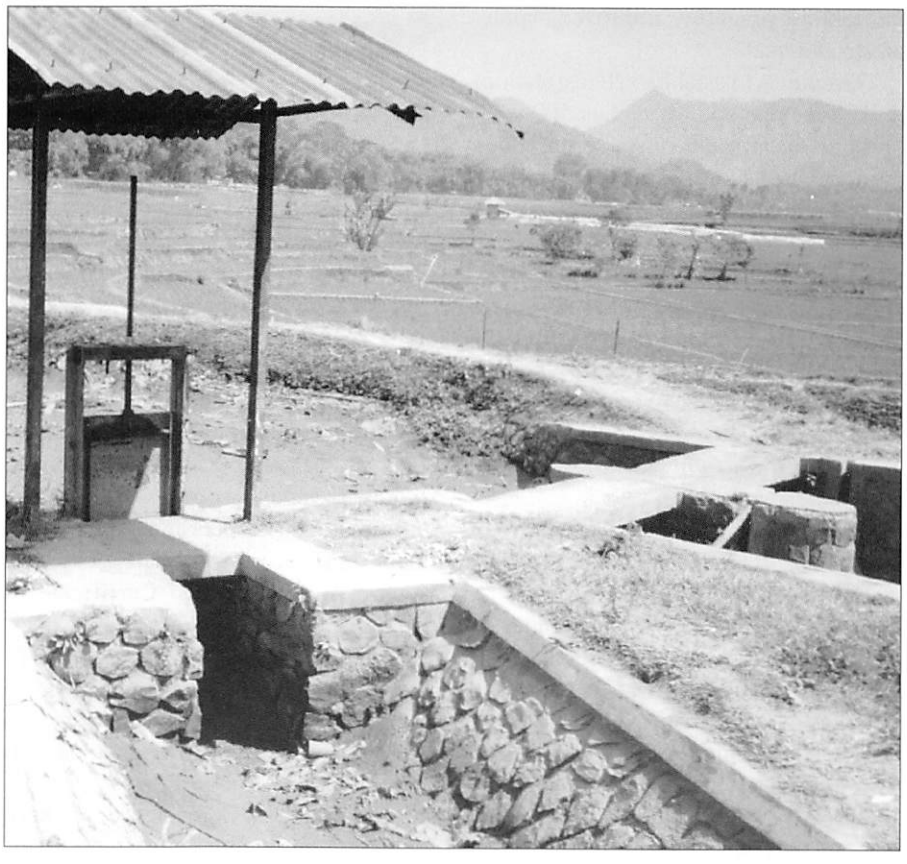


Fig. 1 The simple lift gate in the foreground controls the discharge into a quaternary canal. The structure to the right of the gated outlet is a stop-log regulator used to raise the water level in the tertiary canal so that water can be discharged through the gates. West Java.

Erroll Coles FIAgrE is an Irrigation Engineer with Coode Blizard Ltd working on an irrigation project in the Wadi Hadhramaut, Yemen. Part I of his paper was published in the previous issue of Landwards.

Drains are used to remove surplus rainfall and irrigation water. The yield of most rice varieties is reduced by submergence for periods exceeding three days. The drainage system must therefore be designed to drain off the surplus water within three days to a permissible depth of 100 mm. The procedure described in *Section 4* is widely used for designing the modular discharge for drainage channels.

2. Continuous and rotational water control

2.1 Continuous water supply

Continuous supply means that a constant and an uninterrupted supply water is diverted to the tertiary unit. One of the advantages of continuous supply is that a minimum of management intervention is required except for opening and closing the tertiary turnout at the appropriates times. Where the tertiary unit is divided into quaternary units and proportional division boxes are used, an equitable supply of water can be delivered to each group of farmers with a single control gate.

Continuous supply can only be operated effectively if the main conveyance system supply seldom falls below some minimum level, usually 70% of the main supply discharge.

If the tertiary area is not divided into quaternary units which is rarely the case, no control below the turnout leads to a 'grab-all' by the top-end farmers and the farmers further downstream will receive little or no water.

2.2 Elements of rotation design

Two parameters are required for the design of rotation water delivery, the discharge, Q, and time, T, based on the assumption that the volume to be supplied in a given time is proportional to the area (tertiary unit area or the quaternary unit area in either case), that is $Q\,T \propto A$. The time is a multiple of what is called the 'control interval'.

The control interval varies from infinity for continuous supply systems to 0.25 hours for very sophisticated rotation systems. For better managed systems, however, the 0.25 day, or six hours, is the best control interval and variable time rotations, when used, should be in multiples of six hours. Generally, night irrigation should be avoided if possible.

Implementing equal times of rotation, or ETR, is not possible unless the areas of the sub-units are equal or at least nearly equal, since:

$QT = kA$

For a given Q, T cannot be constant when the areas are of different sizes because:

$T = k\,A/Q$

where,

k = constant coefficient of proportionality

T = control interval, hours or days (or the water supply duration)

Q = discharge, *l*/s

When a tertiary unit area, A, is divided into four quaternary units, a_1, a_2, a_3, and a_4, there will be T_n time periods,

$T_n = T_1, T_2, T_3$ or T_4

$$T_1 = k(a_2 + a_3 + a_4)/Q = k(A - a_1)/Q$$
$$T_2 = k(a_3 + a_4 + a_1)/Q = k(A - a_2)/Q$$
$$T_3 = k(a_4 + a_1 + a_2)/Q = k(A - a_3)/Q$$
$$T_4 = k(a_1 + a_2 + a_3)/Q = k(A - a_4)/Q$$

$$\therefore T_n = k(A - a_n)/Q$$

$$\therefore \Sigma_1^4 T_n = T = k\,\Sigma_1^4(A - a_n)/Q$$
$$= k\,A(n - 1)/Q$$
$$\therefore k = T\,Q/[A(n - 1)]$$

Eliminating k above, T_n can be expressed in a general equation of the form below, where n is an even number of sub-units:

$$T_n = T(A - a_n)/[A(n - 1)]$$

2.3 Rotational water supply

Rotational supply depends on the proportion of the design discharge, Q_m, diverted through the tertiary turnout into the tertiary canal, for example,

* continuous irrigation is possible if the supply is more than, or equal to 75% Q_m,
* rotation between more than two quaternary units if Q_m is less than 75% but more than, or equal to 50%,
* rotation between pairs of quaternary units if Q_m is less than 50% but more than, or equal to 25%,
* rotation between single quaternary units is necessary if Q_m is below 25%.

2.4 An example of rotational design

The application of the procedure is best described by an example. The net area of the tertiary unit is 165.6 ha which is divided into four quaternary units with areas:

$a_1 = 39.4$ ha, $a_2 = 51.2$ ha, $a_3 = 39.6$ ha, $a_4 = 35.4$ ha.

The PWR is 1.4 *l*/s ha and the design discharge capacity, Q_m, for 165.6 ha x 1.4 = 231.8 *l*/s. The duration of the irrigation cycle is 14 days or 336 hours, divided into four sub-cycles of approximately equal times.

The design is based on the following assumptions.

a) The rotations are based on proportional distribution.

b) For $Q \geq 0.75\,Q_m$, continuous distribution can take place, otherwise rotation distribution must be used.

c) For $0.75\,Q_m > Q \geq 0.50\,Q_m$, three units are irrigated simultaneously, namely: a_2, a_3 and a_4 (a_1 is not irrigated); a_3, a_4 and a_1; a_4, a_1 and a_2; then a_1, a_2 and a_3; and so on. The duration of the water supply cycle for the four units is 14 days or 336 hours. The rotation time for each cycle is calculated using the equation T_n given in 6.2 above.

First rotation, $a_2 + a_3 + a_4 =$ 126.2 ha
Water supply duration = (126.2/165.6) x (336/3)
= 85.4 hours, use 85 hours.

Second rotation, $a_3 + a_4 + a_1 =$ 114.4 ha
Water supply duration = (114.4/165.6) x (336/3)
= 77.4 hours, use 78 hours.

Third rotation, $a_4 + a_1 + a_2 =$ 126.0 ha
Water supply duration = (126.0/165.6) x (336/3)
= 85.2 hours, use 85 hours.

Fourth rotation, $a_1 + a_2 + a_3 =$ 130.2 ha
Water supply duration = (130.3/165.6) x (339/3)
= 87.8 hours, use 88 hours.

This procedure is repeated for successive conditions where smaller discharges of Q are supplied to each quaternary unit, the durations for each water supply situation being calculated in a similar way.

d) For $0.5\,Q_m > Q \geq 0.25\,Q_m$, two sub-units are irrigated and two not irrigated, the cycle time being reduced to seven days or 168 hours for both pairs of sub-units.

e) For $Q < 0.25\,Q_m$, one sub-unit is irrigated and three sub-

units are not, the cycle time being seven days or 168 hours.

In order to do the rotations in the time prescribed for the water supply duration calculated above, the capacity of the system must be adequate. The canal capacity is based on the largest DDC, e.g. 70 *l*/s. For the design discharge capacity of 1.4 *l*/s ha, the system capacities are calculated as follows.

Sub-unit, a_1, 39.4 x 1.4 = 55.1 *l*/s
Sub-unit, a_2, 51.2 x 1.4 = 71.7 *l*/s
Sub-unit, a_3, 39.6 x 1.4 = 55.4 *l*/s
Sub-unit, a_4, 35.4 x 1.4 = 49.6 *l*/s
Total $Q_m > 75\%$ = 231.8 *l*/s

Fig. 2 The notice board mounted next to the gate provides details of the respective quaternary unit rotation, and other relevant tertiary system data. West Java.

The capacity for each group of quaternary units for $Q < 0.75\ Q_m$ in the rotation are calculated as follows.

For a discharge capacity of $0.75\ Q_m > Q \geq 0.5\ Q_m$

$Q = 0.75\ Q_m = 0.75 \times 231.8 = 173.9$ *l*/s

The discharge, Q_n, for each unit is,

Rotation 1.
a_2: $Q_{a2} = (51.2/126.2) \times 173.9 = 70.7$ *l*/s
a_3: $Q_{a3} = (39.6/126.2) \times 173.9 = 54.6$ *l*/s
a_4: $Q_{a4} = (35.4/126.2) \times 173.9 = 48.8$ *l*/s

Rotation 2.
a_3: $Q_{a3} = (52.2/130.2) \times 173.9 = 68.3$ *l*/s
a_4: $Q_{a4} = (39.7/130.2) \times 173.9 = 52.9$ *l*/s
a_1: $Q_{a1} = (39.4/130.2) \times 173.9 = 52.6$ *l*/s

The calculations are repeated for Rotation 3 (a_4, a_1 and a_2) and for Rotation 4 (a_1, a_2 and a_3).

For the rotation time for $0.5\ Q_m > Q \geq 0.25\ Q_m$, the cycle time is reduced to 7 days or 168 hours and two quaternary units are supplied simultaneously, that is ($a_1 + a_3$) and then ($a_2 + a_4$).

When $Q < 0.25\ Q_m$, then a 7 day cycle is used and a single unit is supplied with water in turn for the calculated duration.

2.5 Rotational design capacity

The largest discharge - 71 *l*/s in the example above - for each of the rotation calculations is used as the design capacity for the respective canals and structures, thereby allowing the maximum quantity of water to pass down the canals and through the control structures.

Alternatively, the method described in *Part I, Section 5.8*, which may give slightly greater discharges, may be used in place of the maximum rotational discharge. This is the Designer's decision depending on economic factors and site conditions.

3. Tertiary and quaternary canals

The design of tertiary and quaternary canals comprises the alignment plan, the longitudinal profiles and the cross sections. The canal alignments are either surveyed or taken off the tertiary unit layout plan. The longitudinal profiles and cross sections are plotted for all the canals in the unit.

Most tertiary and quaternary canals are unlined earth channels. Canals passing through porous soils and broken rock are lined with concrete and parallel canals are lined to prevent the canals merging.

Canals are usually designed using the Manning's equation, also called the Strickler equation *(Table 1)*. For canals constructed in erodible alluvial soil, the Lacey Regime procedure (Lacey, 1946) is sometimes used but the canal section tends to be too wide and shallow. The small stable earthen channel can be designed using the **Critical Tractive Force** principle and maintaining the flow conditions for Froude numbers for cohesive and non-cohesive soils (Lane, 1955).

3.1 Tertiary and quaternary canal water levels

The water level in the main canals system should be sufficient to maintain the head over the tertiary offtake to divert the required design discharge capacity for 75 - 100% of Q_m. This will depend on the water level in the main canals and some kind of device may be used to maintain the head over the outlet.

Table 1 Tertiary, sub-tertiary and quaternary canal design criteria

Parameters	Tertiary canals	Sub-tertiary canals	Quaternary canals
Maximum velocity, m/s	0.5	0.5	0.3
Minimum velocity, m/s	0.2	0.2	0.2
k value*	35	30	30
Min. bottom width, m	0.3	0.3	0.2
Side slope	1:1	1:1	1:1
Minimum crest width, m	0.75	0.5	0.3
Minimum freeboard, m	0.3	0.3	0.3

* k = 1/n, where n = Manning's coefficient of roughness

Furthermore, there should be sufficient head differential between the tertiary outlet and the highest or critical level in the fields of the tertiary unit. If insufficient head exists, such as in very flat areas, backwater conditions may develop and affect the tertiary turnout. This difficulty maybe overcome by maintaining Q_m near to 100% in the main canals, by carefully regulating the discharge below the offtake and assuring that the farm outlets are of sufficient capacity. This difficulty must be anticipated during the design phase and the takeoff and canals aligned to provide enough head. Larger canals may be needed.

The head differential can be determined as follows:

$$P = A + a + b + c + d + e + f + g + h + z$$

where,

P = water level at the secondary canal upstream of the tertiary

outlet
A = highest ground level in a padi field in the tertiary unit
a = water level in the padi fields, about 100 mm
b = head losses in quaternary canals to padi fields, 100 mm
c = head losses in the quaternary division boxes, 50 mm per box
d = head losses in tertiary and quaternary canals, mm
e = head losses in tertiary division boxes, 100 mm per box
f = head losses in culverts, 100 mm per culvert
g = head losses in measuring devices, usually 0.33H, mm, where H is the head immediately upstream from the measuring device
h = variations in water level in secondary canal, 0.12 of design head, mm
z = head losses in other structures, mm.

The hydraulic design of all irrigation works should start at the tail end of the system and proceed up the head of the system. This applies to the tertiary system accounting for the head losses starts at the field level.

Specific attention should be given limiting the head losses between the quaternary canal and the padi fields, the field turnout should have sufficient capacity to pass at least 30 *l*/s.

3.2 Canal design capacity

The design discharge, Q_m, of tertiary turnout has been explained above. The capacity of the sub-tertiary canals is based on the number of quaternary units supplied, generally the capacity is in multiplies of 50 *l*/s. However, the minimum capacity of a quaternary canal is set at 45 *l*/s unless the areas are very small, when the capacity should not be less than 30 *l*/s. This is the optimum stream size, allowing two farmers to irrigate simultaneously.

A flow of at least 15 *l*/s is delivered to each farm unit, while water is supplied rotationally to the farm units from the quaternary canal. Very simple turnouts to the farms are used, and these may consist of two or three bamboo joints placed in the canal bank. On some projects, plastic syphon pipes have been used but such sophistication has tended to be discounted by the farmers.

4. Drain design criteria

For the effective management of a tertiary unit, a properly designed drainage system is necessary to remove excess water resulting from heavy rainfall, flooding and from surplus irrigation water. The drainage system consists of a network of drainage canals in the tertiary unit discharging into a secondary drain which in turn flows into the main drain.

The amount of excess water to be drained off per unit area is determined by the following parameters:

- the rainfall during a specific period,
- the irrigation water delivered,
- the crop water requirement,
- deep percolation,
- surface storage in the padis,
- size of the catchment area,
- size of any depressions in the unit,
- external sources of floodwater.

These parameters are defined in *Section 4.1* and used to calculate the **Drainage Modulus** expressed as a discharge per unit for a specific time period to drain off the surplus water.

The tertiary drains should have sufficient capacity to drain off surplus irrigation water. The capacity of the drains be able to convey between 70% and 100% of Q_m. The capacity of the larger drains should based on the aggregate of the lesser drains.

All tertiary and quaternary canals should discharge into a drain through an end structure such as a drop chute and proper scouring prevention should be provided.

The design of the drainage channel follows the same procedure for other canals, bearing in mind that drains do not have a berm on the up-slope, thus allowing water to flow off the land into the drain. Usually, a narrow grassed strip is established between the lower padi field and the drain to reduce soil being washed into the drain.

The drain channel should be designed to allow water to drain off the lowest padi by keeping the water level below the 'normal' ground level, and to minimise maintenance and construction costs by limiting flow velocities thus preventing bed erosion and subsequently depositing sediment.

4.1 Drain channel design

Excess water in the tertiary unit resulting from canal spillage and heavy rainfall is drained off to prevent submergence of the crop which will reduction the yield. The capacity of the drainage system is economically justified by comparing the expected yield reduction resulting from submergence to the cost of construction and maintenance of a drainage system.

Traditional rice varieties can tolerate greater depths of submergence for longer periods while modern high yield varieties are more sensitive submergence for shorter periods (De Datta *et al.*, 1972). Most rice plants are susceptible at different growing stages, particularly at the transplanting, tillering and panicle initiation stages. The yield of plants submerged to half their height for seven days or more will be considerably reduced and yield of plants completely submerged for longer than three days will be nothing. Submergence will destroy the field crop.

i. *Submergence* - The normal water depth in the padi is 100 mm, varying from 50 to 150 mm but depths greater than 150 to 200 mm for a duration of more than three days will decrease rice yields significantly (van de Goor, 1973).
ii. *Drainage modulus* - The drainage modulus, or drainage coefficient, is calculated based on the recurring daily rainfall $R_{n,T}$, for return periods of 2 or 5 years, irrigation water applied is in mm/day, the crop water requirement is in mm/day, percolation in mm/day. The storage differential or the difference between the normal padi waterlayer depth and the allowable depth of submergence in mm/day, S_n. The area of depressions as a percentage of the total area A. The number of consecutive days on which rain is anticipated is n.

Various methods using similar equations can be applied but this equation is suitable for irrigation drainage systems:

$$D_n = (R_{n,T} - A\,S_n)/(8.64\,n)$$

For example, assuming the recurring rainfall R_n = 140 mm over n = 2 days, A = 1 and S_n = 50 mm storage, the drainage modulus will be D_n = 5.3 litres per second per ha per day.

4.2 Drainage channels

The criteria for the design of drains are based on the relative capacity derived from the area to be drained of surplus water. The design drainage module in *Table 2* is related to the size of

Table 2 Surface drain channel capacity.

Drainage area, ha	Design drainage module *, l/s ha	Drain capacity l/s
<20	7.5	<120
20 to 120	6	120 to 720
>120	5	600

* The design drainage module is described above

the area. The channel design parameters in *Table 3* may be used as guidelines for designing drains.

5. Tertiary and quaternary water division structures

In order to divide irrigation water between the respective sub-divisions of the tertiary unit, division boxes are installed between the sub-tertiary canals and the quaternary canals. These division boxes should be designed to suit the water management practices current in the locality.

Wherever possible, division boxes and other water control structures should be designed to be safe from damage or intervention by unauthorised persons. Farmers will damage and destroy any structure they believe interferes with their rightful supply of water. Consequently, the co-operation of the farmers should always be obtained when designing layouts and control structures so that the farmers understand the purpose and use of these structures.

5.1 Proportional division boxes

Proportional division of water can be obtained by constructing the width of the openings in proportion to the size of the area receiving water. These structures have a control section with a horizontal sill, vertical sidewalls and vertical upstream and downstream sill faces.

The discharge depends on the upstream head, the breadth, width of the (weir) sill and the height of the sill above the invert level. The characteristics of the openings distinguish the type of weir and the discharge, either sharp crested, short crested, or broad crested weirs (Bos, 1978). The discharge is usually calculated using the Francis or the Kindswater and Carter equations.

To supply water rotationally, the tertiary or sub-tertiary boxes need to be fitted with gates. On the tertiary canal division box, a gate is used to divert the water into one or the other sub-tertiary branch canals. Simple adjustable slide gates are widely used for this purpose.

Flap gates are used to control the flow for rotational supplies on the quaternary division boxes. Various gate arrangements are used and many elaborated kinds of control structures have been tried but they all have serious deficiencies. A simple and effective gate arrangement consists of a set of four flap gates corresponding to the relative discharges for each rotation period.

The flap gates overlap each other and can only be opened in sequence, for example, with all the gates open continuous discharge takes place when $Q \geq 0.75\ Q_m$. With three gates open, $0.75\ Q_m > Q \geq 0.5\ Q_m$. With two gates open, $0.5\ Q_m > Q \geq 0.25\ Q_m$, and with one gate open, $Q < 0.25\ Q_m$. The breadth of each flap gate is related to the relative proportional discharge for each rotation.

Weir type division or control structures should be designed so that the flow over the weir sills is **modular**, that is the discharge is independent of the water level below the weir in the downstream canal. If insufficient head is available, the flow over the sill will be drowned and the discharge will then be determined by the downstream water level and inaccurate division of water will occur. This procedure is not recommended. Modular flow discourages farmers from tampering with the structures and canal. The parameters for design of control structures can be found in various text on the hydraulics of weirs and measuring devices (FAO, 1975).

Table 3 Surface drainage channels.

Parameters	Tertiary drains	Sub-tertiary drains	Quaternary drains
Maximum velocity, m/s	0.6/0.7	0.6/0.7	0.5/0.6
k value*	30	25	25
Min. bottom width, m	0.4/0.5	0.4	0.3/0.4
Depth/width ratio	1 to 3	1 to 2	1
Side slopes	1:1	1:1	1:1
Minimum width of berm, m	**	**	**
Minimum freeboard, m	0.2	0.2	0.2

* k = l/n, where n = Manning's coefficient of roughness.

** No berms are used on drainage channels allowing water to flow freely into the drains

6. Other irrigation structures.

A whole array of structures is needed on an irrigation system and these include roads, culverts, bridges, inverted syphons, flumes, drop structures, side spillways but the design of these structures and relevant design parameters are found in publications available from various international organisation (FAO, 1975). However, it must be emphasised that tertiary and quaternary canals and structures are essentially small in scale while most textbooks and design guidelines provide designs for large structures. There are some important differences in terms of scale that has to be taken in account when using criteria for large structures is applied to small structures.

References

Bos M G (1978). Discharge measurement structures. Publ. 20, IILRI.

De Datta S K, Abilay W P, Kalwar G N (1973). Water stress effects in flooded tropical rice. Water management in Philippine irrigation systems. Research & Operations, IRRI: 1-18.

FAO (1975). Small hydraulic structures. Irrig. and Drain. Paper 26. Food and Agricultural Organisation.

van de Goor G A W (1973). 35. Drainage of rice fields. Design & Management of Drainage Systems, Volume IV. Drainage Principles and Applications. IILRI.

Lacy G (1946). A general theory of flow in alluvium. *J. Inst. Civ.Engr*, **27**(1): 16-47.

Lane E W (1955). Design of stable channels. Trans ASAE, **120**: 1-34.

HSE announces results of ATV research

The results of a two year research project to explore the feasibility of fitting roll over protective structures (ROPS) to all terrain vehicles (ATVs) were announced at the Royal Highland Show. The research, carried out by the Health and Safety Executive's (HSE) Health and Safety Laboratory (HSL), set out to produce a ROPS which would reduce the potential for continuous sideways overturn and perform to engineering criteria. It was developed taking into account the criteria from relevant tractor standards.

Announcing the results, David Mattey, HM Chief Agricultural Inspector, said: "There are roughly 50,000 all terrain vehicles (ATVs) used in agriculture and forestry in Great Britain. There have been eight fatalities since 1986 and our investigations of both these and over 100 non-fatal ATV accidents show that over two thirds of the accidents involve sideways overturns. Frequently, operators are trapped under the overturned machine and suffer crush injuries.

"The ROPS frame is designed to absorb energy without damaging the ATV. This is achieved through its shape and the rubber mounting blocks. Tests show that in a straightforward overturn the frame deforms elastically, i.e. it returns to its shape without damage, having absorbed the overturn energy. Under severe loading, the frame was permanently deformed but, importantly, the novel ROPS frame mounting points and the ATV were protected.

"The ROPS is designed to reduce the risk of continuous sideways overturning on slopes of up to 1 in 1.5 (approx. 35 degrees). We believe this will in turn reduce the risks to operators from crush injuries. The design does not hinder either operation of the ATV or the operator's ability to jump off the machine in an emergency. It should help save lives and avoid some of the awful injuries operators suffer."

HSE is planning to carry out further research using computer dynamic modelling to test the interaction between drivers and the ROPS during an overturning accident. This, together with the work so far will provide design information for manufacturers and suppliers.

Mr Mattey reminded operators: "Our work to develop a ROPS is of course just part of the picture. It is critical that everyone who uses an ATV is properly trained and uses the right protective equipment. Typically our investigations reveal the main causes of ATV accidents as: inadequate training, excess speed, hitting a rut or boulder, tipping on a bank or ditch, steep slopes and carrying passengers or an oversized load. Competent operators can avoid most incidents and eventually, ROPS may help to reduce the effect of the rest ."

Internet opens SKF's electronic handbook to all

Easy on-line access to a wide range of regular updates on bearing theory, design data and selection tools is available with the launch of the 'SKF Electronic Handbook'. Unlike a conventional printed handbook, this one is only available via the SKF Internet web site on: http://www.skf.com.

Once installed on the end user's PC, the Internet will provide a quick and easy access to a comprehensive range of bearing related data from SKF, the worlds largest bearing manufacture, supported by copious graphics via a series of on-screen menus.

The SKF Electronic Handbook can be downloaded from SKF's web site using a 486 or faster PC running Windows 3.1 or above. The PC must have at least 6Mb of RAM and 14Mb of free space on the hard disk.

Once downloaded, the system is simple to use with its 14 major headings. These include introduction, basic theory, bearing types, selection of bearing type and selection of bearing size. Data on friction, speeds and application of bearings, lubrication and maintenance, mounting and dismounting, product data, tutorial questions and application examples are also included. These are then sub-divided into more specific information groups and, if all else fails, on-screen help and a general alphabetical index are available.

As well as providing a wealth of technical information the tutorial section provides a number of exercises which allow keen students to develop and test their knowledge. The SKF Electronic Handbook is currently available in English, Dutch, Finnish, German and Swedish. Use is free of charge, subject to an on-screen, simple, electronic registration process.

Save on the cost of testing: we need to pay the warranty claims

Geoffrey F D Wakeham,

This submission by Geoffrey F D Wakeham, MIAgrE, is taken from material which is designed to stimulate discussion amongst students on the BEng course at Harper Adams Agricultural College, Newport, Shropshire TF10 8NB, and is open to comment from readers.

"The company is committed to developing and introducing quality new products that meet customers' needs. This is vital if the company is to remain competitive, and in the past year it spent in the order of £2 million."
"Action was taken to reduce costs."
"UK workforce was reduced by a third."
"....further rationalised the company...."
"....closed the group's Swedish distributors...."

These quotes are abstracted from the Annual Report of a large UK based company with extensive overseas interests. The commitment to developing quality products while reducing capacity is at variance with the perceived wisdom that introducing new products and quality service leads to commercial success.

In practice, the £2 million is less than 1% of turnover and the company's products are reputed to incur a heavy warranty expenditure.

This is a single case and cannot be used to relate expenditure on design and testing to the performance of companies in general. There are however figures contained in the US PIMS data base (Profit Impact of Marketing Strategy) that do show that perceived quality of goods and services do relate to financial returns. Moores (1995) states: "Those organisations rated above average with respect to perceived quality achieved a six per cent year on year growth in market share and were able to command a nine per cent price premium. Those rated below average experienced a two per cent annual decline in market share."

As something in the order of 80% of all quality is built in during the development stage, one can assume that low expenditure on design and testing will lead to high warranty costs and poor customer perception.

If the figures suggested by the PIMS data are applied to the example company, it may be possible to quantify what effect cash starved development can have on a company's fortunes.

Table 1 is developed based on the following assumptions.

a) 1% of turnover spent on development, leading to 5% warranty claims, is assumed to generate poor customer per-

Table 1 Effect of customers' perceptions on the turnover of a specified company.

Year	Sales x 1 000 000, £			Difference in turnover x 1 000 000, £
	(a) 2% decline	(b) 6% growth	9% price premium	
0	200	200	218	18
1	196	212	231	35
2	192	224	244	52
3	188	238	259	71
4	184	252	275	91
5	180	267	291	111

Table 2 Profit in year five for companies with different perceived quality of goods and services.

	Low investment in design	High investment in design	+ 9% price premium
Turnover, £M	180	267	291
Costs (90% of turnover), £M	162	240	
Profit, £M	18	51	
%	10	17.5	

Table 3 Cost of production design changes.

Change made during	Estimated Cost, $
Design	1 000
Testing	10 000
Process planning	100 000
Test production	1000 000
Final production	10 000 000

ception.

b) 4% of turnover spent on development, leading to under 2% warranty, is assumed to generate high customer satisfaction.

c) Current sales level is £200 million and condition (a) will lead to an accumulative loss of sales of 2% p.a., while condition (b) will lead to a 6% accumulative increase in sales and permit a 9% price advantage.

If it is assumed that total cost of sales is 90% of the sales figures (without the 9% price premium), then the profits at the end of year five are as shown in *Table 2*.

In practice, the company with limited investment in product development is likely to incur more expensive production costs, need to make frequent changes to production processes, stock more spares and mount defensive advertising campaigns.

The profit posted by our example company was in the order of 7%.

It has been suggested by Tatikonda and Tatikonda (1994) that there is a ten fold increase in cost of engineering change for each step between design and final production *(Table 3)*.

This may appear rather too tidy and be more applicable to highly mechanised production systems. In agricultural engineering, a pound not spent at the design stage may not cost as much as £10,000 when it is necessary to change the product once it is in the field because of the relatively low investment in dedicated production facilities. It will cost, however, a lot of unnecessary expense and lead to a loss of reputation.

It has been shown that if money is spent in the development stage this should lead to the need for less subsequent change and increased customer satisfaction.

References

Moores B (1995). Customer Service. In: *The Financial Times Handbook of Management*. Pitman Publishing, London.

Tatikonda L, Tatikonda M (1994). Tools for cost-effective product design & development. *Production & Inventory Management*, **35** (2).

Danger still looms for 46% of landscapers and agri-contractors

Over half of all landscapers and agri-contractors must undergo some form of change or financial restructuring if they are to avoid worsening financial difficulties and potential liquidation. The Plimsoll Portfolio Analysis - Landscapers & Agri-Contractors - 2nd Edition 1997 examines the financial performance of some 1339 companies involved in the industry and has found 46% of the industry to be suffering financial difficulties of some nature.

The analysis has also highlighted a considerable variation in company performance and has found that poor performance is not limited to small companies, of those companies above a £12 M turnover, 33% were found to be in financially weak positions. Confirming this was an article in the Financial Times on June 2nd which stated that '130 companies listed on the London Stock Exchange' had had to seek help from 'company doctors' to improve financial health.

Plimsoll's method of analysis involves examining a company's performance over the last four years. The Plimsoll model interprets graphically the key accounting ratios so that any weaknesses in a company's financial character can be immediately identified. The ratios are then combined to form the Plimsoll Chart which is the ultimate indicator of a company's financial position. From this, a company can be rated into one of five self explanatory categories reflecting its financial strength these being strong, good, mediocre, caution and danger, the latter two representing those companies experiencing financial problems.

These figures represent a deterioration from this time last year when 42% of the industry was found to be struggling. In contrast, 41% of the industry in the latest analysis was rated either strong or good compared with 44% in the second edition 1996. Despite the rise in companies in financial difficulty, there was some good news for the industry as average companies were able to increase sales by 7%.

Larger companies seemed to be setting the pace, those companies with a turnover in excess of £12 M managed an average increase in sales of 10.2% whilst the smallest companies, those with sales of less than £400,000, only managed an average increase of 0.4%. The same pattern was seen in terms of profit margins, the largest companies managing an average 3.6% pre-tax profit margin whilst the smallest companies could only report an average 1.1%. The industry average pre-tax profit as a percentage of sales was 2.6%.

One way which a company can improve prospects is to choose trading partners carefully. Trading with those companies that are aggressively seeking to improve their position in the market place can help to boost your own sales, 11% of companies in the industry managed to increase sales by over 40% in their last financial year. It would seem as well that it is not only possible to achieve phenomenal growth: 6% of companies are posting pre-tax profits in excess of 25%. So clearly it is possible to achieve success even in today's competitive business environment, one factor in such success is knowledge of the industry in which you operate and the companies which comprise it. Analytical tools such as the Plimsoll Portfolio Analysis can provide such information affording the busy manager the knowledge they need in their day to day dealings which is vital to success.

Call **Mark Haynes at Plimsoll Publishing Ltd, on 01642 230977**, for a copy of the Main Report @ £305 & Supplement Report @ £205, with 5% discount available to readers of *Landwards*.

Book reviews

Biotechnical and Soil Bioengineering Slope Stabilisation

(A Practical Guide for Erosion Control)
by Donald H Gray and Robbin B Soter
Publisher: John Wiley & Sons
ISBN 0-471-04978-6
Price: £50 (hardback)

For those not familiar with the terminology, Biotechnical Stabilization implies the use of structures in combination with biological elements (plants) to arrest and prevent slope failure and erosion. Soil Bioengineering on the other hand can be regarded as somewhat unique in that plant parts themselves ie roots and stems, serve as the main structural and mechanical elements in a slope protection system. Both of these stabilization systems provide cost effective and environmentally compatible ways to protect slopes against superficial erosion and shallow mass movement. This comprehensive guide to the selection, construction and installation of soil bioengineering and biotechnical slope protection is a first class work, lavishly illustrated with more than 150 photographs. These are supplemented with a range of well crafted charts and tables. It covers all aspects of the subject from basic principles through to detailed information on such topics as treatment selecting, costing, and critical tractive stresses.

The text is well presented and of sufficient level that it will adequately meet the requirements of practising professionals and researchers as well as students of environmental and landscape engineering and management.

Two particularly valuable sections of the work are the case studies and the discussion of research needs. There are in fact four case studies considered, each well illustrated and addressing in a very comprehensive way different problems and their solutions. Together, they demonstrate the application of a technology as well as the site investigation, planning, scheduling and organisation required to complete a project. There is also a summary of the findings of the National Science Foundation sponsored workshop which assessed the "state of the art" and determine research needs.

I do have one criticism, as is the case with several American texts. It relates to units. Some years ago, I was dragged kicking and screaming into the new age of SI units. The one thing that now bothers me most is not the use of Imperial units. OH NO! it is the use of some mysterious set of units between an SI/Imperial unit mix, guaranteed to send any normal engineer into orbit! This work is guilty of this in the first degree; unit weight for instance varies from g/m^3 to pcf, with other combinations between.

Do not be put off, however, by this oversight. Perhaps, the publishers will see the problem and rectify it. If not, it is still an outstanding reference book, I recommend it to you.

Design of Diversion Weirs

(Small Scale Irrigation in Hot Climates)
Rozgar Baban Wiley Series in Water Resources Engineering
Publisher: John Wiley
Price: £24.95

The aim of this series of books according to Professor J R R YDZEWSKI "is to provide technologists engaged in water resources development with modern texts on various key aspects of this very broad discipline". This book, the first in the series to be seen by myself, certainly meets the aim admirably.

The author argues that there is a need for hundreds of small diversion weirs in many countries to upgrade and maintain small irrigation projects, to reverse the decline in large parastatal agricultural projects. He therefore has presented a text assisting engineers and technologists in designing the structure from a single book. His particular objective is to present those people with a prescriptive work which, step by step, leads them through the hydrological, hydraulic and structural aspects of the design. He argues, with my full agreement, that this should lead to a reduction in cost and time involved in introducing international consultants when, for these smaller structures, people on the ground with adequate training could cope. Armed with this book and a good training in engineering principles, I am sure the author's idea is valid. He is correct particularly because the work is so well crafted. It contains all the technical subjects required by the designer very well explained and backed up by examples which are well prepared and particularly relevant. In detail, it deals with site and soil investigations, topographic surveys, hydrological and hydraulic analysis, uplift pressures, sediment control devices, structural analysis and finishes with a section on financial analysis.

As I have already stated, the book is well presented, but my one major criticism is in the quality of some of the diagrams. Compared with the rest of the work they are third class, in some cases unreadable, what a pity! However, I am sure Wiley will address this problem in good time and not let this detract from an otherwise excellent book. It is a must for all working in this area and, personally, it will be essential reading for my engineering students.

MJH

Workshop on rural roads

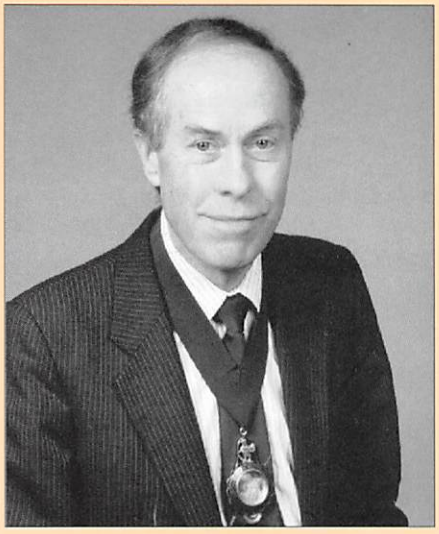
The 3rd International Workshop on Secondary Rural Roads is being organised jointly by the World Road Association (PIARC), the International Commission of Agricultural Engineering (CIGR) and the General Directorate of Public Roads in Poland (GDDP) and will be held on 19 - 21 May 1998 at Józefów, 25 km from Warsaw, Poland. Abstracts are required by 31 October 1997.

Contact: **Ms Magdalena Ataman, GDDP, ul. Wspólna 1/3, 00-921 Warsawa, Poland. Tel: +48 22 830 08 83.**

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Autumn 1997

Michael J Dwyer - President of the Institution



Michael J Dwyer, CEng, FIAgrE, MIMechE, President of the Institution, died very suddenly at the age of 58 on 27 August 1997. He had been a member of the Institution for over 30 years, had served with distinction on the South East Midlands Branch Committee, the Council of the Institution, the Membership Committee and the Branch Affairs Panel. He would have completed his term of office as President in May 1998.

Michael gained his BSc (Mechanical Engineering), MSc and PhD at Southampton University over the period 1958-65. He spent two separate years as a university apprentice and then graduate apprentice with Rolls Royce Engines. He joined the National Institute of Agricultural Engineering at Silsoe in 1965, leaving what had become Silsoe Research Institute in 1992 to work for the Chief Scientist's Group of MAFF in London. Over that period he made a substantial contribution in the field of traction, tyres, tractor braking and implement coupling and control, published many refereed and more popular papers, including some outstanding ones in *The Agricultural Engineer*. He was in demand as a platform speaker and was internationally respected for his work in Terramechanics and for his presidency of the International Society of Terrain Vehicle Systems.

On leaving Silsoe Research Institute in 1992, Michael worked for MAFF in London as a Scientific Liaison Officer, his main concern being the commissioning and monitoring of research work at Silsoe and elsewhere. He retired from MAFF to join the staff of the Institution of Mechanical Engineers, and had been with them for less than a year when he died. Michael Dwyer was a gifted, modest and consistently friendly and courteous colleague. He leaves Brenda his widow, three daughters and a son as a close knit and talented family. We offer them our deepest sympathy.

JBF

Editorial

Many of you will already know of the sad and untimely death of our President, Dr Michael Dwyer. The whole Institution has been stunned and shocked by the news and we at the Secretariat have found it hard to express our sense of grief and loss. As President, Mike made a point of visiting the branches whenever he could, and he was in discussion with branch officers about ways in which the President could help them in their work. He was also heavily involved with The Year of Engineering Success, becoming Chairman of the Agriculture Theme Group. He was deeply disappointed when the funding for a mobile exhibition for the theme was not forthcoming and he felt that a great opportunity had been lost. A formal obituary appears separately in this issue, but suffice it to say here that we will miss him and his gentle good humour.

This sad occasion gives me the opportunity to write my one and only Editorial for *Landwards*, for I will be leaving the Institution in the next few months. When I joined nearly five years ago, the emphasis was on financial control and information systems. The emphasis has now shifted to something more outward looking, and we have a need for new skills in marketing and promoting the Institution. I will always remember the Institution with affection, especially the friendliness of the people and their willingness to offer help. Long may it prosper.

Michael Hurst

Secretary

© Institution of Agricultural Engineers

Young Engineers Competition

John Kilgour congratulating the winning team of BEng students from Silsoe College, Dave Price (left), Stuart Brown (centre) and Chris Saunders (right).

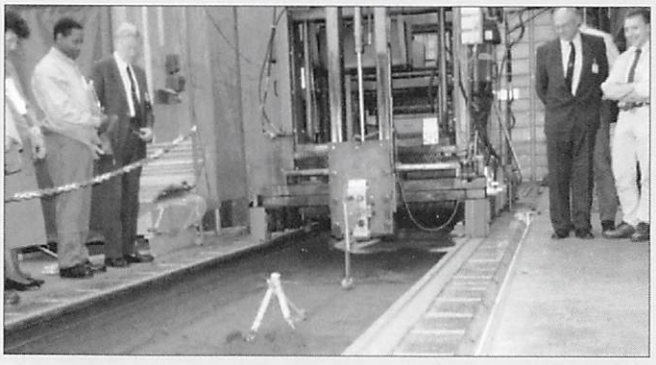
A Young Engineers' Competition, held during the lunchbreak of the Annual Conference on 13th May 1997, was once again organised by John Kilgour and held in the Norman Hudson Building, Silsoe College. This year marked a departure from the "model tractor pull" of the last few years. Four teams representing Harper Adams, Rycotewood and Silsoe (2) were provided with a strip of wood 10 mm square x 2 m long and a ball of plastic string, together with a limited selection of tools. They were given 30 minutes to produce a Ground Anchor. The finished anchors were then buried in the soil bin and loaded. The anchor recording the highest resistance to a horizontal load at the soil surface was the winner.

The construction phase produced some interesting designs as did the different approaches to burying the anchors in the soil bin where the soil was quite compact.

The eventual winners were a Silsoe College team of final year BEng students: Stuart Brown, David Price and Chris Saunders. The runners-up were a Rycotewood College team of final year HND Agric. Engng students: Ryan Jackson, Peter Ridley and Rob Davidson.

To ensure the students did not get too cocky, John Kilgour, with some help from Geoff Wakeham (mainly his feet) entered a design which offered the most resistance by some considerable margin - they were of course disqualified immediately on the basis of maturity!

In a frenzy of activity, from left to right Darren Bentley, Tom Hennessey and Ed Hoare seem to be tying up a lot of loose ends.



The moment of truth watched intently by conference delegates, John Fox (left) and Peter Crossley (right) flanking the soil bin carriage.

Dearing cites 'SARTOR' as prime example of his 'national framework'

On behalf of the engineering profession, the Engineering Council has welcomed the Dearing Report and broadly endorsed its recommendations, saying it clearly reflects the engineering profession's own commitment to raising educational standards.

In particular, the Council applauds the recommendation that university courses should not all be at the same level and of the same duration. This mirrors one of the key elements of the Council's revised Standards and Routes to Registration (SARTOR) document, which specifies that engineering courses should be between two and four years long and permits students to transfer between courses depending on their progress. The Council is greatly encouraged that Dearing's model for a 'national qualifications framework' fits so perfectly with SARTOR, which the Report quotes as the main example of how Sir Ron sees his framework operating.

In responding to the Report's view that quality should be assessed through output standards, the Council said this did not represent any fundamental incompatibility. The Council agrees that if robust, verifiable and guaranteed outputs are achieved by the processes proposed by Dearing, together with accreditation of courses by the engineering Institutions, the need for specified entry standards will diminish.

The Council has received an invitation from Sir Ron Dearing to meet and discuss further the relationship between his Report and SARTOR and intends to accept this invitation.

Long service certificates

50 Years

Name	*Grade*	*Date of Anniversary*
Francis **Coleman**	FIAgrE	12/8/1997

35 Years

Name	*Grade*	*Date of Anniversary*
John Thornton **Calvert**	IEng MIAgrE	27/9/1997
Urban George **Curson**	IEng MIAgrE	26/6/1997
Gabriel John **Harris**	AIAgrE	26/6/1997
David Frederick **Kane**	IEng MIAgrE	27/9/1997
Ronald **Russell**	CEng MIAgrE	26/6/1997
Norman **Smith**	CEng FIAgrE	26/6/1997
Jeffrey Nicholas **Tullberg**	FIAgrE	26/6/1997
John **Tyblewski**	IEng MIAgrE	27/9/1997
Arthur Ernest Lawson **Walker**	IEng FIAgrE	27/9/1997

25 Years

Name	**Grade**	**Date of Anniversary**
Martin **Baxter**	IEng MIAgrE	27/4/1997
Donald **Bowler**	AMIAgrE	10/7/1997
John William **Britain**	AMIAgrE	20/7/1997
Jeffrey **Burr**	IEng MIAgrE	27/4/1997
Henry **Gunston**	MIAgrE	27/4/1997
Peter William **Haw**	EngTech AMIAgrE	27/4/1997
David Mercer **Hicks**	IEng MIAgrE	27/4/1997
Rupert Frederick **Hill**	AIAgrE	27/4/1997
Richard Edward **Hughes**	IEng MIAgrE	27/4/1997
Chee Yan **Kwok**	FIAgrE	27/4/1997
Andrew **Murison**	MIAgrE	27/4/1997
Stephen Benjamin **Paddock**	EngTech AMIAgrE	27/4/1997
John Spencer **Rice**	MIAgrE	20/7/1997
Thomas Wilson **Robertson**	IEng MIAgrE	26/4/1997
George Brian **Sangster**	AMIAgrE	20/7/1997
Thomas **Smirthwaite**	AIAgrE	2/7/1997
John David **Stephenson**	EngTech AMIAgrE	27/4/1997
Philip John **Thirtle**	MIAgrE	20/7/1997
John Harry **Tobutt**	IEng MIAgrE	20/7/1997
Colin Duncan **Watt**	CEng MIAgrE	20/7/1997
Robert William **Yardley**	IEng MIAgrE	20/7/1997

Volumes of free Journals

A largely complete set of volumes of the IAgrE Journal, *The Agricultural Engineer*, from 1964 onwards has been offered free to any library or individual by one of our Members. The shipping cost must be paid by the recipient.

For further information, contact: The Editor.

Young Engineers Evening at Writtle College

Every year, the 3rd (final) year students of the Batchelor in Engineering (Agricultural Engineering) course at Writtle present their major projects to a panel of judges. These judges comprise members of the local Herts and Essex Branch of the Institution of Agricultural Engineers, some of whom are lecturers at Writtle.

The evening follows an informal pattern, with the students on hand to explain what they have done and achieved, and reasons for choosing their topics. If things have not quite turned out as they expected, they need to explain this as well. On 4th June, this year, there was, as usual, a wide range of subjects covered. There was an investigation into temperature and carbon dioxide levels in piggeries; a review of micro-environments relating to livestock transport; research into the effects of different straw bedding methods on dust levels and livestock health, and numerous notable ones besides.

At the end of the evening, the judges gather in a corner to decide on an overall winner. The best presented project would receive a tankard with the runners-up being awarded certificates. The overall winner went to **Robert Causer** for his design of a test rig to explore the characteristics of a solar drier employing natural convection. Highly commended certificates went to *Kamree Mambang* for his project on the dewatering of sago; to *Richard Edwards* for his research into the reduction in size of seedbed clods; and to *Jon Littlechild* for his design and construction of a device for measuring water runoff rate from a tramline in a field. We were pleased that the President of the Institution of Agricultural Engineers, Mike Dwyer, attended to help with the judging and to present the prizes.

It had been an interesting and enjoyable evening, and we were pleased with the support from both College staff and members of the Institution.

R W Langley

Membership movements

Mem No	Name	From	To
6057	P K **Afful**	Kenya	Lancashire
3572	J E **Ashburner**	Ecuador	Merseyside
5167	D G **Cruickshank**	London	Hertfordshire
6222	R G **Donald**	Wiltshire	Oxfordshire
6491	H **Korte**	Tyne & Wear	Germany
6178	A M **Lindsay**	Warwickshire	West Yorkshire
6567	S M **Maguire**	Essex Northern	Ireland
5236	B G F **Mathew**	Somerset	Scotland
2362	W F **Maunder**	Cambridge	Dorset
6636	C M **Moore**	Uganda	Essex
5375	C A **Morse**	Worcestershire	Northamptonshire
6138	R M **Nutt**		Norfolk
6606	J P **O'Neill**	Shropshire	Northumberland
6598	T J **Reidy**	Essex	Ireland
1436	R **Russell**	Lancashire	Lincolnshire
6298	S A **Thomas**	Cheshire	Worcestershire
5722	M J **Troughton**	Warwickshire	Kenya
6433	R J **van Bentum**	Thailand	New Zealand
6513	S D **Vaughan-Jones**	Bedfordshire	Carmarthenshire
6401	P E **Walmsley**	Shropshire	Staffordshire
4450	I J **Yule**	Durham	New Zealand

Gone Away

Name	Last known address
J W **Blackwell**	24 Andover Road, Micheldever Station, Winchester, Hampshire SO21 3AU
M A K **Ghazavi**	Department of Agricultural and Environmental Science, University of Newcastle, Newcastle upon Tyne, NE1 7RU
R H **Berry**	12 Bathurst Road, Cirencester, Gloucestershire, GL7 1SA

Institution membership changes

Admissions - a warm welcome to the following new members:

Member
P Homer (Bedfordshire)
P G Kaumbutho (Bedfordshire)

Associate Member
S M Bettany (Warwickshire)
C Taylor (Scotland)

Associate
H C Lloyd Jones (Avon)
C M McNicol (Scotland)

Student
P G Ridley (Hertfordshire)
J G Wilson (Yorkshire)

Transfers - congratulations on achieving a further phase in your professional development:

Member
M J Holden (Essex)
R Lockhart (Staffordshire)
G B Lovelace (Hertfordshire)
N J Skea (Scotland)
M V Westwood (Oxfordshire)

Associate Member
Md K U Sarker (Beds)
D M E Thompson (Devon)

Pioneering Technology Specialist Group video library

The Pioneering Technology Specialist Group, which is overseen by the West Midlands Branch, is aware that it is never easy to plan technical meetings. This has the accompanying risk of the late cancellation by a speaker. To assist with planning and to prepare for cancellations, it was decided to create a small video library.

The Specialist Group has an important role to fulfil within the agricultural engineering profession to examine the major developments of the past. Many of these developments have been recorded on film and much of the material is therefore available to the public.

Massey Ferguson has been very generous in making some of its archive material available, and other titles are commercially available. The Specialist Group also has access to a small private technical video collection.

The Group proposes to make these titles available on loan for a small charge to cover administration and postage. It must be appreciated, as with all material of this nature, that copyright must be respected. For example, we have been given access to one group of films as long as it is for "Institution use only" and no attempt is made to market them. Others are available commercially. To assist borrowers to obtain their own copies, we will be making available the source of each title.

Please make all enquiries to the convenor of the Pioneering Technology Specialist Group. If you or your company have a video or videos which would be useful additions to this library we would like to know, as we are keen to make the collection a useful and appreciated resource to colleagues throughout the Institution.

William Waddilove (Convenor and Librarian),
The Hollies, Priory Road, Wolston,
Coventry CV8 3FX.
Tel: 01203 544255.

Electronic, Electrical and Mechanical Incorporated Engineers join forces

Formation of **The Institution of Incorporated Engineers in electronic, electrical and mechanical engineering** has been agreed following positive voting in favour of amalgamating The Institution of Electronics and Electrical Incorporated Engineers (IEEIE) and The Institution of Mechanical Incorporated Engineers (IMechIE).

At Extraordinary General Meetings of IEEIE and IMechIE, Corporate Members of both Institutions voted overwhelmingly to combine together: of the 1775 votes cast at the IMechIE meeting held in June, 91% were in favour; of the 1715 votes made at the IEEIE meeting held in July, 85% were in favour.

The positive feed-back from members has given the two organisations added impetus and conviction that bringing together the three disciplines will be a beneficial leap forward into the millennium for the profession.

The merger of the two Institutions is a natural progression after many years working closely together; the signing of a Memorandum of Understanding; the development of joint activities; and with the convergence of technologies, the necessity to be educated and trained to serve multi-disciplinary industries.

Plans for the launch of the new Institution in April 1998 are now being progressed by the Councils, Committees, Officers and staff of both Institutions.

Speaking immediately after the votes had been counted, both of the Councils' Chairmen expressed their delight at the confidence shown by the members of the two Institutions in their Councils' plans for the future.

The Institution of Incorporated Engineers in electronic, electrical and mechanical engineering will have a membership of nearly 35,000 securing its place as the fourth largest of all the engineering Institutions and making it the prime and most influential organisation for Incorporated Engineers and Engineering Technicians.

Paper challenge: the Secretary, the Editor and the Silent Majority

Busy people, see end.

The Secretary and the Editor have combined their extensive ability in, and unique experiences of Information Technology, respectively, to offer mailbox facilities for the receipt of manuscripts and news by E-mail. There are no losers in this challenge. You improve your literary talent and your understanding of transferring attached documents. We receive copy faster, processed, and with excellent quality guaranteed.

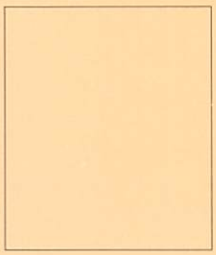


Fig. 1 Incipient diagram with full disclosure anticipated.

'It didn't work that way before', I heard you mutter. Then click on the *Editorial Assistance* box in the *Wish List* menu. There is a virtual update on the latest version which automatically routes all attached documents through a signal filter system and amplifies transmission of interesting copy. Imperfect items are lost in confusion to generate background noise (it has to come from somewhere). The underlying program is highly complex and relies heavily on fuzzy logic. The best analogy is the pending pile in your office - on your desk, on your conscience, deadline past, topicality gone, play it low and let it go.

It probably isn't worth wasting much time trying to find the update. Instead, proof read your manuscript because there may have been an oversight in your haste to dispatch your *magnum opus*. Check especially for spelling mistakes, grammar, uncited references, unenclosed enclosures. Then try again.

On the other hand, maybe you didn't send it correctly.....or just maybe we couldn't handle the overwhelming quantity of communications. The E-mail addresses are on the Contents Page. Send text in a Rich Text Format (RTF) file and don't embed graphics. We have to disembowel (is that the write word?) them again. Graphs and barcharts may be transferred to the Editor in a separate Excel file for editing in the Journal style; the Secretary can handle Lotus 123 but subsequent publication will probably involve a redraw. On Encapsulated PostScript (you know they're there but can't quite see them) files from other software packages, the only editing success to date has been deletion! And as for the problem of 'cross platform compatibility', the phrase encapsulates that indefinable ring of technological superiority which usually distills down to 'won't work'.

By all means try scanning your own photographs. If the screen image is poor, don't send the photograph to the Editor.....and don't send the scan at all! It took ten minutes to download a tractor scan recently. The quality was good enough to slip through the signal filter like a dream, but I'm losing my memory fast. (No, I don't know why either. Some people say it is age-related, whilst others recommend a drive upgrade.) Crisp prints or transparencies will do just fine, along with the hard copy of your manuscript and diagrams so that the Editor knows exactly what is in his mailbox, just as soon as he has the time or the random memory to check.

Whilst accepting no responsibility for the accuracy of any statements contained above, the Editor welcomes *bona fide* contributions to *Landwards*. Even editorial criticism provides positive feedback (negative feedback corrects previous errors whereas editors only apologise for past transgressions)! In anticipation of the deluge of constructive comment, the Secretary is always pleased to hear from members as well as interested in gleaning information for *Membership Matters*.

Busy people attach documents with text as RTF files, graphs as separate Excel files and exclude bitmaps.

BDW

John Deere invests £2.5 million in new training centre

A new training centre and extra office accommodation is to be built by SOL Construction at John Deere Ltd's UK headquarters in Langar, near Nottingham, at a total cost of £2.5 million.

The training centre will replace the company's existing facilities at nearby Bingham, which were established 16 years ago. John Deere Ltd is the UK and Irish arm of the world's largest manufacturer of agricultural and groundscare machinery, and commenced trading at Langar in January 1966.

The first sod at the new site was turned, and a commemorative tree planted, by Doug Walker at a special ceremony held at Langar in June. Doug Walker was closely involved with the establishment of John Deere Ltd in the UK in the mid-1960s, becoming managing director in 1968. He was succeeded on his retirement by the current managing director, Alec McKee, in February 1993.

Nottingham-based SOL's Design & Build Division started site work in mid-June, and is due to finish in February 1998. The architects are Franklin Ellis of Nottingham, and the project has been managed for John Deere Ltd by Peter Townsend of the building surveying division of Lambert Smith Hampton, Northampton. The new two-storey building will cover a total of 4160 m^2. Together with the existing premises, this will allow John Deere to have all its office, training, workshop and parts storage facilities on one site.

"Since 1966, John Deere Ltd has grown to be one of the biggest suppliers of agricultural and groundscare machinery to British and Irish customers," said Alec McKee at the ceremony. "We are proud of our reputation for product quality and performance, as well as excellent back-up support, both from our company and our dealer organisation. Regular staff and dealer training courses, and continuing investment in new products and manufacturing systems, ensure that the company is able to provide the most advanced and reliable machines possible, backed by efficient and knowledgeable service and customer support. We are now looking forward to future challenges. The new training and office facilities at Langar will enable us to continue providing a superior service to our dealers and customers."

Full training on all aspects of management, sales, parts and service support is available to John Deere dealers at the company's training centre. There is also some technical training offered to customers, such as local authority fleet owners who have their own workshops. Each year the company delivers around 5000 training days covering 40 different courses, for both the agricultural and the commercial & consumer equipment (groundscare) businesses.

"Now that I've got more time on my hands," IAgrE Past President Douglas Walker (centre) could well have reflected, "I'll dig the 'founds' myself, if necessary, to get this new training facility under way," but Alec McKee (right) who took over from him as MD of John Deere UK and Chris Truman (left), SOL Construction Director thought that some back-up resources wouldn't come amiss!

Government commitment strengthens voice of the Profession

Mike Heath, Director General, Engineering Council

A significant landmark has been reached in the profession's concerted efforts to strengthen its influence, and have its voice heard on matters of national importance, with the recent signing of a Memorandum of Understanding (MoU) between Government and the Engineering Council.

Signature demonstrates a clear Government commitment to the engineering profession and clearly defines its role in ensuring that the UK maintains a world-class, professionally qualified engineering workforce. It represents a ringing endorsement of the direction that the Council and the professional Institutions have taken since unification, and Government approval of the targets we have set ourselves.

Specifically, of course, the MoU establishes the Engineering Council as the principal voice of the engineering profession and the body recognised by Government to speak on profession-wide issues. Additionally, and of increasing significance, it confirms Government recognition for the Council to represent the UK profession internationally. It is also recognition of the constructive contribution of engineers to the debate on appropriate major issues.

A good deal of our activity over the past twelve months has been focused on strengthening our relationship with Government and persuading it to listen to our views on issues affecting the wider profession. I believe we have achieved considerable progress in that respect. I hope, however, that Institutions will continue to enhance their own links with Government, Parliament and Whitehall and continue to speak for themselves on issues relating to their particular areas of interest.

The MoU was, of course, signed by a Conservative Government and many people have asked me how its status is affected by the election of the new Government. I am able to report that Margaret Beckett, the new President of the Board of Trade, pledged her support for the agreement prior to the recent election. The arrival of a new Labour administration does not affect its validity in any way.

I do not for a moment see the signing of the MoU as an end in itself. It merely establishes a framework within which the Council and Government can work together to further the cause of professional engineers in the UK, and signals to the rest of the country that Government considers engineering to be important and worthy of its support.

It is an indicator of how far the profession has been transformed in the relatively short time since the new relationship between the Engineering Council and the Institutions was established. The success of the partnership, however, will be gauged on our results. All we have done between us is to create the necessary platform from which we can raise our profile, improve public standing and increase our influence.

During 1997, the Year of Engineering Success (YES) is providing us with the extra stimulus to drive forward a programme that reflects the Council's mission statement: "To enhance the standing and contribution of the engineering profession in the national interest and to the benefit of society."

This statement mirrors what engineers and technicians on the Council's National Register repeatedly tell me they want to see the profession achieve. As the Engineering Council and the Institutions have found to their advantage, working in partnership can be the best way forward. There is potential, therefore, to extend this strategy to the wider engineering community.

One example is the proposed establishment of a National Engineering Group, aimed at drawing not only on the talent and imagination of people from within the profession but also appropriate individuals from outside. We believe that such a pooling of ideas will result in policies which demonstrate the true value of engineering and help convince the brightest young people that it offers exciting, stimulating and well-paid careers.

Nonetheless, I am fully aware that most responsibility for developing the necessary climate of change will continue to fall on the Engineering Council. With this in mind, a decision was taken last October to develop the internal running of the organisation in order to be in the best possible shape to meet the challenge. We are working, therefore, towards best practice through achievement of the Investors in People (IIP) national standards.

The key to IIP success is setting organisational objectives and communicating these to all staff. It means focusing the right people on the right corporate objectives.

IIP is not change for change's sake. It is about 'cloning' good business practice and tapping into the talent of each member of staff. As with all organisations, our success is in the hands of our staff. I would commend IIP to any organisation that has not yet tried it.

News of Members

J P Middleton has recently moved to Uganda where he is Production Manager for G M Company Ltd, who are one of the largest steel fabricators in Uganda, with around 45 shop floor staff. Their main product lines are tanks (fuel and water), trailers (agricultural and commercial), bowsers, lorry/coach bodies and wheel barrows. In addition they will undertake virtually any type of work involving steel. Current 'odd jobs' include a 12 m chimney, concrete moulds and a barbecue for spit roasting a whole cow.

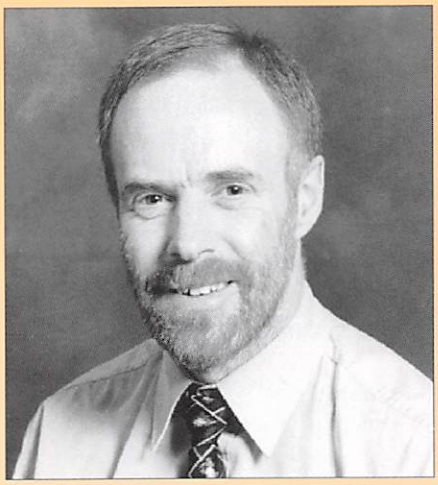
Jonathan Booty who was a Project Engineer with Briggs (UK) Ltd and is now an Applications Project Engineer with Perkins Engines at Peterborough.

David Mattey is now Chief Agricultural Inspector for HSE and also Regional Director for HSE in the Midlands. He started with MAFF and moved to HSE in 1975. During his career he has moved 10 times and been a member of four IAgrE branches. His most recent move was from Scotland, where he was Director of Field Operations. He also thinks that he was the first mature candidate to gain ERB registration via the IAgrE in 1977.

S A G Perera has left the Plateau State PADP Service in Nigeria and has joined Palwatte Sugar Industries Limited in Sri Lanka as an Engineering Consultant. Palwatte Sugar Industries Ltd is the largest sugar company in Sri Lanka with a crushing capacity of 3500 tonnes per day. If any member is visiting Sri Lanka Mr Perera would very much like to meet them to exchange views on land developments and land preparation, sugar cane loading and harvesting. The sugar estate is about 325 kilometres from Colombo City and his telephone number is 501195.

One of our prominent members in the South West, **Bob Painting**, is proposing to stand for election to the Engineering Council Senate in October. Bob has been active in Engineering Council activities at local level for many years.

George O'Connell has been appointed Managing Director of Tripp Batt & Co Ltd, Agricultural & General Engineers of Bury St Edmunds. George, an Agricultural Engineering graduate of Newcastle University and with an MSc in Applied Science, joined the company in 1990 as Contracts Director, and has been Deputy Managing Director since the beginning of this year. Having nearly 20 years experience in the design, selling and installation of all types of crop storage, drying and handling systems, he is well known over a wide area of the country, particularly to farmers in the Eastern counties. He plans to continue Tripp Batt's strong commitment to, and reputation for, quality advice, design, equipment selection and project installation.



George O'Connell

As a Member of the Institution and an Incorporated Engineer, he is a committee member of the Drying, Storage & Processing Specialist Group, and has served as chairman of the East Anglian branch.

Tripp Batt has been established for over 40 years, and has a wide range of customers. Some of their many and varied recent projects include grain drying and storage for Fengrain, Barton Bendish Farms and Bartlow Estate, coarse feed processing and grinder plants for Dodson and Horrell, potato store ventilation refrigeration for Abington Farms, S J Parr and J W Grant, and improvements for Bayer plc, Omex Agriculture Ltd and S W Cross & Sons.

Jim Adams and his wife, who have lived in Canada for almost 30 years have recently retired to Chester, a village on the south shore of Nova Scotia. He says that their house is on the edge of the sea looking across the water towards Britain. This is a tourist area for people from the USA and Europe, and he would be pleased to see anyone from the Institution if they are in the area. Jim left Scotland at the end of 1967 and moved to Alberta, Canada. He says that the contrast with living in Britain was that the winters were colder and drier and the summers were warmer and all year there was more sunshine, which led to faster growth. Farms and farm equipment were on a much larger scale. In 1969, they moved 5000 km east to the Nova Scotia Agricultural College in Truro which reversed the contrast from British conditions, being surrounded by sea and having older historic features. The scale of farms and equipment was also more in proportion to British agriculture. Jim says that when working in Britain he looked towards North America for advanced information but when working in Canada he found that it was considered desirable to investigate ideas and developments in Britain.

Jonathan G M Wood, whose company is Structural Studies and Design Ltd, is now a Royal Academy of Engineering Visiting Professor in The Principles of Engineering Design at Aston University. He is working with Prof Chris Page and his colleagues in the Civil Engineering Department and says that it provides new opportunities for teaching and research. Structural Studies and Design Ltd continues to flourish and provides expert consultancy to a range of organisations in France, Netherlands and Hong Kong as well as the UK and links with the academic community continue to develop world wide.

Earlier this year **Colin Campbell** moved to Botswana where he is teaching general agriculture at a senior secondary school. He says that there is a great shortage of suitably qualified staff for agriculture in general and as they follow the Cambridge Certificate course there is not a lot of scope for engineering specifically, except under the options section of the course. Botswana is a difficult country in which to attempt any kind of agriculture, as the climate is described as semi-arid to arid and, as such, really requires the input of engineers to provide and distribute bore hole water for growing crops and animals. He says that the technology is available nearby but there is a need for a good input of UK engineers to train the local people.

Francis Coleman who celebrated his 84th birthday on 7 May was due to try out his new sailing boat on the Norfolk Broads at about that time. We hope that he had a happy birthday and that the boat was a success! Congratulations also on achieving 50 years of membership of the Institution (see Long Service Certificates).

Lloyd Mwale is now the Agricultural Workshop Engineer for Zambia Sugar plc. The workshop is responsible for the maintenance of a fleet of over 450 cars, vans and tractors up to 201 kW. Zambia Sugar grows 12000 ha of sugar cane which produces over one million tonnes of sugar cane and 165000 tonnes of processed sugar per year, on site. Lloyd says that it is an ideal place for an agricultural engineer who wishes to remain in touch with both the agricultural and industrial side of the agri-business. Lloyd graduated from Harper Adams Agricultural College in 1994 with a BEng degree. During his sandwich year he worked for Ford tractor dealer George Oakley Ltd, agricultural engineering manufacturing company J A Harris Engineering and in the Design, Construction and Test Divisions at Silsoe Research Institute.

Sean MacGloinn is now a research and development engineer with Micron Sprayers Ltd in Bromyard, where he is involved in the development of new and existing products and ensuring products meet all relevant standards. His duties include the specification and drawing of component parts, identifying potential suppliers of products and field testing of prototypes. The product range is mainly hand held sprayers, but also includes air assisted sprayers and mounted equipment.

We apologies to **Grant Fear,** who lives in South Africa, for omitting his name from the 1997 Members' Directory. He says that he hopes that his old colleagues will not think that he is no longer with us. He also mentions that he was invited to join the Institution by Col Philip Johnson.

L J Edwards is now Farm Manager with the Rotian Seed Company Ltd at Arusha in Tanzania, which mainly produces seed for export. Previously, he has worked on the ODA Cashew Research Project, and more recently he was Farm Manager at the Kifufu Coffee Estate in Tanzania.

Ian Yule has recently moved to the Department of Agricultural Engineering at Massey University in New Zealand where he is a lecturer.

Richard Nutt is now a Design Engineer for FMC at Fakenham, where he is working on pea and green bean harvesters.

Congratulations to **Tim Reeves** who has recently been awarded an MBA from Sheffield Business School. He has also left MF in Manchester and is now working for Intermediate Technology in Rugby. He is specialising in the development and application of support programmes for small scale manufacturing enterprises in Africa, Asia and Latin America.

Brian Mathew who is with DFID in Zimbabwe is working on the Bakita Integrated Rural Water Supply and Sanitation Project which is concerned with small water supplies in the developing world. He is currently undertaking a part time PhD at Silsoe College.

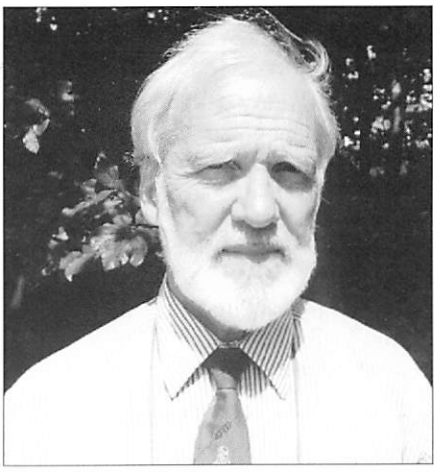
AAWC

Produced by: Land Technology Ltd, Edinburgh

Printed by: Barr Printers, Glenrothes

INSTITUTION of AGRICULTURAL ENGINEERS, WEST END ROAD, SILSOE, BEDFORD, MK45 4DU, UNITED KINGDOM. Tel: 01525 861096 Fax: 01525 861660

A forestry role for *fast* tractors?



James R Christie

This paper sets out the various forestry duties which can be performed by both custom-built tractors and forest-adapted agricultural tractors. Examination of these duties provides the advantages and disadvantages of both approaches. Suggestions are proffered as to possible duties where *fast* tractors may have a role to play. Future trends in the industry are also anticipated, together with the possible implications that these may have for *fast* tractor deployment.

This paper was presented at the IAgrE Scottish Branch conference entitled: "Fast Tractors", held at the Isle of Skye Hotel, Perth on 19th February 1997. James Christie MIAgrE is Plant Engineer, Mechanical Engineering Services, Forest Enterprise, 231 Corstorphine Rd, Edinburgh EH12 7AT.

The following opinions are based on the experiences of Mechanical Engineering Services (MES) which is that part of Forest Enterprise (FE) which purchases, owns and maintains all the vehicles, machines and equipment (VME) used by the Forestry Commission. The fleet is currently valued at £60 million and MES take great pride in the professional manner in which the VME purchased match exactly the complex, and often unique requirements of their customers *(Table 1)*. It has been demonstrated by various Market Testing exercises that no other organization exists in the UK which could offer a competitive service.

Seventeen workshops and some fifty mobile mechanics are strategically positioned throughout the country and focused on afforested areas which are not well served by other commercially available services. They are responsible for the repair and maintenance of all the VME, with minimum inconvenience to the users.

A recent shift in policy now allows us to make available to parties outside the Commission surplus equipment and facilities at competitive prices and, in fact, we are being encouraged so to do.

Definition of terms

Forestry The production of timber on a scale such that the majority of ma-

Tractor type	Number	
Custom- built forest tractors (skidders):		
Skidders (timber extraction)	9	
Skidders (adapted for basic cultivation)	5	
		14
Forest-adapted agricultural tractors:		
Skidders	6	
Skidders (semi-retired)	14	
Basic cultivation*	6	
Forest maintenance**	20	
		46
Standard agricultural tractors:		
Nursery duties	66	
Civil engineering	2	
Other duties	12	
		80
GRAND TOTAL		**140**

*Includes one JCB Fastrac 125
**Includes one Unimog U 1700 Ag

Table 1 Forest Enterprise tractor fleet statistics.

chines deployed are engaged in one specific task and are not required for multi-purpose duties.

Tractor A-self propelled prime mover with an off-road capability and the means of supplying power in a manner convenient for use by various other pieces of equipment.

Fast *Either* 70 km/h.

Or Having a suspension system, steering system and tyres which enable the tractor to safely achieve speeds greater than those which can be attained by other tractors not so equipped.

Current tractor deployment in forest operations

Forestry involves a wide range of duties which, depending of the scale of the enterprise, can require the use of tractors.

Nurseries

In a tree nursery, the work includes: basic cultivation, formation of beds, sowing, weeding, thinning, transplanting, various row-crop type operations to stimulate root development, and finally the lifting of the young trees ready for planting out in the forest.

Many tractors involved in these operations are equipped with 'crawler' gearboxes since low forward speeds are required, particularly when transplanting. We commonly demand tractors with cross-ply tyres for these duties in order to give maximum lateral stability and, although our nurseries are on flat ground, four-wheel drive is also regarded as essential, since it makes steering more precise.

Forest establishment

While the young trees are being produced in the nursery, the area to be planted is being prepared. Since Forest Enterprise is reducing its land holding, this inevitably means that the ground being prepared has already yielded a timber crop and is therefore strewn with brash and stumps.

Ploughing this type of terrain with large, specially built ploughs pulled by 110 kW+ crawler tractors is no longer commonly practised, since it is wasteful of energy, slow and extremely demanding on both man and machine. It also adversely affects the run-off of rain water, thus causing sediment deposition in water-courses.

The current selection of cultivation method varies greatly and is dependent on soil type, crop to be planted and the degree of natural degradation of the residual stumps and brash. The primary object is to expose vegetation-free mineral soil to allow the tree to be planted. Two basic techniques are used. One involves a mattock wheel which produces rows of scrapes and mounds into which the trees are planted; the other approach is to use a form of disc plough. The mattock-wheel cultivator is usually mounted on a forwarder chassis, a factor dictated by the need for lower ground pressures on the wetter soil-types where the mattock is deemed to be more suitable *(Figure 1)*. Other regimes may allow tractors to be used as prime movers.

The arm mounted mattock wheel is coupled to a disc brake controlled by a computer. This would be typically set to give a final plant density of 2200 plants per hectare. The lateral spacing is set by the mechanical adjustment of the carrying arm setting. When a tine is at the correct presentation angle, the disc brake locks it from further rotation causing it

Fig. 1 Caterpillar D6 with Mattock cultivator prepares brash covered land for planting.

Fig. 2 Timberjack 380A with disc cultivator powered by a Perkins donkey engine.

to act like a scarifier and scrape the soil into a mound ahead of the tine. The brake is then released and the mattock assembly rotates further, thus rolling the newly formed mound and compressing it to a suitably firm density determined by the downward pressure which is adjustable and regulated by the operator in accordance with the changes in the immediate soil conditions.

The brake is again released for a time proportional to the forward speed of the unit to produce the correct linear spacing of the planting sites. The forward speed is sensed by a transducer on the tractor drive wheel. Thus, the next tine rotates into the initial presentation position, and the cycle begins again. Three tined wheels offer the best compromise between mound profile and ground clearance for UK conditions.

All of the computer generated commands are overcome in the event of a tine contacting an unyielding object such as a boulder or stump, and the tine is allowed to take up a free-wheeling mode until the cycle can be re-established. Such events are sensed and triggered by pressure transducers in the various hydraulic lines.

The mattock wheel has also a small hydraulic motor so that it can be positioned for the correct initial presentation, and to run it in reverse to clear any accumulation of brash which can prevent the proper operation of the wheel. They are not regarded as powered in terms of function.

Forest Enterprise which is responsible for re-stocking one third of the UK forestry area has only one these machines mounted on a forwarder to ensure low around pressure and good traction. It is not uncommon for this machine to operate with band-tracks on all four bogies, a good indication of its deployment in the wetter soils.

The other cultivation method involves a serrated and dished angled disc which is normally driven by hydraulic power, although some smaller units are ground driven *(Figure 2)*. The addition of a donkey engine was tried to ensure that the disc speed would not be effected when the motive power requirement was high, but a better solution is to use a larger tractor providing power for both traction and disc rotation. This has the added advantage of better stability and balance resulting in a higher capability for two-way working.

A number of 4 wheel-drive agricultural tractors have been used in lighter conditions where it was possible to use ground-driven discs but they required rather complicated guarding, around the steering linkage, radiator and the sides of the engine compartment. The cab and tyres also required special treatment.

The *Forest Machine Journal* recently published some excellent practical advice on the adaptation of agricultural tractors for use in the forest. The information is extracted from a FERIC publication entitled "Equipping the farm tractor for forest operations" (McCallum, 1993) "The farm tractor in the forest", published by The National Board of Forestry, is a similar Swedish publication (Nilsson, 1982).

In order to avoid complicated steering-link guarding, the use of a large frame-steer agricultural unit was considered as an alternative. Inadequate ground clearance and cost mitigated against the building of a prototype. Things may have been different had the manufacturers been prepared to offer a realistic deduction for the three-point lift system which was not required. The fitting of larger diameter wheels would have overcome the first difficulty.

This type of disc cultivation treatment produces either two, more or less continuous scrapes, or the system can be programmed to lift and lower the discs to produce planting sites at predetermined densities. Forest Enterprise uses this approach on drier mineral soil types, reducing the risk of the sedimentation problems, and enhancing the suitability of a tractor as the prime mover.

FE's only *fast* tractor was purchased largely for use in the basic cultivation of previously clear-felled areas, with a secondary requirement to do general duties such as hedge and road-verge maintenance. In the Marches region which lies on the border between England and Wales, there was a requirement to fulfil a programme of cultivations spread over a scattered number of small forests. Traditionally, this had been worked by a County tractor which either spent much time on the roads driving between sites wearing out tyres, or waiting for, and travelling on, a low-loader.

Careful consideration was given to the *fast* tractor and two immediate problems were identified. One was that there were no tyres available which would survive both forest and high-speed road use, and the other was that some extremely complex guarding would have to be attempted.

Forest machine belly-plates normally operate with no apertures, are shaped like a boat's hull and are strong enough to support the full weight of the machine. Our *fast* tractor would have to have, not only holes, but slotted holes in its bellyplate due to the steering and suspension linkages. Ground clearance considerations dictated against the boat-shaped belly-plate and strength was compromised by the aforementioned slots and the flatness of the shape.

The purchase of two sets of wheels offered a somewhat inconvenient solution to the first problem, but the attraction of the potential flexibility for the other main-

tenance duties led us to purchase our first *fast* tractor. The guarding was heroically undertaken on behalf of JCB by Outreach Ltd of Larbert.

In operation, the unit is well regarded by the users and considered to be a resounding success. The operator rarely uses the 'road' wheels except when on maintenance duties. When involved in itinerant cultivation duties, he retains his 'forest' wheels, preferring to self-impose a speed ceiling rather than swap water ballasted wheels! Thus, a unique problem was solved by an effective but somewhat inelegant solution.

Maintenance of the growing forest

Once the trees have been planted out in the forest location, the site enters what is called the 'maintenance stage'. This involves the maintenance of drains and fences, the control of vermin and tourists, fire-prevention and, if necessary, fire-fighting. Drainage, fencing, hedge maintenance, scrub and grass cutting duties are identical to those involved in marginal agricultural operations and need no explanation here, but a mention of fire-fighting is appropriate.

Due to the massive reduction in manpower working in forestry, the fighting of forest fires is now almost exclusively the responsibility of the local brigade. South Wales, where arson is particularly acute, presented an interesting problem. It was discovered that the use of helicopters as a fire-fighting tool encouraged the arsonists in their activities and this increased the requirement for a rapid distribution method to be set up to replenish the ground based fire-fighting units in the front-line. Local brigades asked that the FE should adopt this supporting role of water supply.

In essence we required a vehicle that could rapidly self load up to 4000 litres of water, transport it rapidly on both tarmac and unmaintained tracks, and discharge the load equally rapidly. As a secondary consideration, it would be advantageous if it had a high pressure capability so that it could be used as a front-line unit from the road. Lastly and most importantly, whatever we bought had to be cost-effective and earn its keep. This meant that it had to be capable of other duties outwith the fire season (Easter).

There were two possible solutions, one based on a trailer-tanker with suitable capacity and pumping systems, pulled by a tractor, and the other based on a similarly equipped demountable tank carried by a suitable vehicle.

The tractor-trailer option, if based on a *fast* tractor at first seemed to be the best solution; it had the power and speed, convenience of pto drives for the pumps, and offered the potential to be deployed on a wide range of other duties outwith the fire season.

The demountable route was limited to the selection of a carrier with adequate payload and an acceptable rough-road capability coupled with a reasonable top speed. When considering cost and payload, the choice had to be made from the Unimog range of vehicles as it was in 1994. This created difficulties in identifying 'other uses' outwith the fire season. Other concerns were cornering stability when loaded and at speed due to the high centre of gravity of the demountable system and, not least, initial cost.

On balance, the *fast* tractor and trailer approach had many advantages but, after much discussion with the users (an essential part of our machine selection process), a Unimog U 1700 Ag with a demountable tank was eventually purchased *(Figure 3)*. The crucial factor in its favour was its ability to execute a rapid about-turn on a forest road should the unit become engulfed in a conflagration. The cornering worry was addressed by careful selection and training of the personnel allowed to operate the unit.

Felling

As the crop matures, the maintenance work continues but eventually the first thinning operation also commences. Thinning cycles are repeated for arboricultural reasons to enhance the final crop quality, but the availability of a lucrative market for the produce also plays a large part in the frequency and timing of these operations.

The exact timing of the final clearfell operation is also a complex decision. Within the industry, there are many contractors and small woodland operators who use tractor based thinning harvesters on 'forest adapted' agricultural tractors. Forest Enterprise do not own any.

Fig.3 Unimog with a demountable water tank used for fire-fighting duties in Morgannwg, Wales.

Winch-based extraction methods

'Forest adapted' agricultural tractors are used as a basis for ground skidding operations and, although FE have a number in use, none has been purchased in the last fourteen years. To put that into perspective, it should be noted that in the same period we have purchased eight custom built skidders but only two work as skidders. The others were bought to be prime movers for forest cultivation duties which has already been explained.

Within this area of work, another duty which is commonly linked with 'forest adapted' agricultural tractors is skylining. In the simplest terms, a skyline is a 'chairlift' for trees and consists of a tractor mounted tower which supports a fixed line on which a carriage is pulled to an fro by two winches powered by the tractor. As one winch pulls in, the other spools out. The outer end of the fixed line is supported by, and guyed to, care-

fully selected trees. A maximum range of 600 metres is generally accepted as the economic limit of operation. As well as tractors, other base units have been adapted such as trucks, excavators and forwarders.

Currently, there is a renewed interest in this method of timber extraction because of the lack of ground damage and its ability to operate on steep inclines. A clear requirement for the base unit to be positioned off-road is currently emerging, with a consequential demand for them to be built onto bases with better rough terrain performance than that available from the two-wheel drive agricultural tractor traditionally used.

Although demand for skylines is much increased, the total UK demand is unlikely to top six units per year and market saturation is a real possibility, since these are only economic for use in isolated instances. They are labour intensive in comparison to other available techniques so that, in the event of a timber price slump, they would be the first casualties

It is significant that tractors used as skyline bases for more than twenty years often have their tyres robbed from them and fitted to other units. This indicates that they operate almost entirely as stationary units and therefore they are unlikely to benefit from a high speed capability!

Timber forwarding

This term refers to the transportation of timber from the stump to the forest roadside by means of a self-loading carrying unit. At the roadside, the forwarder normally offloads into a stack for subsequent transfer to a road-going lorry for delivery to the end user.

In Forest Enterprise operations, this is almost exclusively done by custom built machines imported from Scandinavia, but other organizations and some contractors use forest converted tractors pulling timber trailers *(Figure 4)*. These trailers normally have a driven wheel system, walking beam suspension, and a hydraulic loader, but there are a number of variations.

The tractors are always 4 wheel-drive but, where the going is easy, it is common practice to drive the unit by means of the trailer transmission. This is done to avoid transmission wind-up between the tractor and trailer, since the matching of the tractor and trailer drive ratios is only approximate. Only in slippery conditions when wind-up is unlikely is the tractor transmission engaged.

Fig. 4 Tractor/trailer on forwarding duties in Scandinavian conditions.

The working method involving this forwarding process is, to an extent, driven by the road distribution pattern currently adopted by the forest industry in this country. Within FE forests, only one class of road is approved. It is capable of withstanding repeated passage of any road-legal lorry and so a definite boundary exists which separates the off-road part of the operation from the on-road part.

Innovation or evolution

Timber harvesting in the UK is an excellent example of an industry which has embraced both machine evolution, and fundamental changes in working practices largely driven by the availability of machines which never before existed. The forwarder evolved from the horse and sulky, through the tractor and trailer, whereas the harvester was created from a clean sheet of paper.

To market a machine which is an improvement on those currently available is much easier, and commercially less risky, than to build, develop and market a machine which requires a totally new working approach to be adopted before it can be used. Added to that are the problems associated with the retrieving of development costs of a new design over the limited potential market which exists in the forest industry.

Examination of the preceding 'Job Descriptions' of machines within the forest indicates that, for machines with a high speed capability to be introduced into forestry, we have to look at the possibility of changing well-established working practices.

A *fast* forwarder?

Timber carrying must be done by an off-road vehicle up to the road-edge. Downstream of this boundary, the most cost-effective method of carrying the timber is by road-going lorry; indeed, using off-road vehicles on-road does immense harm to the road.

If, however, this road building policy was to change and a intermediate class of road was to be introduced, it may be economic to employ a vehicle with better road speed than the current forwarder and with better off-road capability than the current road going-lorry.

This could throw up the possibility to use a *fast* forwarder in a situation where the end-user of the timber was relatively close to the forest. This machine could possibly be used from stump to mill, provided the forest floor conditions were not too severe. Or perhaps, if the distances were too great, it could be used to take the timber from stump to the end of the second class road, the final leg being undertaken by lorry.

In areas where conditions are more difficult, the load could be transferred from a conventional forwarder to a *fast* forwarder which would then take the load out of the forest to its final destination, again provided that distances were not too great.

It is unlikely that three separate machines would be cost-effective due to the expense of the extra loading and unloading operation that this would require. The possibility of using demountable bunks which would be loaded at the stump while on the rough-ground forwarder, and subsequently transferred from vehicle to vehicle until it reached its final destination

could be considered.

MES did a paper study on this technique some years ago and concluded that it would not be cost effective. The study was based on a Forwarder - Lorry system. It may offer a different result when based on a three vehicle system involving two classes of road and the forest floor.

The introduction of the *fast* tractor was as much a break-through in tyre design as it was in tractor design. A possible stumbling block for a high-speed forest machine, be it a forwarder or a tractor, will be the requirement for very special tyres which can offer robust multiply construction capable of running at low inflation pressures, and yet capable of high speeds without overheating. Perhaps on-the-move tyre inflation and deflation techniques will offer an answer.

It is interesting to note that the South African company, Bell, which makes civil engineering articulated dump-trucks has recently introduced a new dumper which is road-legal and has a top speed of 50 km/h. If it is possible for a dump-truck, it is possible for a forwarder; and if it is possible for a forwarder, then why not a 'forest adapted' *fast* tractor and a *fast* forwarding trailer? The FE is seriously considering its current road building approach along the lines outlined above.

Market potential in agro-forestry

Although FE have been able to identify an application for only one *fast* tractor within its operations, a closer analysis of the rationale behind its choice opens up the possibility for other organizations which operate on a smaller scale to be able to identify uses. Smaller operations demand versatility from their capital assets in order to ensure an economic level of utilization.

Dual, or even multipurpose, tractors are common on estates with forestry interests. They often have tractors which are deployed in normal agricultural duties as well as being used for timber-skidding by the addition of a three-point linkage, butt-plate and winch and minimal guarding. They may also fit a linkage mounted timber-loader and couple a forest trailer to do forwarding.

As in any versatile system, compromise plays a large part in the design and expectations of performance must be modified appropriately. Provided that these limitations are accepted, it may be that *fast* tractors can find a greater acceptance in the future in these areas.

Conclusions

Two not insurmountable practical problems have to be overcome before the *fast* tractor is mature enough for use on the forest terrain and on the highway.

One problem is tyres, and the other is the development of guarding around the relatively complex linkage associated with the suspension and steering. With these problems overcome and a preparedness within the industry to accept a change in working practices, we may yet see an increase in the *fast* tractor population in the forest.

As always, that preparedness to change will have to be driven by the certain prospect of lower costs and better productivity.

References

McCallum B (1993). Equipping the farm tractor for forest operations. FERIC Handbook No 11, Forest Engng Res. Inst. Canada.

Nilsson M (1982). The farm tractor in the forest. National Board of Forestry, Jönköping, Sweden. Trans.: Forest Extension Service, N.B. Dept Natural Resources, RR#5 Fredericton, New Brunswick, Canada E3B 4X6.

Scott Wilson Kirkpatrick in River Darent Action Plan

The Environment Agency has commissioned the firm to work on the Darent Action Plan, their flagship project aimed at alleviating low flows in the valley of the River Darent. Frequently in the national media spotlight, this river epitomises the increasingly contentious water resource issues between water supply demands and environmental requirements that have been exacerbated by the long running drought in S. E. England.

Scott Wilson Kirkpatrick are required to bring into commission three boreholes, pumping groundwater from the Chalk aquifer to augment summer flows within the river. The work will encompass environmentally sympathetic design of permanent headworks, pumping plant, power supplies, discharge lines and river outfall structures, contract supervision and construction management, H&S Planning Supervisor role, full testing and commissioning of the scheme. An important aspect of these works will be the design and integration of the sites as outstations within the Agency's existing telemetry scheme, to allow remote monitoring, control and operation.

In addition, we have been asked to organise an accelerated programme of emergency pumping from the boreholes during the coming months, whilst the permanent works are in process of construction, to immediately help alleviate the rapidly dwindling river flows.

This appointment further contributes to SWK's impressive record of experience and involvement in balancing environmental needs with those of the water industry, commissions during the recent past having produced: a national R&D study of low flows due to abstraction; augmentation borehole drilling and commissioning of permanent works for river (low flow) schemes in Lichfield and Bromsgrove; environmental appraisals of the Hiz, Oughton and Purwell rivers near Hitchin (all impacted by low flows); and Drought Orders for various rivers in Yorkshire.

Scott Wilson Kirkpatrick is an independent firm of consultants providing expertise in airports, environmental engineering, information systems, geotechnical engineering, maritime engineering, roads, bridges and tunnels, railways, structural engineering, transportation planning, town planning, water and wastewater. Over 2600 staff are employed worldwide at more than 50 locations throughout the UK and Europe, the Middle East, the Asia Pacific and Africa.

Contact: **Steve Booth (SWK), tel: 01256 461161**.

What a CE mark means to the welding equipment user

An important new guide available from Esab Group (UK) Ltd should be of interest to ail users of welding equipment. It focuses on the demands made by the new European Directives on manufacturers and suppliers for the protection of all welding operators.

All machines and equipment produced after 1 January 1996 are required to carry the CE mark. This mark indicates that these products meet the various Directives that must be complied with before they can be legally sold in the UK and the rest of Europe. It also means that the machine satisfies the EU regulations regarding safety and radio interference.

In brief, the Directives include Low Voltage Directive (LVD). This applies to power sources, wire feeders and other electrical equipment such as motor speed controllers. Torches and electrode holders should also comply with the LVD and be CE marked. Here, CE marking became compulsory on 1 January 1997.

The Electromagnetic Compatibility (EMC) Directive limits the amount of electrical interference that may be generated by electrical equipment and requires equipment to operate without being susceptible to interference. However, the welding arc is by nature 'noisy' and some interference may still occur.

The Machinery Safety Directive (MSD) applies to machines where there is an appreciable mechanical hazard. This Directive requires that mechanical hazards be assessed and minimised. Since 1 January 1995, mechanical welding equipment has required the MSD and CE marking.

Finally, there is the Personal Protective Equipment (PPE) Directive. This applies to the full range of PPE products, i.e. helmets, goggles, masks, clothing and filters.

The PPE, unlike other Directives, requires third party certification to European standards. Unfortunately, most of these standards are new and some have not yet been published. This means that many PPE products have changed or will have to change soon and will have different markings.

These EU Directives do not apply to products that are already in use. They apply only to products manufactured after the implementation date.

Second-hand and hire equipment which fall within the MSD or LVD must be safe as defined by the relevant Directives.

To ensure that the various regulations are adhered to, the Health & Safety Executive (HSE) and Local Authority Trading Standards Departments are in charge of policing. Either policing authority can stop the use of any machine that does not conform to the CE regulation and if a company does not conform, the penalty could be a fine of up to £5,000 and/or imprisonment.

For copies of this important guide, contact: **Esab Group (UK) Ltd, Hertford Road, Waltham Cross, EN8 7RP. Tel: 01992 768515.**

Training on rural roads

A course organised by the Transport Research Laboratory and Intech Associates on *Appropriate Technology Roadworks for Developing Countries* will be held on 22 - 26 June, 1998 and has been timed to immediately precede the TRL course on *Roads and Transport in Developing Countries* (29 June - 10 July, 1998) at the same venue.

The economic circumstances and available resources in many developing countries support the use of labour and tractor technologies as viable and appropriate options for road construction, rehabilitation and maintenance. This applies to both rural and urban roads. This course presents the opportunities for and justification of the range of alternative technologies, shows practical examples of their application, and advises engineers how to develop the environment and capability of their successful introduction. The course focuses on unpaved roads and alternatives to asphalt pavements.

Contact: **Overseas Centre, Transport Research Laboratory, Crowthorne, Berkshire RG45 6AU. Tel: 01344 770551.**

NIG moves from Edinburgh to Stoneleigh

The Health and Safety Executive's (HSE's) Agricultural Inspectorate has transferred the work of its Forestry, Agriculture and Allied Industries National Interest Group (FAAINIG) from Edinburgh to the Midlands.

The principal topics dealt with by the FAAINIG were: forestry, arboriculture, fish farming, game keeping, deer farming, all terrain vehicles (ATVs) and land drainage. All these will remain under one roof, they have now been assigned to the three sections of the Agriculture/Wood sector.

Greg Bungay, Head of the Ag/Wood sector said: "Although the sector no longer has an office presence in Scotland, it is not a case of 'out of sight is out of mind.' As a national interest group, we shall continue to play our part in securing, maintaining and, where possible, improving standards of health, safety and welfare in those industries whether they are in England, Wales or Scotland."

The NIG's new address is: **HSE, National Agricultural Centre, Stoneleigh, Kenilworth, Warwickshire CV8 2LV. Tel: 01203 696518**

New standards for crop protection

The British Standards Institution announces the publication of a further part of *BS 6356: Spraying equipment for crop protection.*

BS 6356: Part. 13: 1997

Air-assisted sprayers. Dimensions of nozzle swivel nuts.

No current standard is superseded.

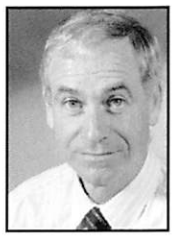
Price: BSI members £8.75

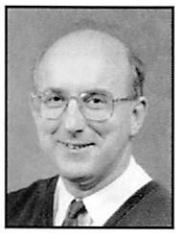
non-members £17.50

Contact: **BSI Customer Services, tel: 0181 996 7000.**

The economics of traffic control in combinable crops

W C Tim Chamen & Eric Audsley





Introduction

The adoption of any new system on a commercial farm is normally undertaken to improve the profitability of the enterprise. No farming business can afford to adopt systems just because they seem to be a good idea or are environmentally friendly. Any significant change to current practice needs to be rigorously assessed in terms of its economic impact. Although it may seem reasonably straightforward to do this on any given farm, it is not trivial to calculate how to adjust existing practices to make best use of the new system. Trying to predict the outcome on the hypothetical "average" farm is considerably more difficult. However, this was the aim of the authors when they undertook the task some years ago in relation to controlled traffic systems. This paper highlights the main results which were subsequently published (Chamen & Audsley, 1993). Although it has not been possible to update the 1990 prices, some additional crop yield information has been included in the study.

The economics assessment

A mathematical model (Audsley, 1981) was used to consider the whole farm economics of a number of controlled compared with conventional traffic systems on a farm growing combinable crops. The model was able to look at all factors which influence farm profitability, including rates of work, timeliness of operations, crop rotations and soil type as well as the more generally accepted costs of labour, machinery, etc. Thus, for example, the study started by considering differences in soil resistance for both primary and secondary cultivation, under the differently trafficked regimes, to determine cultivator rates of work. The main aspects considered are highlighted in the following sections.

This paper was presented at the IAgrE conference entitled: "Profit through traffic control?", organised by the Soil & Water Specialist Group and held at Silsoe College, Cranfield University on 20th November 1996. Tim Chamen MIAgrE who organised the conference runs an engineering consultancy, 4 'C'easons, Church Close Cottage, Maulden, Bedford MK45 2AU. Eric Audsley is Head of Mathematics and Decision Systems Group, Silsoe Research Institute, Wrest Park, Silsoe, Bedford MK45 4HS.

The machinery and crop production systems used in the study

Table 1 lists the five machinery systems which were compared. Three tractor sizes were available to the conventional system (56, 75 & 112 kW (DIN)) while the gantry systems (see Chamen, 1997 for description of gantry tractors) used engines with 70 kW (12 m gantry) and 125 kW (6 m gantry). The 6 m tractor system (T6) could use only the 75 and 112 kW tractors. As it was impossible to plough with the T6 system, it was assumed that a 6 m combined disc and share cultivator would be used to incorporate surface residues and create a tilth. The gross margins of wheat and barley were reduced by £57/ha with this system to allow for additional weed control measures (ADAS, 1988). Medium and heavy soils were compared, these represented by ploughing resistances of 70 kPa and 120 kPa.

Cropping and yields

The model was programmed to choose the most profitable crop rotation for each system. Crops which it could choose were: winter wheat; barley and beans; and spring barley and beans. Oilseed rape could be grown on up to 25% of the total area. In line with research data up to 1996, crop yields on completely non-trafficked soil were increased by 15%, and estimates for other systems were based on this figure and the degree of wheeling on the cropped soil. Yield loss from the permanent wheelways or annual tramlines was assumed to be equivalent to half the area lost.

Primary cultivation

Plough resistance on the non-trafficked and partially trafficked (PG) heavy soil was reduced by 45% and 15%, respectively. This was in line with research results from a number of countries (Soane & van Ouwerkerk, 1994). On the medium soil, these savings were reduced by a factor directly proportional to the difference in the ploughing resistances of the soils. Ploughing in all cases was at 200 mm depth, while the T6 straw incorporator worked to around 150 mm depth. With the latter, some allowance was made for cultivating out compaction caused by the wide wheels of the combine harvester lapping over onto the cropped area. Where two widths of gantry were used

Table 1. The five machinery systems used in the study and their abbreviated names.

Machine system	Description	Effect on yield, %	Tyre width, mm
Conventional (CT)	Conventional tractor- based plough system with implement widths to suit the tractor power and soil type.	-	458
6 m tractor (T6)	Tractor-based controlled traffic system using a straw incorporator; all implements in multiples of 6 m width; machines with a common track width used at 6 m centres, 6 m combine harvester.	+15	532 [1]
Partial gantry (PG)	Ploughing and harvesting with conventional equipment. All other operation, including transport, with a multi-purpose 12m two-wheel drive gantry.	+7	488
Two gantry (G6/12)	Ploughing and harvesting with 6 m wide four - wheel drive gantries. All other operations, including transport, with a multi-purpose 12 m two-wheel drive gantry.	+10	488
6 m gantry (G6)	All operations, including harvesting, with 6 m four-wheel drive gantries.	+15	488

[1] The combine harvester wheels were assumed to be 800 mm wide, see section on primary cultivation

(G6/12), the additional wheelway was removed during primary cultivation and the work rate for this system was reduced by 10% as a result. In all the controlled traffic systems, allowance was made in terms of work rates to allow for the width of wheelways not cultivated.

Secondary cultivation

Defining the secondary cultivation work rates was particularly difficult because of the large number of alternatives. To maintain comparability, the aim was to achieve a common seedbed quality regardless of the traffic system employed. Thus, the cultivators and their speed of operation were selected systematically based on the energy input required. In practice, these consisted of a draught operation depicted by a spring tine, and a powered cultivation represented by a power harrow. Thus on heavy soil, the conventional system used both of these implements, while the controlled traffic systems used only the power harrow. Similarly on the medium soil, one or two passes of the spring tine were used appropriately. Forces on these cultivators were adjusted in the same manner as for primary cultivation. All crops were rolled where necessary and a common figure of 4.4 kW/m at 7 km/h was used for this operation. Where width of roll was limited, speeds were restricted to 7 km/h.

Sowing and chemical applications

Work rates were calculated from first principles using hopper and bowser sizes, etc., appropriate to each system. An average 1 km travel distance from the farmstead was assumed and various different travel and field speeds were selected. The main variation in these was between the gantry and tractor systems, where spray and fertiliser application speeds were increased from 8 km/h for tractors to 8.7 km/h for gantries. (These data were based on research still being undertaken at that time. When this was published subsequently (Chamen *et al.*, 1994), speeds of 8.7 and 10.0 km/h for spraying and 10.5 and 13.0 km/h for fertiliser application were reported, respectively.) For drilling with the controlled traffic systems (where rolling resistance losses are lower, no wheel eradicating tines are needed and draught is less) it was assumed that only half the axle power was needed for a given forward speed (see also Tullberg, 1996).

Harvesting

Work rates for harvesters were based on a 6 m, 163 kW combine harvester having a gross output of 20 t/h in wheat. Work rates for other sizes of harvester were pro rata with engine power. For all systems, the model was allowed to choose the most

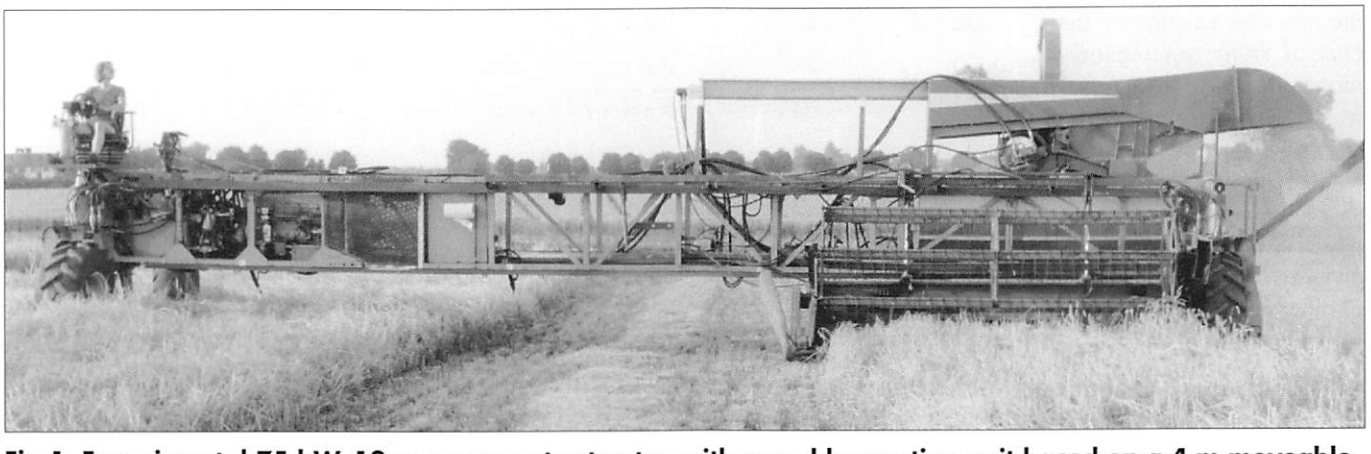


Fig.1 Experimental 75 kW, 12 m span gantry tractor with cereal harvesting unit based on a 4 m moveable header and threshing system.

Table 2 Examples of some of the machinery prices used in the study.

Machine	Purchase price, £		
	Tractor systems	Gantry systems	
75 kW 2-wd tractor	21,012	62,000	(70 kW)
112 kW 4-wd tractor	43,211	85,500	(125 kW)
Plough & press (4 furrow)	6,680	5,360	
4 m power harrow	7,000	7,000	(6 m)
6 m spring tine cultivator	6,000	3,840	
6 m drill	9,500	4,000	
6 m, 163 kW combine harvester	93,635	95,000	

profitable transport system. Thus for the conventional system, two tractors and trailers were selected, while because of the high cost of gantries, the model generally elected to use only one 12 m gantry for transport. This effectively reduced the net output of the 163 kW gantry harvester from 14 t/h to 12 t/h. *Figure 1* shows an experimental 12 m gantry harvesting with a 4 m wide moveable header.

Costs

The majority of the prices for the equipment were obtained from the Farm Management Pocketbook (Nix, 1990), but best estimates and some known prices for gantries were also used. As gantries can provide full width support for implements, and no folding is generally needed for road transport, equipment can be lighter and cheaper than tractor mounted equivalents. The price of a commercially built 12 m wide cultivator for a gantry was therefore used as the basis for calculating the cost of some other gantry mounted implements. A factor of 0.64 was identified compared with conventional equipment. Gantries and tractors were assumed to have the same operational life, while labour was costed at £10,000 per annum. *Table 2* provides some examples of the prices used.

Results

Table 3 shows the farm gross margins (FGM) for each of the systems studied on a 250 ha farm and for the scenarios described. The FGM in this case is the net return on the cropping enterprise but without deduction of the fixed costs of land, buildings and administration. These results assume an infinitely variable solution, i.e., the model is allowed to select fractions of machines, vehicles and labour. In general, restricting the model to whole numbers has a limited effect on the FGM, but in a number of instances this was not the case. With the T6 system, a minimum farm size of around 500 ha was required to fully employ the machinery needed, i.e., the model was using 0.4 and 0.5 of various tractors and machines on 250 ha. This was also true for the conventional system on medium soil, and here a farm size of around 400 ha would be needed. Results for the G6 and G6/12 gantry systems also suggest a minimum farm size of around 400 ha as a viable unit.

It can be seen that all the systems, other than the part gantry system, are more profitable than conventional practice, particularly T6 and G6. In the case of T6 it was assumed that the extra £57/ha spent on chemicals was able to maintain the yield of all crops to the level of conventional practice. In today's climate of concern over excessive chemical use, it may be of interest to consider not using these extra chemicals on this treatment. From the yield effect percentage for the T6 treatment listed in *Table 3*, calculation shows that yield on the heavy soil would have to fall by around 23% before the FGM was reduced to that of the conventional system. Obviously this provides scope for introducing other means of weed control; perhaps chemical application combined with inter-row weeding and/or rotational ploughing in dry seasons when the latter would cause little soil damage. Results for the G6 system are encouraging and, compared with G6/12 , almost certainly reflect the saving in number of gantries. (G6/12 employs a 6 m gantry harvester, a 6 m primary tillage gantry and a 12 m secondary tillage and transport gantry). The argument that profitability will be compromised because the main gantry cannot be used for field operations while transporting grain, does not seem to hold water (timeliness of sowing is a major factor within the model). The model also imposes restrictions on the days available for carrying out cultivations and other tasks.

Table 3 Farm gross margins on a 250 ha farm for all of the systems and basic scenarios described.

Machine system	Wheeling centres, m (tramlines)	Net rate of harvesting, t/h	Farm gross margin on two soils, £/ha		Yield effect on two soils, £/%	
			Medium	Heavy	Medium	Heavy
CT	24[2]	14	311	275		
T6	6[2]	14	343	357	5.4	6.1
PG	12[1]	14	314	239	6.4	7.0
G6/12	12[1]	12	332	295	6.2	7.0
G6	6[1]	12	351	349	5.9	6.9

[1] One wheelway at specified distance [2] Two wheelways at specified distance

Profitability of the partial gantry system was constrained by low power availability and the fact that even a low intensity of wheeling seems to have a detrimental effect on soil conditions and crop yield. It seems logical therefore that a system of this nature should be run in parallel with some control of conven-

Table 4 Results of tests to determine the effect of different assumptions associated with, or constraints to, the controlled traffic systems employed.

Change to system	Machine system	Effect on FGM, £/ha	
		Medium soil	Heavy soil
• 70 kW gantry price reduced to £50,000	PG	+20	+21
• Double engine power of 70 kW gantry to allow faster power harrowing: increase price to £78,000	PG	+20	+21
	G6/12		+17
• Restrict conventional system to 56 kW tractors post ploughing	CT	-19	-56
• Labour cost increased from £10,000 to £14,000/a: effect relative to CT	T6	+6	+16
	G6/12	+4	+10
	G6	+5	+13
• 20% reduction in crop prices: effect relative to CT	T6	+13	+15
	G6/12	+1	+4
	G6	+5	+6
• Subsoil 1 year in 4 on CT system	CT	-8	-20
• Straw incorporation on CT rather than ploughing	CT	-23	-13
• Net harvesting work rate increased from 12 to 14 t/h	G6/12	+6	+8
	G6	+6	+7

tional wheelings. Further analysis of this system is provided in the next section. There are also other arguments for the adoption of a partial gantry system whose monetary values are difficult to define. These are listed in a paper on gantry tractors (Chamen, 1997). One of these advantages, for example, could allow use of the power harrow or other secondary cultivators at a much shallower depth because there are no wheel ruts to cover up from the tractor in front.

Sensitivity tests

This is really a "what if" section. Although we have used well documented research results for most of the assumptions made in the comparisons, the extent to which these would be experienced on any given farm is uncertain. Results in *Table 4* therefore provide us with the opportunity of seeing how changes to the system affect the FGM.

The first two comparisons allow us to assess the effect of changes in gantry cost and engine power. Capital cost changes profit for the PG system by £1.75 per £1000 on the heavy soil, suggesting that the additional cost of the more powerful gantry should reduce its profitability by around £28. The actual result shows that this £28 has been more than offset by the increase in power, which in effect has increased profitability by £28 + £25. The next comparison confirms the large effect of engine power on heavy soil, and in fact shows the penalty which the PG and G6/12 systems are paying by having an under-powered gantry. (As transmission losses on a gantry are about 10% greater than on current tractors, the 70 kW gantry is only a little more powerful than a 56 kW tractor).

An increase in the cost of labour has a positive effect on the profitability of the controlled traffic systems compared with CT. This is slightly artificial, however, in that one is unlikely to have a large increase in labour cost without other costs also increasing. The 20% reduction in crop price shown in the next test is, unfortunately, far more probable in today's uncertain world. Here again, the controlled traffic systems show a great degree of resilience and persuade us further in their direction.

We were uncertain about including subsoiling within these comparisons for reasons which are unfortunately too lengthy to include here. Suffice it to say that we are reasonably happy that this shows a true picture of normal practice, and is an additional cost to the CT systems which would *not* normally occur within a controlled traffic regime.

The effects of straw incorporation on the CT system show the penalty of not being able to plough with T6, this being of greater detriment on the medium compared with the heavy soil. The final comparison enables us to assess the restriction of transporting crop with only one gantry, due to the cost of the latter. Perhaps a less sophisticated lower cost gantry, designed specifically for transport operations, is needed. It is certainly not logical to employ a tractor in this system, unless it is restricted to a specific headland path where perhaps only a couple of extra wheelings would be imposed.

Conclusions

Machinery systems which completely isolate the cropped and wheeled areas within a field were more profitable than a system employing random traffic. This was true for both a 6 m tractor-based controlled traffic system, where over 17% of the land was lost to wheelways, as well as for gantry tractor systems where these losses were considerably smaller. Increased profit was due primarily to lower tillage inputs, improvement in yield and some implement cost savings. The provision of more than adequate engine power to the gantry systems was particularly important in maintaining their profitability. Increased labour costs and reduced crop prices both improved the competitiveness of all the controlled traffic systems compared with conventional practice.

References

Agricultural Development and Advisory Service, 1988. Gross Margin Budgets, 1988: Arable Crops, ADAS, London, 46 pp.

Audsley E (1981). An arable farm model to evaluate the commercial viability of new machines or techniques. *J. agric. Engng Res.*, **26**: 135-149.

Chamen W C T (1997). Gantry tractors as a basis for traffic control? *Landwards*, **52** (1): 10-14.

Chamen W C T, Audsley E (1993). A study of the comparative economics of conventional and zero traffic systems for arable crops. *Soil and Tillage Research*, **25**: 369-390.

Chamen W C T, Dowler D, Leede P R, Longstaff D J (1994). Design, operation and performance of a gantry system: experience in arable cropping. *J. agric. Engng Res.*, **59**: 45-60.

Nix J (1990). *Farm Management Pocketbook.* Wye College, University of London, 203 pp.

Soane B D, van Ouwerkerk C (editors) (1994). *Soil Compaction in Crop Production.* Elsevier Science B.V., P.O. Box 211, 1000 AE Amsterdam.

Tullberg J N (1996). Tractor based systems for traffic control in Australia. Paper presented at the Institution of Agricultural Engineers National Conference, Profit Through Traffic Control?, November. IAgrE, Silsoe, UK.

Branch Diary

South East Midlands Branch

Saturday, 18th October 10.30am
Rally Karting
(Social Event - Shefford)
Contact Secretary by 26th September

Tuesday, 28th October at 8.00pm
Silsoe College, Englands Hall
The Lotus Elise - Back to the Future by Tony Shute, Lotus Cars.

Monday, 3rd November at 7.30pm
Silsoe College, Dining Room
Using Virtual Reality to Improve Safety in Equipment Based Operations by Bryan Denby, University of Nottingham.

Monday, 1st December at 7.00pm
Silsoe Research Institute, Conference Room
Improving the Welfare of Farm Animals During Road Transport -Solutions! by Peter Kettlewell, Silsoe Research Institute.

Monday, 12th January at 7.30pm
Silsoe College, Dining Room
Research Papers:
Spray Deposition in Cereal Crop Canopies by James Alford, Silsoe Research Institute;
Optical Method for Assessing Fruit Quality by Agus Margiwiyato, Silsoe College;
Plastic Mulching Techniques for Maize by Robert Merrall, Silsoe College;
Variable Application of Applied Nitrogen by Martin Peters, Silsoe College;
The Recognition and Tracking of Animals by Neil Sumpter, Silsoe Research Institute;
Engineering, Ethology and a Sheepdog by Richard Vaughan, Silsoe Research Institute.

Hon Sec: D Pullen Tel: 01525 863038

Scottish Branch

Wednesday, 8th October at 7.30pm
Moredun Foundation, Pentland Science Park, Bush Estate, Penecuik
Genetic Engineering in Agriculture by Professor John Clark, Roslin Institute.

Tuesday, 28th. October at 7.30pm
SAC, Auchincruive
Animal Traceability and Quality by Brian Simpson and Peter Brown.

Wednesday, 19th November at 7.30pm
Aberdeen University, Fraser Noble Lecture Theatre 1
Renewable Energy - Where Now in Scotland? by Alastair Hunter, SAC.
(Joint meeting with IMechE)

Wednesday, 10th December at 7.30pm
Lomond Hills Hotel, Freuchie
Modern Diesel Engine Development.

Hon Sec: G Owen Tel: 01968 675943

Video Reviews

During the last few months I have received two videos to review. What follows is the result of my mastering, at last, most of the switches on my set at home.

ROADLESS TRACTORS

This video runs for 52 minutes, is narrated by broadcaster Alan Stennett and is available at £15.99.

As with other videos from Farming Press, it is extremely well crafted and retains the viewer's interest throughout.

It is basically a film of the history of Roadless from the pioneering work on tank track design during the First World War, which led to Roadless and the development of a range of tracks and half tracks until its closure in 1983.

It contains unique archive footage from the 1920s showing many of the early Roadless vehicles. Much of the later film is that shot by Roadless' sales manager, Van Dodge. As such, it is very much a "company sales manual" on film and a very good one at that.

I am sure it will appeal to the enthusiast and, for them, it is a must; for the rest of us, it is interesting but not our first buy.

CLASSIC COMBINES 1930s to 1990s

This video, by Brian Bell, runs for 59 minutes and retails for £15.99.

As with his previous videos (Classic Farm Machinery, etc), Brian Bell has brought together some excellent archive material and woven it into an excellent presentation.

Some of the footage of early reapers and horse/mule drawn machines is remarkable. On top of this there is a mass of company machines, many probably almost forgotten. So once again we have a stroll down memory lane, extremely well presented and targeted at those with interest in our "machinery past". If this is your "bag" then go for it, you will get hours of pleasure.

MJH

Plough settings and ploughing on video

A 40 minute video guide to achieving optimum plough settings and operation is now being supplied free of charge to all buyers of new Dowdeswell ploughs.

Mailed to customers following receipt by Dowdeswell of the plough's registration card, the professionally-produced video is intended to help novice and experienced ploughmen and women extract peak performance from the implement.

Opening with a history of the development of Dowdeswell ploughs over the past 27 years, the video introduces the main components of the plough and the principal interchangeable soil-working parts available from Dowdeswell to suit different soil types and field conditions. Also covered is the setting-up by ploughman, Keith Williams, of the tractor and plough in the farmyard and the field, together with a guide to good ploughing techniques and the correction of common faults.

The video concludes with a visit to the British National Ploughing Championships, where the camera focuses on the work of 1995 reversible champion, Peter Waters, who is also Dowdeswell's service engineer for the eastern counties of England.

For a copy of the video, contact: **Dowdeswell Engineering, Blue Lias Works, Stockton, Rugby, Warks CV23 8LD. Tel: 01926 812335.**

Thwarting the thieves with hydraulic starters

In rural Africa, batteries are an important part of life and are used to power necessities such as fridges, televisions, agricultural machinery and lighting. In areas where there is no electricity, 12 volt batteries can be charged during the day by solar panels in order to give enough power during the night. Unfortunately, there is a real problem with thefts and batteries feature high on the thieves' "shopping list".

Therefore, a mini hydraulic starting system which does away with the need for a battery is an ideal solution to this problem. For example, on a basic tractor used for general work, there is no need to have lights, alternator or dynamo; so there is no need for a battery. The mini system can also be fitted to irrigation pumps and marine applications.

This mini hydraulic starting system is easy to maintain and service which is useful in areas where there is often very little skilled labour and the electrics can deteriorate during the long periods between seasons. It is suitable for engines up to approximately 12 litres and can be fully primed in around 20 seconds. The system is 43 cm x 20 cm x 38 cm (HxWxL).

Industrial Power Units Ltd have over 25 years experience in the starting market, covering all related applications - from mining to offshore applications. IPU aims to provide a total solution for starting needs, from consultation through design to commissioning.

Contact: **David Caddick, IPU Ltd, Sutherland Ave, Wolverhampton WV2 2RA. Tel: 01902 452138**

Pro Wash from Peal

Peal Engineering, the Lincolnshire based agricultural machinery manufacturer, has launched a high output Pro Wash system for growers supplying the processing industry.

The basic machine, suitable for processing potatoes and vegetables, comprises an inclined continental web elevator with height adjustment and overhead spray bars. This feeds onto 16 rows of special brushes which have overhead spray bars, followed by 3 rows of rubber-covered rollers to disperse the water. All of the water is re-circulated after collection in a common tank.

The collected water is circulated via an integral pump to the Pro Cleaner, a mobile water reclamation plant. Water is pumped into a wedge wire screen and debris over 1 mm is scraped off and discharged into a skip. Water passing through the screen is diverted into the tank via a series of weir plates which encourage the solids to settle. In the bottom of the tank, there is a scraper chain which is controlled by a timer. It operates according to conditions, scraping the sludge and ejecting it into a suitable receptacle. The pump in the tank creates a flow and returns the water to the spray bars on the Pro Wash unit.

The Pro Wash unit is fully mobile and additional equipment can include a 2 metre long integral pre-soak tank, sponge drier, and roller table, in any combination. Price of the Peal Pro Wash begins at £20,000 + VAT.

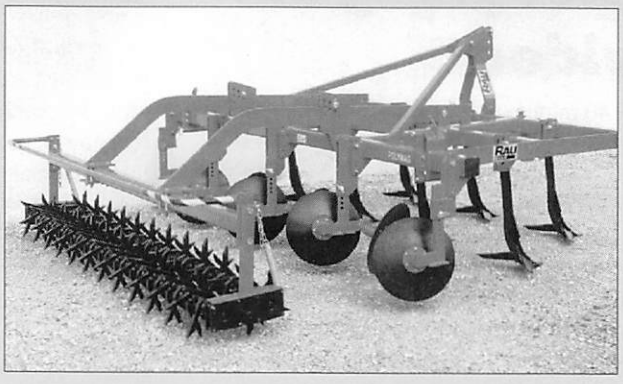
Contact: **Alan Toon, Peal Engineering Ltd, Boston Road Industrial Estate, Horncastle, Lincolnshire LN9 6EL. Tel: 01507 522888.**

RAU land power STARTiLLER

The new RAU STARTiLLER consists of land-driven twin rollers with tangentially fixed tines which have a high wear resistance and require practically no servicing. In addition, they offer a high degree of versatility.

The double rollers crumble and mix the soil both intensively and consistently, whilst at the same time having a unique self-cleaning action. The penetration angle of the tines helps to consolidate the soil especially at seeding depth.

The STARTILLER is multi-functional and can be used together with a spring-tined cultivator and drill combination as a fast, low-cost alternative to a power harrow. Alternatively, when used in conjunction with the POLYMAG cultivator, replacing the standard pipe roller, the STARTiLLER both enhances straw incorporation and improves reconsolidation which stimulates the germination of weeds and volunteers and minimises moisture loss.



Designed for use at speeds of up to 11 km/h, and currently available in 3 and 4 metre working widths, the additional cost of a 3 metre POLYMAG complete with STARTiLLER is £650.

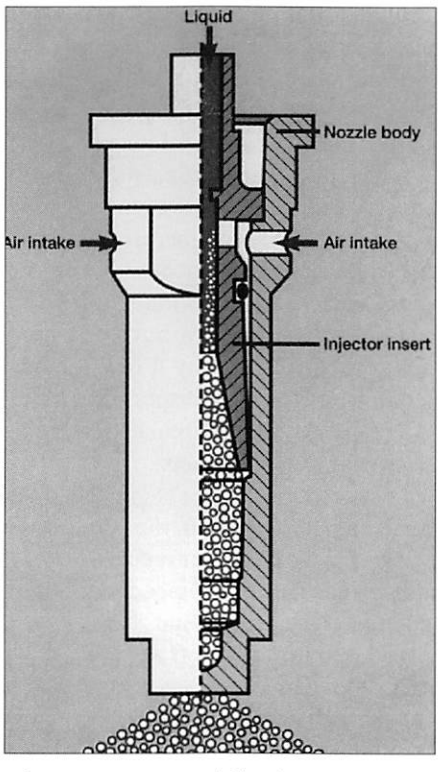
Contact: **G.E. Randles, Ferrag Ltd, P.O. Box 90, Haydock Lane, Haydock Industrial Estate, St Helens, Merseyside WA11 9UU. Tel: 01942 272777.**

New agricultural spray nozzles from Lechler

Lechler, a leading manufacturer of nozzles and spray systems, has developed a new range of air injector nozzles specifically designed for agricultural spraying applications.

The new aerated flat jet nozzle has a 120° spray angle and is designed to maximise coverage and minimise wastage. Drift is up to five times less than conventional flat spray nozzles, and spray distribution is exceptionally even. The nozzles, which come in plastic or ceramic, are compatible with Lechler's 'Twist-Loc' quick release system for simplicity of operation and servicing.

Lechler was established in 1879 and now supplies nozzles and systems worldwide, solving the problems of a vast range of industries from surface finishing, de-scaling steel, tank cleaning and odour control to applying icing to buns! The company has been involved in agricultural spraying for many years, designing nozzles in co-operation with agrochemical manufacturers, original equipment manufacturers, major research authorities and National Advisory Institutions in many countries world-wide.



The new aerated flat jet nozzle from Lehler.

The product range now includes nozzles for the application of herbicides, fungicides, insecticides, liquid fertilisers, bio-regulators and for irrigation, via boom, band, orchard or knapsack sprayers. These different applications require different types of nozzles, to achieve the required biological effect. Optimisation of droplet range and spray volume (volume rate per hectare) is essential and Lechler's nozzle selection guide shows the recommended nozzle for most applications - nozzles are grouped according to international colour coding, and exterior dimensions correspond to this international standard so are interchangeable with any manufacturers spraying equipment. Also available are a Drop Size Calculator and Dosage Calculator, together with a wide range of spraying accessories. Technical information is also available at http://www.lechler.com on the Internet.

Contact: **Bill Sheldon, Lechler Ltd, 1 Fell Street, Newhall, Sheffield S9 2TP. Tel: 0114 249 2020.**

Security tagging

A supplier of innovative, transportable security solutions has just launched a new range of electronic security tags and a hand portable base station. **Tag Guard** systems can now protect most items of equipment, materials, stores and buildings. Using differently configured hardware, the systems can protect against fire and theft, both outside and inside buildings.

The battery operated tags use technology pioneered in the UK. The new tags supplement the original range, extending the use of tagging to the agricultural industry. A **Tag Guard** system can now secure almost any remote farm location, even if it does not have a mains power supply. The advent of this technology means thieves cannot strike anywhere and be confident their actions are undetected.

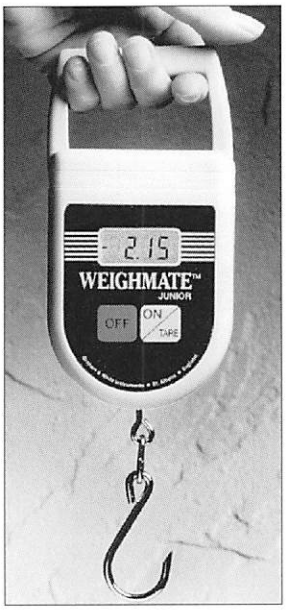
A 240 V supply normally provides the power to the single base station located on site, but in remote areas, two 12 V vehicle batteries will do equally well. The base station can monitor and control up to 150 tags within a 300 to 350 metre radius. An appropriately configured tag then protects each piece of machinery, fence, or building against fire or theft. If activated, a tag sends a signal, via the base station, to either a local centre or a central monitoring station from where staff will raise the alarm. The system tracks all events and is open to complete audit.

As **Tag Guard** sensors communicate using radio, they do not require hard wiring and an installation can be substantially cheaper than CCTV. A system can protect one site and then be moved to protect a different risk. It takes, typically, around an hour to set up the base station at a new location. As each item of machinery, building or fence has an individual tag, the system, if correctly deployed, is not susceptible to blind spots.

Contact: **Richard Lang, Tag Guard Ltd, Blendworth Farmhouse, Blendworth, Horndean, Hampshire PO8 0AG. Tel: 01705 598218.**

Portable digital scales

The **WEIGHMATE** ***'Junior'*** portable, digital, hanging scale is claimed to offer- a number of important advantages over conventional dial scales.



It is not necessary to interpret correctly, readings from needle & dial instruments - just read the liquid crystal numerical display. No need to make mechanical adjustments - just press the 'TARE' button and weigh. Capacities of 15 kg, 25 kg and 50 kg and higher are available. The unit is housed in a robust -ABS plastic enclosure, and operates from a 9 V dc battery.

It has a wide range of applications in industry and commerce such as, check weighing, batch weighing, HSE manual handling regulation checks, post room weighing, recovered refrigerant measurement and, in fact, wherever traditional scales are used.

Contact: **Mr J Beck, Graham & White Instruments Ltd, 135 Hatfield Rd, St Albans AL1 4LZ. Tel: 01727 841692.**

Final evaluations for Krone Big M mower

After two seasons of evaluation in the hands of farmers and contractors, the Krone self-propelled Big M mower from Bemard Krone (UK) Ltd is to be marketed with final modifications to suit UK conditions from next spring. Powered by a John Deere 225 kW diesel engine, the four-wheel drive machine has a cutting width of 9.1 metres.

Drive is hydrostatic through radial piston motors on each equal size wheel and a three speed transmission, giving speed ranges of 0 - 10 km/h, 0 - 20 km/h and 0 - 40 km/h, the latter speed range being for road use with the drive to the front pair of wheels only.

Changes to the original prototype, first tested in 1995, include an improved turning circle (9 metres) and increased fuel tank capacity to 460 litres. Other detail changes are scheduled prior to commercial production.

Main features of the Big M include hydrostatic steering, three 3.2 metre mowing units, each with 'V' tine conditioner and hydraulic folding from the 9.1 metre cutting width, to 3.0 metres for transport. Like other Krone mowers, those on the Big M have the facility to alter cutting height and the position of the conditioner elements to suit differing crops and conditions. The conditioners can also be operated at either 700 or 1,000 rpm by simply turning a lever on top of each mower module.

The price of the Krone Big M self-propelled triple mower will be announced when final modifications have been made.

Contact: **Tony Hird, Managing Director, Bemard Krone (UK) Ltd, Gainsborough Trading Estate, Old Road, Southam, Warks CV33 0HP. Tel: 01926 817161.**

Shering lands largest ever weighbridge order

Shering Weighing has received a major order from Hampshire Waste Services for computerised weighbridge systems.

Hampshire waste Services are the waste management contractor for Hampshire County Council and are responsible for implementing a 25 year integrated waste management plan which includes recycling, composting, incineration and landfill operations. As part of the project, they were looking for accurate weighing and data capture at all their locations. Long-term reliability and user-friendly operation were also important, along with site to Head Office electronic transfer.

Shering's weighbridges, incorporating their Sabre 8000 software provided the solution. Designed to provide superior structural integrity over many years, the weighbridges feature patented technology which, combined with shot blasting of all steelwork and an anti-corrosion finish, further enhances lifespan and reliability. A mixture of 9020 surface mounted and 5020 pit/surface mounted models will be used at the sites, with Shering also providing a two hour service facility and on-line software support. The company has also introduced new traffic management systems, including traffic lights, intercoms and CCTV, to work in conjunction with the weighbridge system.

Richard Bray, Hampshire Waste's Operations Director, states: "Following extensive investigations into the weighbridge market, Shering Weighing Ltd were selected as a result of their superior weighbridge technology, quality, software and service support. Their technical ability is most apparent in the structural design of their decks which incorporate several patented features. In our organisation, we recognise the vital importance of an accurate weighbridge system to maximise our profitability. Shering's total quality solution provides us with the answer, giving significant financial benefits for the twenty five years life of our contract. Shering's ability to design, manufacture and support their entire range 'in-house' was also a key factor in our decision to place the order with them."

Contact: **Jack Gold on 0131 228 2939.**

Award winning tillage equipment reduces costs

By utilising the latest tillage techniques, fewer, more efficient passes are needed, reducing both labour and machinery costs. Väderstad, the Swedish machinery manufacturer has added the Rollex Crossboard Roller to the range, further developing the concept of utilising inputs most efficiently whilst optimising yield possibilities.

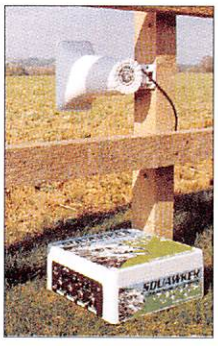
The Rollex Crossboard Roller, a Royal Highland Show Silver Medal Award winner, combines a series of levelling boards with self cleaning, hardened coil steel tines which crush clods, even out ridges and fill holes. The self cleaning tines ensure effective tillage even under moist conditions and where straw residues are present.

On heavy land and stiffer clays, the angled wear plates claw at the surface, grinding down the clods efficiently. Levelling capabilities can be varied easily using the hydraulics, pushing a wall of soil in front of the Crossboard and making the tillage effective even in varying soil conditions and after rough ploughing.

Contact: **Lars Hannell, Väderstad. Tel: 01909 561234.**

The ultimate bird deterrent

Totally green and environmentally friendly, the species specific "Squawker" uses a combination of natural predator calls and bird distress and alarm sounds to convince invading flocks that the crop area is completely unsafe and must be avoided. The countless benefits of the system will quickly establish the "Squawker" as the ultimate in pest-bird deterrents



with widespread applications both within the farming industry and beyond.

Two years of field trials have proved the effectiveness of the "Squawker" which, for maximum efficiency, should be installed prior to crop damage occurring, as the equipment is designed primarily to be a deterrent as well as a "scarer".

A flexible system, using pre-programmed cards, allows the "Squawker" to be set to deter the most destructive pest-birds in your area, with further sound sequences available if required. Currently, you may select from sounds designed to deter pigeons, rooks, geese, seagulls, crows or starlings.

The "Squawker" works by mimicking nature and convincing the pest-birds they are being hunted. For example, to deter wood pigeons a combination of the following sounds is used: buzzard cries, a single pigeon wing clap (known to alert other pigeons to danger), the sounds of a flock of pigeons taking off and the distress calls of rooks.

Simple to install and virtually maintenance free, the "Squawker" is powered by a 12 V battery and can be used inside (in grain barns) or outside, to protect fields of growing crops. Features include volume control, light sensor (the unit can be set to automatically switch off at night) time lapse adjustment and programme control. Each unit comes with two 30 watt speakers each equipped with 100 metres of cable which will protect up to 4 hectares. Further speakers are available separately to enable a single "Squawker" to cover an area of up to 18 ha.

Available from local agricultural merchants, the "Squawker" has a recommended price of £495 plus VAT.

Contact: **Bramley and Wellesley Ltd, Chancel Close Trading Estate, Gloucester GL4 7SN. Tel: 01452 300450.**

Wood-Mizer portable band-sawmill

A new portable band-sawmill which cuts up to 18.5 m of 30 cm wide oak a minute and has faster hydraulic functions plus other innovations, is now available from Wood-Mizer UK.

Engine options on the new Wood-Mizer LT40 Super Hydraulic include: a 30 kW turbo-charged industrial diesel; a 27 kW petrol engine; or a 19 kW electric motor. They all come as either portable or stationary equipment and can each cut logs up to 91 cm in diameter or 6.4 m long. Logs up to 12.8 m long can be cut with an optional bed extension.

This new sawmill follows the arrival in Great Britain last year of a new 'Super' series of Wood-Mizer sawmills which cut 50% faster than the then industry standard - Wood-Mizer model LT40HD. The Super Hydraulics feature a dual-pump hydraulic system that performs all log handling functions up to 40% faster than the LT40HD. Sawyers can load, clamp, rotate and level any log with a throw of a lever on the control box located at the front of the mill. The Super Hydraulics' faster, heavy duty log turner quickly rotates full capacity logs, and extra wide hydraulic toe boards compensate for long taper and allow easy log positioning. Another innovation is a 'two-plane' clamp which simplifies sawing of stressed logs. In addition to the normal 'in-out' motion, this robust clamp moves to hold down bowed logs or cants on the bed of the sawmill while cutting.

All Super Hydraulics have durable, + kW, fan-cooled electric motors to position the cutting head and feed the carriage. This industrial power feed system is capable of driving the cutting head up to + m/s and returning at 1 m/s. The new mill also features an automatic board return to expedite off-bearing for sawyers working alone or with a crew.

Contact: **Wood-Mizer UK, High Oak Farm, Oswaldkirk, York YO6 5YF, UK. Tel: 01439788030.**

BENEFITS IN EVERY FIELD

with membership of the

Institution of Agricultural Engineers

Professional Contacts
Network with national and international experts from many fields in the industry for help to solve your problems. IAgrE, through its professional and technical committees, provides a regular forum for members' views.

Professional qualifications
Many employers recognise the value of IAgrE membership and the professional registration with Engineering Council that it provides.

Professional registration
IAgrE is a body nominated by Engineering Council to register members as Chartered Engineer (CEng), Incorporated Engineer (IEng), and Engineering Technician (EngTech). Chartered Engineers may also be registered as European Engineer (EurIng).

Professional meetings
Participate in meetings suited to the wide and varied interests of members at national conferences, regional branch meetings and specialist group events.

Free publications
Every member receives their own personal copy of the IAgrE journal, *Landwards*, covering research, technical developments and applications, company and product information, and the IAgrE Newsletter. *Membership Matters*, with news of Institution activities and members Registration, provides a guide to engineering competence at national and international level.

Other entitlements
Education and Careers advisory service; Appointments Register and advisory service; extensive technical library facilities.

STUDENT

ASSOCIATE AIAgrE

COMPANION CIAgrE

FELLOW FIAgrE

ASSOCIATE MEMBER AMIAgrE

MEMBER MIAgrE

AFFILIATE ORGANISATION

If you have found something of interest in this journal, you will surely fit one of these categories. Send for details of membership to:

The Secretary, Institution of Agricultural Engineers, West End Road, Silsoe Bedford, MK45 4DU.
Tel: 01525 861096 Fax: 01525 861660