IAgrE Journal

Landwards

Volume 55 No. 3 Autumn 2000

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We look forward to seeing our Institution of Agricultural Engineers colleagues in Cancun!

Landwards

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

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Front cover: *Grapes on the vine (photo: Land Technology Ltd).*

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The tractor factor - ploughing a road out of poverty

Increasing the contribution of tractors to the development of agriculture and rural infrastructure in the Third World was the topical theme for the lively second annual seminar on **Engineering in Agricultural and Rural Development.** This early evening event held in November at the imposing headquarters of the Institution of Civil Engineers (ICE) in Great George Street, Westminster was organised jointly by the Overseas Development Specialist Group of the IAgrE, the Appropriate Development Panel of the ICE and the Tropical Agriculture Association. Over fifty members came along to hear invited speakers from Zimbabwe, Thailand and the UK; to browse on the poster displays by manufacturers; and to participate in the lively discussion that followed.

The advanced modern agricultural systems in developed countries depend almost totally on highly sophisticated tractors and machinery and a tiny labour force. By contrast in developing countries, large numbers of people depend entirely on agricultural work for their survival and agricultural tractors are generally more basic and only provide a small proportion of total farm power requirements. The small farm size, short working season, high capital investment required, high cost of finance and low annual utilisation are some of the factors that limit the cost-effectiveness of tractors as a robust, highly flexible, mobile power source. It has meant that small farmers (the majority) in developing countries have so far been denied access to this versatile farm power source. Making the technology more affordable depends in part on spreading the investment 'load' such that tractors can achieve a higher level of utilisation and reduce the unit cost of ownership. In typical rainfed small farm systems in developing countries, utilisation rates for tractors used only for agricultural tasks and some transport may be 200 or 300 hours per year or less, even with multi-farm (or contract hire) opportunities. Economically viable utilisation rates under these circumstances may require two or three times this figure.

Fortunately, there are many other important rural infrastructural development tasks that can also benefit from the application of the agricultural tractor. Rural road maintenance and construction, rural structures and buildings, water pumping, mobile generators and compressors, earthmoving and excavation, sinking wells and boreholes, lifting and transporting goods and materials, agroforestry operations, and many other services requiring a mobile power source. This presents the prospect of higher utilisation and increased viability for tractor owners, lower cost infrastructure for rural communities, flourishing rural service enterprises, increased income generation and employment opportunities and improved sustainability of rural livelihoods for poor people.

Under the Chairman, Rob Petts of Intech Associates, excellent presentations by the three speakers dealt with the key aspects of the role of tractors as a robust, flexible, mobile power source for agricultural and rural infrastructure development - the theme for the evening. Kingstone Gongera, Chief Engineer (Roads) of the District Development Fund in Harare, Zimbabwe described the maintenance system he manages for over 25,000 km of rural roads using labour intensive methods complemented by the use of tractors and locally made equipment. The ambitious target in Zimbabwe is that no one should live more than 10 km from a maintained road (see paper on pages 3-9). Gajendra Singh, Professor of Agricultural Engineering at the Asian Institute of Technology, then gave a fascinating insight into the booming tractor manufacturing industry in India and a detailed account of the history of its growth since the 1940's. He concluded with illustrations of the many agricultural and non-agricultural tasks for which tractors are used in India and other parts of South East Asia (see paper on pages 26-27).

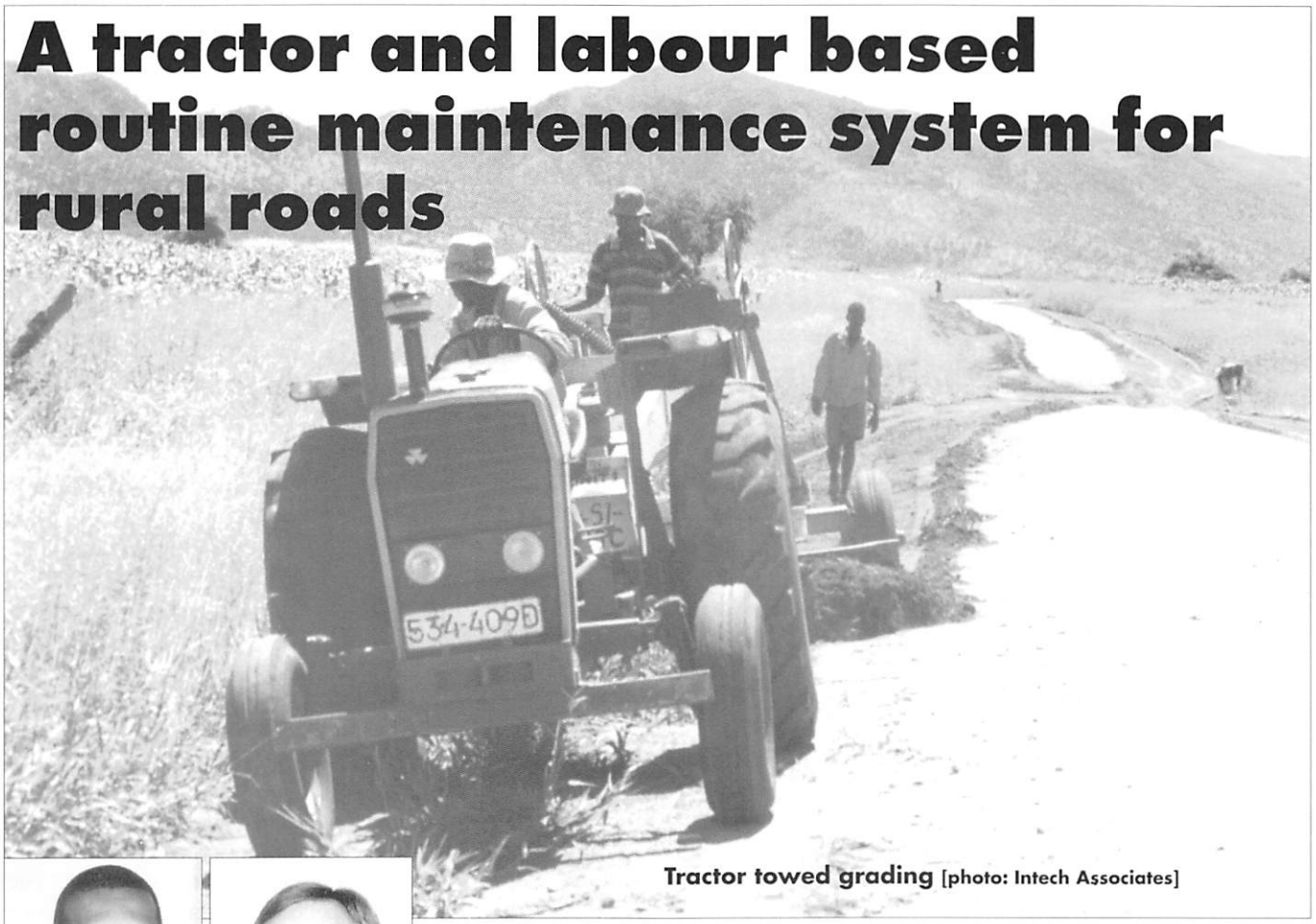
Malcolm Cutler, Managing Director of FSC Development Services Ltd, then completed the picture with a thought provoking description of the crucial financial, business management and enterprise development aspects. He emphasised the importance of creating opportunities for employment and income generation and of equity of access to the benefits of appropriate technologies, such as tractors as well as the ultimate aim of eliminating poverty. He provided a useful checklist of the requirements for launching sustainable business enterprises, such as those involving the provision of tractor services, as part of the improvement to rural infrastructure and services. He concluded with a challenging proposal for donors to consider a public/private partnership approach to the problem (see paper on pages 28-30).

In his summing up Derek Sutton, Agricultural Engineering Adviser, Department for International Development concluded the evening by reminding us that the mention of tractors in some international development circles still causes a variety of often negative reactions. This is partly based on the legacy of some bad highly publicised experiences several decades ago that resulted in the infamous 'machinery graveyards' in West Africa and elsewhere and partly on a poor understanding of the very positive aspects of using this type of technology in rural development. The form of ownership and use of such technologies is crucial both to realise the full potential of the technology and just as important - to avoid the negative social, employment and equity aspects.

Harry Ferguson and Henry Ford would have been well pleased!

DHS

A tractor and labour based routine maintenance system for rural roads



Tractor towed grading [photo: Intech Associates]

Kingstone Gongera and Robert Petts

Kingstone Gongera is the Chief Engineer, Roads for the Zimbabwe District Development Fund, responsible for a rural road network of 25,000 km. He is also a farmer and a Zimbabwean representative on the World Road Association Committee on Technological Exchanges and Development.

Robert Petts (MIAgrE) is the Principal of Intech Associates, Consulting Engineers to the road management and maintenance sector. He is a member of the Appropriate Development Panel based at the Institution of Civil Engineers, and a UK representative on the World Road Association Committee on Technological Exchanges and Development. E-mail: rob@intech-consult.demon.co.uk

Synopsis

Effective and sustainable road maintenance systems in Africa are a rare commodity for a range of funding, institutional, economic, technological and management reasons. However, the Zimbabwe District Development Fund routine maintenance system, for 25,000 km of gravel, all-weather feeder roads, demonstrates that by identifying and tackling the range of considerable challenges, a low-cost (US$ 260/km year) and effective system can be established. The application of tractor and labour technology in a framework of well-justified, regular funding, and efficient and focussed management has achieved a methodology which could have lessons for the managers of other national, regional and private road networks.

This paper is based on the 10 November 1999 presentation to the joint meeting, held in London, of the Appropriate Development Panel of the Institution of Civil Engineers, The Institution of Agricultural Engineers and the Tropical Agriculture Association.

Background

The Zimbabwe road network has developed substantially in the last twenty years. Prior to 1980 (Pre-Independence period), provision of rural roads was not a priority item for the government. There was also limited technical and financial support for construction and maintenance of roads. The 'Rural Areas' of Zimbabwe made up 40% of the total area of the country, most of the rest being allocated to commercial farming. Eighty per cent of the population lived in the Rural Areas then known as Communal Lands.

This dense population in the Communal Lands had a road network of barely 3,000 km to

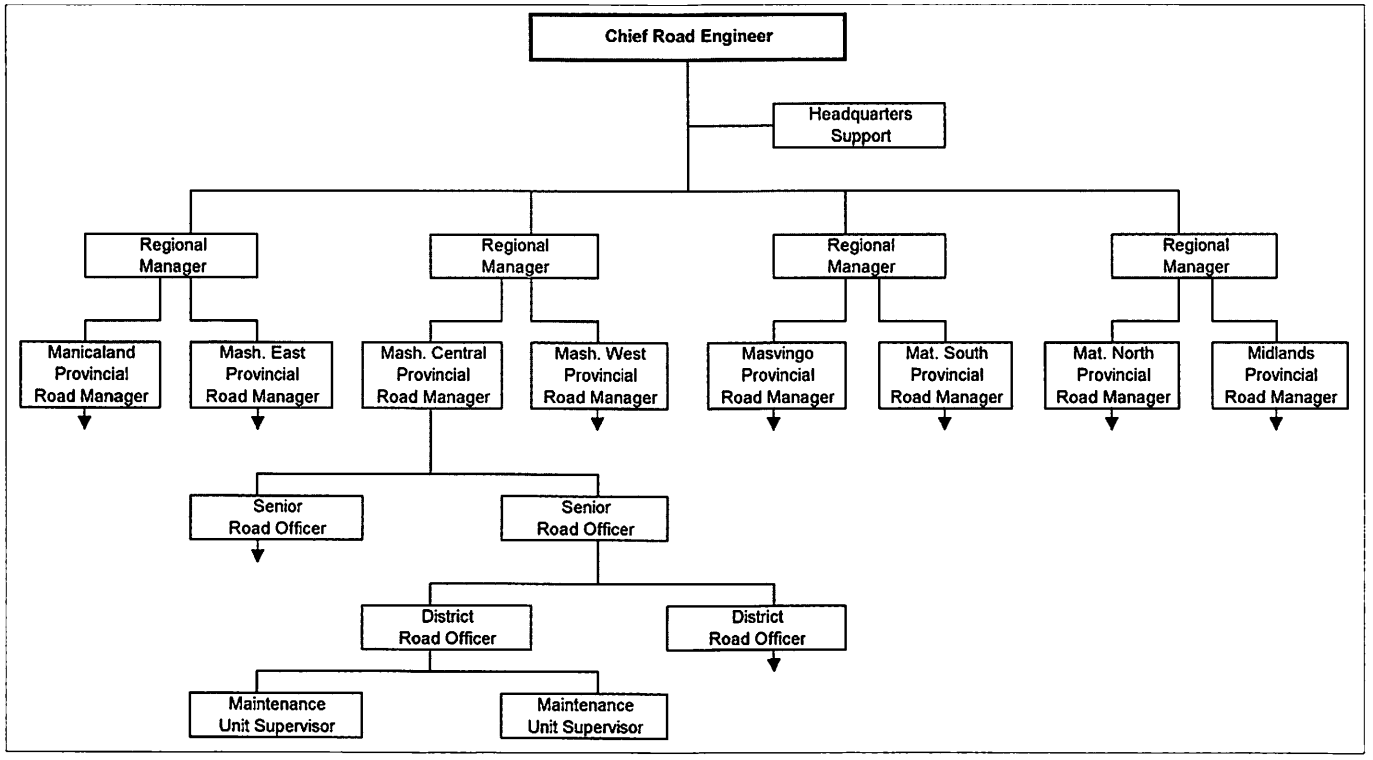


Fig. 1 District Development Fund routine road maintenance, national organisation

service them. These roads were mainly to administrative centres.

This imbalance triggered the need to plan a Rural Road Network that addressed the socio-economic demand for a young nation that had just witnessed a political transformation and was ready to address the social demands of the population. A road network based on socio-economic consideration was then planned using criteria that were sensitive to agricultural potential.

District Development Fund

The District Development Fund (DDF) is a government agency within the Ministry of Rural Resources and Water Development which is charged with the responsibility of providing and maintaining rural infrastructure within the Communal, Resettlement and Small Scale Commercial Farming areas of Zimbabwe.

The DDF, since 1980, has been responsible for establishing all-weather road access throughout the rural areas of Zimbabwe. The DDF has implemented the planning, selection, construction and/or re-construction, and the establishment of proper periodic and routine maintenance for some 25,000 km of rural roads throughout the country.

These activities were carried out under a comprehensive Rural Road Programme which was co-financed by the Government of Zimbabwe and the Government of Germany through Kreditanstalt für Wiederaufbau.

One of the notable achievements of this Programme is the successful establishment of the 'Routine Road Maintenance System' that was developed during the implementation of the construction programme, and has now established full road maintenance on 25,000 km of road. This system is fully funded by the Government of Zimbabwe and costs the equivalent of only US$ 260/km year including overheads, finance and depreciation.

The Road Maintenance System is based on the portioning the country into manageable sized Maintenance Unit Areas, each area being typically responsible for between 120 - 160 km of roads. This is the length of road which can be efficiently maintained by a single maintenance unit. The defined maintenance areas mean that maintenance requirements for the area are known, and can therefore be properly planned and budgeted for; and the implementation can be monitored closely according to the work plans, budgets and quality control. Periodic regravelling is managed separately and is carried out by contract or DDF construction units. The main aspects of the routine maintenance system are described in this paper.

DDF Routine Maintenance System

The road maintenance unit area concept

The rationale behind the Routine Road Maintenance System in Zimbabwe, is based on the segmentation of districts into a number of unit areas (*Fig. 1*), where each individual unit area contains some 120 - 160 km of road under maintenance. These unit areas are each the responsibility of a Road Maintenance Unit, which is located at a Maintenance Area Base Camp located centrally within the unit area. This base camp accommodates the personnel, equipment and tools required to execute the road maintenance activities.

The main purpose of the Road Maintenance Unit is to ensure that, through proper execution of planned routine maintenance activities, the rural road network is kept in good trafficable condition throughout the year and that the useful life of the road surface is extended until periodic maintenance (re-gravelling) is required.

The routine road maintenance mainly

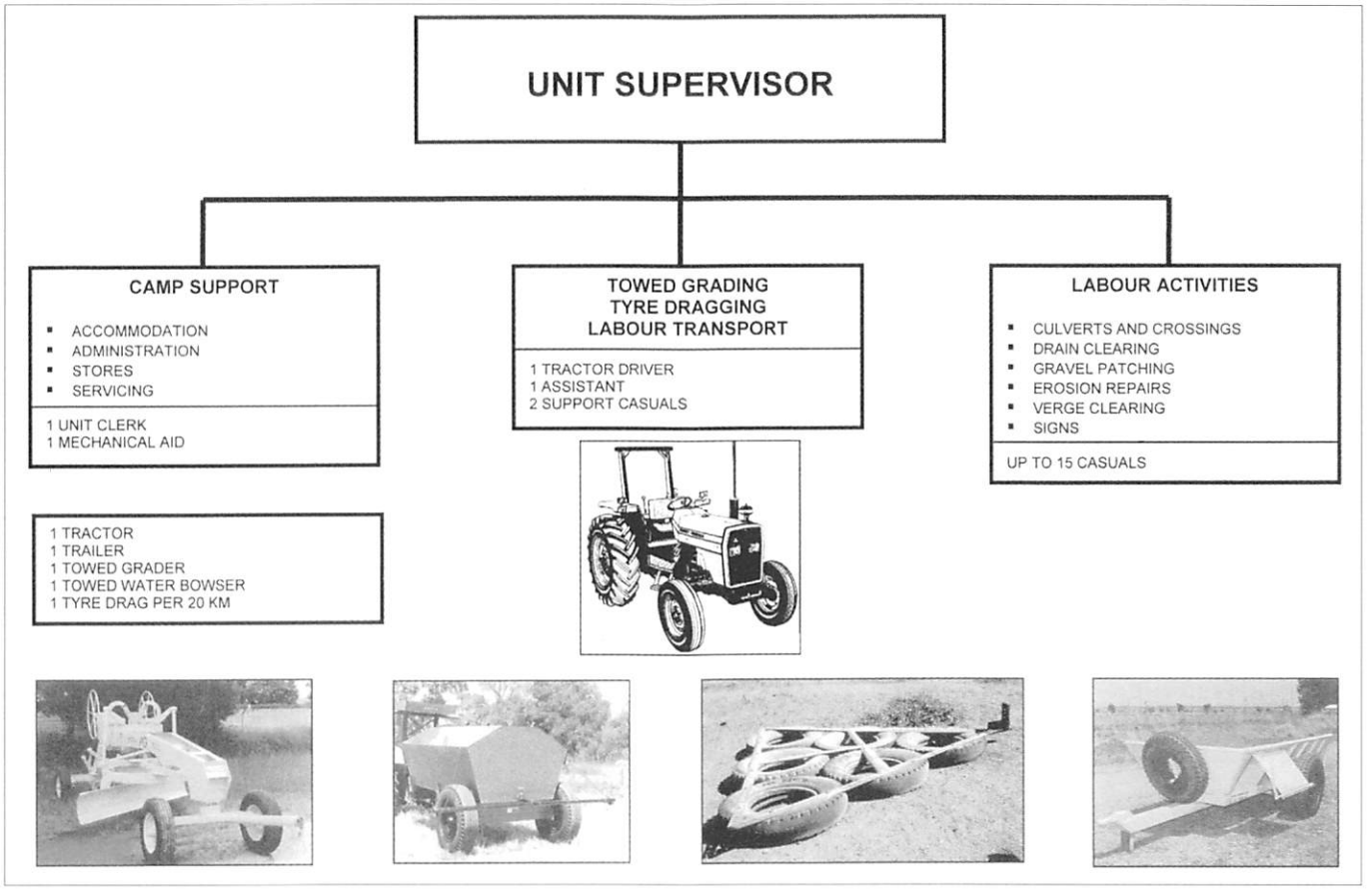


Fig. 2 Organisation of a rural road routine maintenance unit for a 100-200 km network

comprises activities that have to be performed regularly throughout the year. These maintenance work activities are straightforward routine activities which once mastered are repeated throughout the year according to seasonal requirements. The most effective way to ensure that these activities are properly carried out is to prepare detailed individual work programmes, tailored for each Road Maintenance Unit area, taking account of each road's specific needs. The smaller sizes of the maintenance unit areas make the management of the maintenance easier (less roads to plan, easier organisation for the execution of activities and better control of activities) and reduce the need for highly qualified technical staff.

The Road Maintenance Unit organisation

The Road Maintenance Unit (RMU) is the core element of the maintenance system (*Fig. 2*). The RMU comprises a team of trained staff (Maintenance Supervisor, Unit Clerk, Tractor Driver, Towed Grader Operator, and Assistant Mechanic), who along with the necessary equipment and material resources, operate from a centrally located base camp within the Maintenance Unit Area.

These area based units are completely self-contained regarding their day to day operation and look after all rural roads within their specified influence area. The maintainable length of road is dictated by what can be handled using one agricultural tractor, which is the key item of equipment required for towed grading, tyre dragging and transporting the labour and materials. This length is between 120 and 160 km of road, principally depending on traffic quantities and terrain.

The advantages of the area based maintenance system are as follows.

- The maintenance staff live close to their place of work, thereby improving their personal responsibilities to the maintenance work and also providing quick and easy access to the workplace.
- With the fixed roads and resources, the maintenance work cycles can be specified and detailed work programmes prepared for each maintenance area.
- The supervision and monitoring of work is easier for smaller quantities and can be achieved by less skilled supervisors.
- Improved usage and efficiency of equipment can be achieved through the proper planning and on-the-spot supervision and support.
- Unproductive travelling to and between worksites is minimised.

Maintenance Area Base Camps

The Maintenance Area Base Camps provide permanent accommodation for the unit staff, as well as office and store facilities. A small basic workshop is also part of the camp structure in order to enable the servicing and repair of the unit's equipment. Additionally pull-in camps have been placed at strategic points to provide overnight accommodation where units have to move too far from the base camp.

Maintenance Unit core staff

Each Road Maintenance Unit has four permanent core staff – Unit Supervisor, Unit Clerk, Tractor Driver and Towed Grader Operator. An Assistant Mechanic, responsible for equipment servicing, serves a number of maintenance units .

The Unit Supervisor is responsible for the day-to-day organisation of the Unit, the allocation of equipment, and organisation of duties and activities according to his monthly work programme. The clerk is responsible for

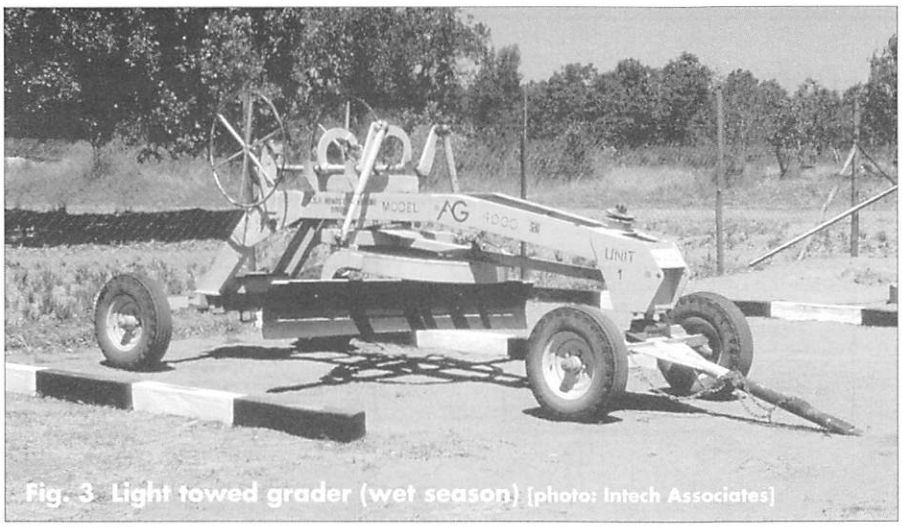


Fig. 3 Light towed grader (wet season) [photo: Intech Associates]

unit administration – reporting, fuel, materials and stores control. The tractor driver and towed grader operator are responsible for respective equipment operations.

Casual labour is recruited from the maintenance area to carry out manual operations. The number varies according to the seasonal workload.

Fig. 4 Tyre drag made from discarded items (dry season) [photo: Intech Associates]

Routine maintenance activities

There are two main categories of routine maintenance activities, equipment related activities – mainly for maintaining the road carriageway in a smooth condition, and labour related activities for maintaining the drainage systems and road margins.

Equipment related activities

The two types of equipment activities for routine road maintenance are - towed grading (*Title photo & Fig. 3*) in the wet season and the tyre dragging (*Fig. 4*) in the dry season. Both these activities require a tractor to tow the equipment.

The agricultural tractor (60 kW, 2 wheel drive) is a common 'tool' in many countries such as Zimbabwe with agriculture based economies, and therefore has a relatively extensive backup service compared to specialised heavy equipment such as motorised graders. In addition, tractors are low-cost and simpler to maintain and repair than heavy plant. All of the tractor towed items are locally manufactured in Zimbabwe.

Using the tractor for both the dry and wet season activities means that the tractor is fully utilised throughout the year and it reduces the number of different pieces of equipment required. The tractor is also used with the trailer to transport the labour and materials for the road maintenance.

Table 1 Frequency and duration of equipment activities

Frequency and duration of activity	*Towed grading Wet season, Dec-Mar*	*Tyre dragging Dry season, Apr-Nov*
Cycles /month		
Light traffic	0.25	1
Medium traffic	0.5	2
Heavy traffic	1	4
No of passes	4	4
Route km/day	10	30

1) Towed grading

Routine grading (usually four passes) is carried out to smooth the carriageway surface and to restore the road profile to its correct shape (using the existing surface material). This grading is most effectively achieved by mechanical means. The two equipment options for grading roads are either a motorised grader or a tractor drawn towed grader. For a number of reasons the (2 t) towed grader (cheaper to own and operate, easier to maintain, easier to operate, provides better utilisation of equipment, a better grading tool for rural roads, locally manufactured) is a better choice for routine rural road maintenance.

Motor graders become ever larger and more powerful to meet the requirements of the high-wage, low-cost-finance economies of the developed world and are inappropriate tools for routine maintenance of rural roads in a resource-limited environment typical of developing countries. It is interesting to note that when motor graders were first developed some 50 – 60 years ago their rated 56-75 kW was quite adequate for road construction and maintenance purposes.

It is also noteworthy that the locally manufactured Arthur Garden 2 t towed grader has been in production in Zimbabwe since 1951 with all current model spares being still compatible with the earliest machines. The ex-works price of the towed grader is still less than US$ 8,000. In the year 2000 the company will be producing their 2,000th towed grader.

Grading (without watering and compaction) of the carriageway can only be satisfactorily carried out when the soil condition is damp so that the loosened material can rebind onto the surface. Grading carried out in dry conditions results in severe loss of carriageway material and considerable shortening of the surface's life-span.

2) Tyre dragging

Grading is not carried out during the dry season as it causes damage to the road. There is, however, a definite need to keep the running surface smooth during the 7 or 8 months of the Zimbabwe dry season.

Tyre dragging is carried out using a tyre drag which is pulled by the tractor. The tyre drag retards minor deformations (corrugations) on the road carriageway. Tyre dragging is generally only carried out during the dry season as it is not

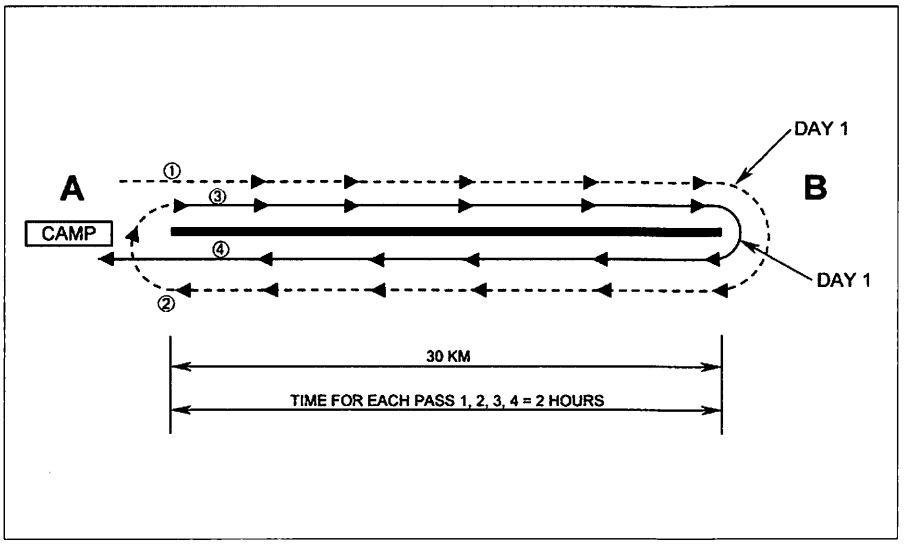


Fig. 5 Tyre drag circuits for a single road

effective when the road surface is damp or wet.

Tyre drags are deployed at strategic points on the road network and coupled to the tractor to operate on pre-planned circuits of typically 20 – 30 km.

Typical tyre drag circuits are shown in *Figs 5* and *6*. *Figure 5* shows the method for tyre dragging a single road (the distance shown applies to tyre dragging for four passes of the drag).

For a situation where two roads are to be tyre dragged to achieve the required minimum daily output of 30 kilometres (*e.g.* one road is 24 kilometres and second leads off the first and is 8 kilometres long) the sequence is as shown in *Fig. 6*.

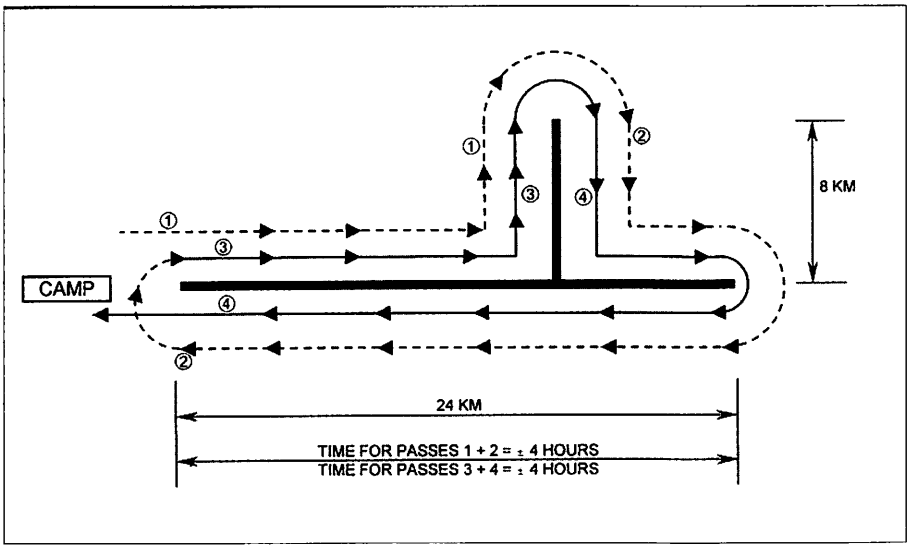


Fig. 6 Tyre drag circuits for two roads

The towed grading follows a similar pattern, however, the distances vary to allow for the lower daily distance output.

Labour related activities

Labour activities include: repair of potholes, verge clearing, opening of drainage structures and sign maintenance. It has been found for a number of reasons (organisational, supervision and labour availability difficulties) that the length-men system is not satisfactory for the DDF circumstances. Employing casual labour according to the specific maintenance requirements is much more effective. These casual employees are local residents who live within the maintenance unit area and are recruited according to the maintenance requirements. The types of labour activities that are required, are dictated by the season.

1) Patch gravelling

Patch gravelling is carried out to repair minor defects on the road surface by adding new surface material to rough or eroded areas of the carriageway. This consists of importing suitable material to the road and placing the material on the road.

2) Clearing drains

Clearing drains is carried out to remove materials (rock, silt, sand, weeds, bushes, tree trunks or other debris) which may collect in the drains thus allowing the water to flow freely. This includes side drains, mitre drains, catchwater drains etc.

3) Verge clearing

Verge clearing comprises the cutting of grass on the sides of the road and the cutting or removing of any bushes, trees, *etc.* which may affect the vision of road users.

4) Road furniture maintenance

Road furniture consists of the markers, guide stones, signs *etc.* which need to be repaired, repainted or replaced as necessary in order to maintain them in good condition.

Work organisation within the maintenance unit

The work organisation is based on the need to complete a specified number of work cycles over the year. The type of activity in a work cycle is determined by the time of the year (wet/dry season activities) and the number of cycles is determined by the traffic quantity on the road and the terrain.

The key item affecting work organisation and implementation is the tractor. It has to handle both the equipment activities (towed grading or tyre dragging) and transport of labour and maintenance materials.

While labour can walk to work when close to a base camp or pull-in camp, at other times the labour component has to be transported. Once transported to the work site however, the tractor is no longer required until the end of the day and can be used for tyre dragging or towed grading activities.

Work plans

In order to ensure the proper utilisation of the labour and equipment, the roads in each of the maintenance unit areas are divided into sections. Detailed monthly work programmes are then prepared for each maintenance area, taking account of

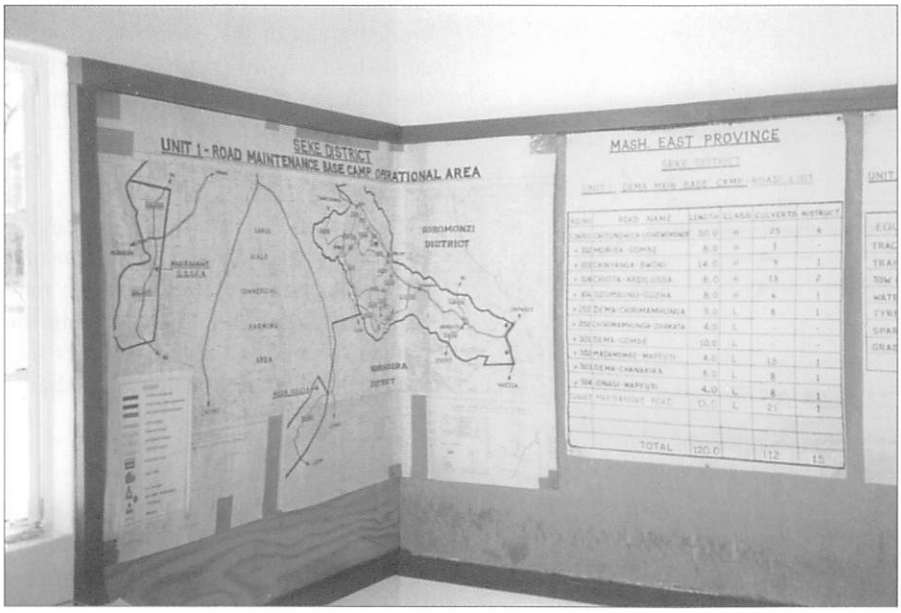


Fig. 7 Planning charts [photo: Intech Associates]

the seasonal activities, and the movement of equipment to service both the equipment and labour related activities.

Contingency time is built into the programme which compensates for any road sections that require additional work or for equipment down time. With the area based system, the maintenance staff are on site, and soon learn where specific maintenance problem areas are on the roads, and what is required to contain these problems. This is then built into the work plan.

Planning, monitoring and control

The maintenance is closely monitored by provincial staff who are involved in all aspects of the maintenance. Regular co-ordination seminars are held which include the Head Office, Provincial and Maintenance Unit staff. During the seminars each unit presents its work achievements and plans. Any problem areas are discussed and action plans and programme adjustments made accordingly.

The Provincial Staff then follow-up the seminars with site visits monitoring the work against the presentations and plans – and assisting and instructing the maintenance units where required.

All planning and reporting at Field, District and Provincial levels, is achieved without computers.

Costs

The cost analysis in Table 2 demonstrates the low cost, and efficiency of the system.

Summary

The routine maintenance system described in this paper has been developed since 1985 by the District Development Fund and has been successfully implemented across the country.

Presently the maintenance system is established on 25,000 km of road through 192 maintenance areas. Each of these areas has an established Maintenance Unit Base Camp, a fully equipped Road Maintenance Unit, and a full complement of trained Maintenance Unit core staff.

The proof of the maintenance success lies in the good condition of the rural road network. The roads have generally been kept in good condition throughout the recent years despite exceptional rainy seasons and severe droughts.

The DDF continues to invest considerable effort and resources in the recruitment and training of the Maintenance Unit core staff to ensure a continued high standard of routine road maintenance.

The following assessment summarises the reasons for the system's success.

The DDF Routine Road Maintenance System - reasons for success

- Uses appropriate, low-cost and largely locally-based technologies.
- Priority given to routine maintenance rather than periodic maintenance and construction.
- Routine maintenance is carried out as a 'routine' activity.
- Routine maintenance is separated out from the operations which require particular technical & management expertise (construction and periodic maintenance).
- Government has been convinced of the importance of routine maintenance and is willing to fund it sufficiently.
- Efficient organisation & management systems - low overheads.
- System is freed from bureaucratic constraints of the civil service.
- Managers able to actively manage the human resources.
- Managers able to motivate to achieve performance.
- Active planning of work involving field managers.
- Ongoing programme of training and re-training.
- National co-ordination, consistency and standards.
- Effective performance monitoring systems.
- Roads are initially brought to a 'maintainable' condition.
- System is adapted to seasonal maintenance requirements.
- Sufficient flexibility built into system to tackle contingencies.
- Simple equipment which is standardised, specified to match requirements, easy to support & well managed.
- Long equipment operating lives achieved (about 10,000 hours per tractor).
- Effective equipment replacement policy.

References

District Development Fund Documentation **Intech** (1998). Equipment and Rural Road Maintenance Cost Study for Department of Roads, MOTE, Zimbabwe and Association of Rural District Councils, Intech Associates & Sesani Projects, November 1998.

Table 2 Assessment of real direct and overhead costs; costs have been calculated for two extreme cases of the road network under the responsibility of a standard maintenance camp, *i.e.* 100 km and 200 km (network average of 150 km); excludes erosion control and bridge repair works

DDF Routine Maintenance System for district roads

Prices are mid 1997. US$1=Z$ 12

						ANNUAL COSTS (Z$)	
					Network km	100	200
1.	**DIRECT COSTS - ANNUAL**						
1.1	**Labour**						
	Monthly wage rate	608	Z$/month				
	Average monthly casual labour force - 100 km			7			
	Average monthly casual labour force - 200 km			14			
	Annual casual labour costs					51,072	102,144
1.2	**Handtools @ 5% of labour costs**					2,554	5,107
1.3	**Equipment**						
	Finance/opportunity cost on capital		15	%			
	FINANCE/OPPORTUNITY	cost new	life years	residual%			
	MF 275 tractor (52 kW)	240,000	10	15		19,800	19,800
	AG 4000 towed grader	85,000	10	20		7,013	7,013
	5 tonne trailer	60,000	10	10		4,950	4,950
	4,500 litre bowser	60,000	10	10		4,950	4,950
	Tyre drag/20 km	500	10	0		206	413
	DEPRECIATION						
	MF 275 tractor (52 kW)		using			20,400	20,400
	AG 4000 towed grader		the			6,800	6,800
	5 tonne trailer		above			5,400	5,400
	4,500 litre bowser		assumptions			5,400	5,400
	Tyre drag/20 km					250	500
	Towed gradings/year (average)		4				
	Tyre draggings/year (average)		12				
	Tractor hours/road km/year		4.4				
	SPARES & SERVICE PARTS	@	3	% of cost new		5,874	11,748
	including tyres and consumables			per 1,000 hours			
	FUEL	@	6	litres/hour		10,560	21,120
		@	4	Z$/litre			
	LUBRICANTS	@	5	% of fuel costs		528	1,056
	INSURANCE	@	2	% of equipt cap.		8,900	8,900
1.4	**Materials**	@	200	per km/year		20,000	40,000
1.5	Contingencies	@	5	%		8,733	13,285
				TOTAL - DIRECT COSTS Z$		**183,389**	**278,985**
				COST Z$/km		**1,834**	**1,395** *1.*
2.	**UNIT OVERHEADS**						
	Facilities and buildings	Capital Cost (Z$)			250,000	Including pull-in camps	
	Finance					19,375	19,375
	Depreciation	over	30	years		8,333	8,333
	Maintenance & repair	@	0.4	% asset v.		1,000	1,000
	Finance for store stockholding		20,000	Z$ value		3,000	3,000
	Unit supervisor		32,400	inc. allow.		32,400	32,400
	Clerk		25,200	Inc. allow.		25,200	25,200
	Tractor driver		22,800	Inc. allow.		22,800	22,800
	Towed grader operator		12,000	Inc. allow.		12,000	12,000
	Mechanical assistant		25,000	Inc. allow.		25,000	25,000
	Administration/telephone, etc.					1,500	1,500
				UNIT OVERHEADS Z$		**150,608**	**150,608**
				COST Z$/km		**1,506**	**753** *2.*
3.	**HQ & PROVINCIAL OVERHEADS**						
	(8 Provincial offices)	divided by		190 Units			
	Salaries (HQ & Provinces)				3,500,000		
	Personnel allowances & expenses				1,000,000		
	Supervision vehicles				3,000,000		
	Equivalent office rental cost				300,000		
	Administration/stationery costs				100,000		
	Telephone and communications				60,000		
	Insurances				50,000		
	Training & evaluation costs				750,000		
					8,760,000	46,105	46,105
				HQ & PROVINCIAL OVERHEADS Z$		**46,105**	**46,105**
				COST Z$/km		**461**	**231** *3.*
4.	**TOTAL REAL COST Z$/km, DIRECT COSTS & OVERHEADS**				*(1 + 2 + 3)*	**3,801**	**2,378** *4.*
					US$/km equivalent	***317***	***198***

Lifting the lid on the corporate car park

A study of the 367 directors responsible for the Top 102 companies in the UK Landscapers & Agri-Contractors industry has revealed that only 123 directors running 28 companies deserve the accolade of being classed as truly a 'top' director. This is according to Plimsoll's new publication, *Landscapers & Agri-Contractors Top Directors Analysis.*

Based on a combined measure of corporate success and staff salaries, the analysis places each of the 102 companies as either *Rich, Fit, Fighting* or *Peanuts.* There are 28 *Rich* companies which have the right balance of corporate success and staff salaries; 18 *Peanut* companies are losing out in corporate success and staff salaries; 18 *Fighting* companies have yet to see rewards in corporate success despite paying higher than average staff salaries and 29 *Fit* companies pay below average staff salaries, yet are finding success; 9 were not classed.

The top 123 directors of *Rich* companies have been in office long enough to have a material effect on the financial performance of their companies. Crucially they have been responsible for creating 'harmony' in that, the company, the directors, the shareholders and the employees are all sharing in the success. These companies are:

- growing faster than their *Peanut* counterparts;
- making many times the profit over their *Fighting* competitors;
- paying over 2.1% of sales on dividends back to shareholders;
- paying staff on average of £24,000 per year.

For their ability to get results, the directors themselves also benefit in the end. They are rewarded by earning an average of £51,000 a year. Although, the highest paid directors could see this rise to £97,000. These salary figures are up 13.4% from last year.

From the 54 directors of 18 companies classed as *Peanuts,* 44 directors have held office where their responsibility for these companies is indisputable. These companies are currently 'out of tune' and have suffered declines in corporate success. Salaries are also below average for the industry. These companies are:

- declining in sales;
- making a slim profit, many are loss making;
- paying hardly anything back to shareholders;
- paying staff on average of £15,000 per year.

In an attempt to turn these *Peanut* companies around, 10 directors have been recently appointed to tackle these problems. Whilst not to blame for the company's current state, they now have some serious decisions to make.

Also named and analysed are the 106 directors of the 29 *Fit* companies. These are successful, growing companies that have below average salaries. There are 72 directors in the 18 *Fighting* companies who are in the same weak position as those in the *Peanut* companies, yet arguably they have an added problem in that they are paying above average salaries.

Conclusion

Directors are responsible for the companies they run and as such there should be a quantitative means of measuring their effectiveness on company performance. What this analysis hopes to deliver is hard evidence to evaluate a director's decisions and results, measuring these against their nearest peers.

Lifting the lid on the corporate car park by removing the public image on these companies takes no account of the human and emotional side. In fact, this is precisely the intention of the analysis.

In analysing the 367 directors and their 102 companies in the Landscapers & Agri-Contractors industry through the 2-paged graphical Plimsoll Model, the individual strengths and weaknesses of every company are revealed. The trend in their performance can be viewed over the last 4 years.

The 354-paged *Landscapers & Agri-Contractors Top Directors Analysis* is available for £449 including next day delivery. *Readers of this publication will receive a 5% discount if mentioning this article upon ordering.*

Contact: **Jennifer Ovington, Plimsoll Publishing Ltd, The Vangard Suite, Broadcasting House, Middlesborough TS1 5JA. Tel: 01642 257800**

Horticultural farmers leading the way in farm energy efficiency

Figures recently published by energy supplier npower™, and the Farm Energy Centre at Stoneleigh, show that horticultural farmers are topping the charts for energy efficiency awareness.

Out of nearly 600 information packs distributed by the Farm Energy Centre on behalf of npower over the past year, almost 50% of the original enquiries from the main farming sectors came from horticultural farmers. New developments in lighting and combined heat and power (chp) were the reason for many of these calls.

In association with npower, the Farm Energy Centre provides advice on all aspects of energy - with tips on what to do in a power cut through to advice on renewable energies.

Nearly half of the total calls to the Farm Energy Centre last year, from across the farming sectors, related to general energy efficiency advice. This reflects the requirements of farmers to be kept up to date with the very latest in energy efficiency.

Maurice Bottomley, npower's SME agricultural consultant is impressed with the interest demonstrated by farmers in energy efficiency: 'Because we understand the needs of the different farming disciplines, we pride ourselves in being able to provide farmers with the information they require on all aspects of energy efficiency and the ways in which they can save money.

'We believe that the cheapest unit of energy is the one that you don't use and in today's tough business climate horticultural farmers in particular have a real need to be as energy and cost efficient as possible.'

Overall, enquiry levels to the Farm Energy Centre have risen by around 15% compared with the sarne period last year. Further data showed that nearly 40% of the total number of enquiries were received at agricultural shows, where attendance figures in 1999 exceeded 230,000.

This year npower will be attending Smithfield 2000 at Earls Court, London between 26 and 29 November.

Self-propelled mechanical harvester

Mechanical harvesting of grapes

Pietro Catania and Pierluigi Febo

Experimental mechanical grape harvesting began in the Nineteen Fifties in the USA, at first using a cutter bar and then a mechanical shaker-catching device. The first mechanical grape harvesters became commercially available in the Nineteen Seventies. They were over-row machines fitted with two types of harvesting systems:

- the vertical-shaking head pickers, suitable for vineyards, such as the Geneva double curtain (GDC); and
- the horizontal slappers,

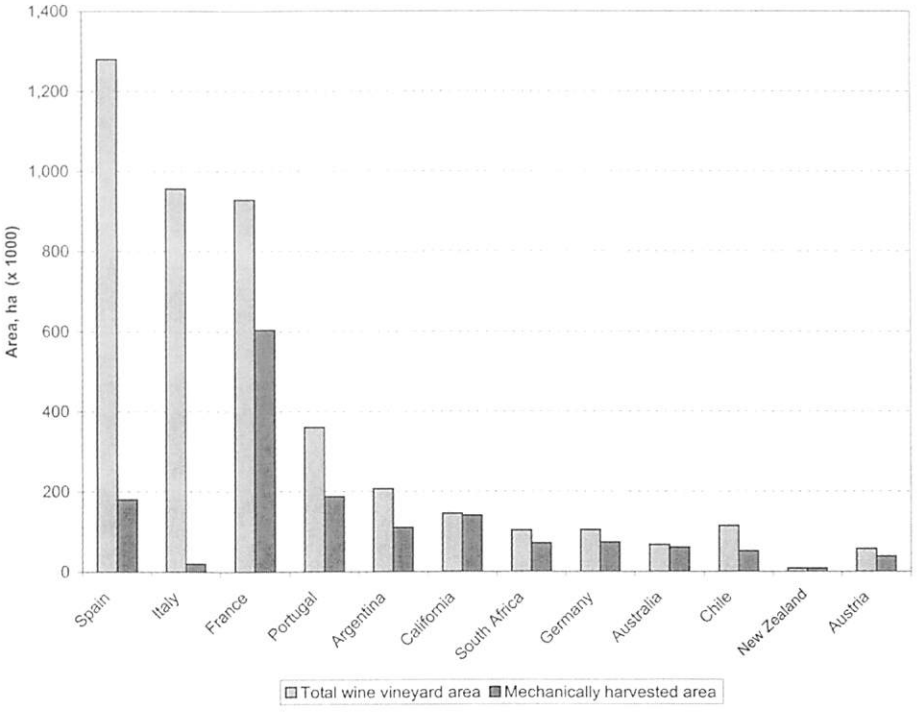


Fig. 1 Total wine vineyard area and mechanically harvested area in some of the most famous wine producing countries (Gasparinetti et al., 1996)

Pietro Catania is a Researcher working with Professor Pierluigi Febo at the Department of Agricultural and Forestry Engineering and Technology, University of Palermo, Italy

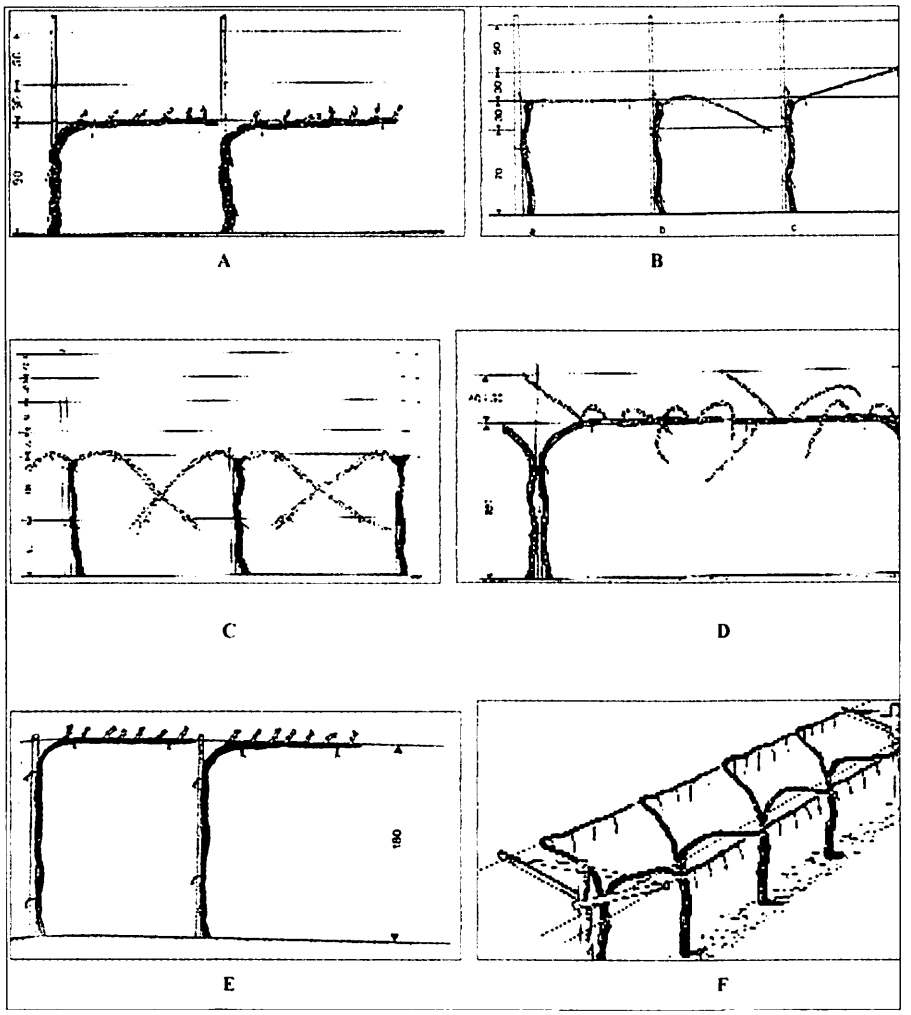


Fig. 2 Vine training systems suitable for mechanical harvesting (Volpelli & Poni, 1988).
Hedgerow (espalier) systems: A, spur-pruned cordon; B, Guyot; C, head training; D, Casarsa.
Curtain systems: E, simple curtain; F, Geneva double curtain (GDC)

suitable for hedgerow vineyard systems.

Since then, the design of both harvesting systems has been constantly and significantly improved. However, many factors have influenced the diffusion of grape harvesters in various countries, including vineyard type and location, availability and cost of hand labour, efficiency of fruit removal, catcher and juice losses and value of the crop.

Figure 1 shows the vineyard area in 1996 of the most famous wine producing countries (Gasparinetti *et al.*, 1996). The bar graph also shows the area mechanically harvested. The traditional wine producing countries (Spain, Italy, France and Portugal) have the highest areas, but are also the countries where mechanical harvesting of wine grapes has undergone the lowest diffusion. The only exception to this trend being France, where in 1996 almost 75% of the wine grape crop was harvested mechanically.

The very low diffusion of mechanical grape harvesters especially in Italy (only 2% of the vineyard area is harvested mechanically) is due to various factors. One of the most important is that some traditional grape training systems are not suitable for mechanical harvesting. Other reasons are: the land topography, (more than 60% the vineyards are on hills or mountains) and the relatively small size of most of the vineyards and the consequential lack of prosperity of the farmers. Many farms are, in fact, still family run, and/or employ seasonal workers, while the use of contractors is not very common.

Grapevine training systems suitable for mechanical harvesting

The grapevine is a plant with long flexible stems which creep along the ground or climb by clinging to a support by means of tendrils, leafstalks, *etc.* Therefore, it is relatively easy to train the vine and position the shoots in growing systems suitable for mechanical harvesting.

In the past, when harvesting was always carried out by hand, most of the grapes, both for wine making and direct consumption, were grown in a very thick curtain. Some attempts were made to design suitable harvesting machines, but their performance was never of a high enough standard.

More suitable training systems were therefore adapted (*Fig. 2*). The Guyot, Casarsa, Head training and Spur-pruned cordon are hedgerow/trellis systems which allow full mechanisation of all the operations, including shoot positioning and binding, winter and summer pruning.

The GDC and Single curtain are curtain systems requiring more accurate hand-shoot positioning and binding, and sometimes hand-pruning, to make mechanical harvesting easier.

Table 1 Grapevine training systems suitable for horizontally or vertically shaking mechanical harvesters

Training systems	*Horizontal shaking*	*Vertical shaking*
Hedgerow trellis:		
Guyot	Yes	No
Head training	Yes	No
Casarsa	Yes	No
Spur-pruned cordon	Yes	No
Curtain:		
Geneva double curtain	No	Yes
Single curtain	Yes	Yes

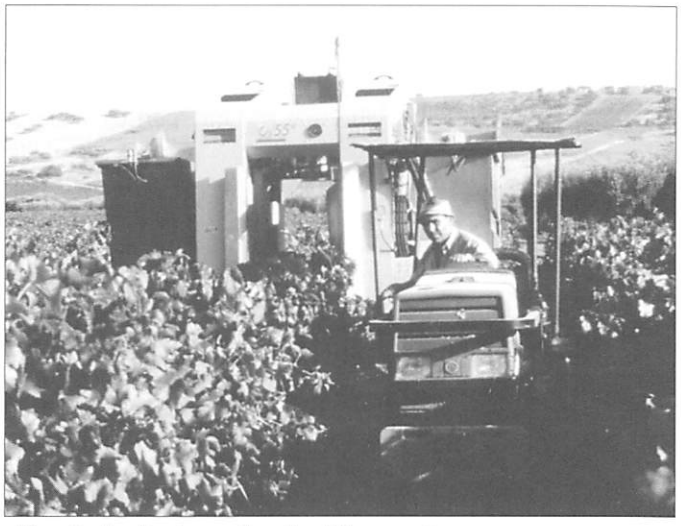


Fig. 3 Trailed mechanical harvester

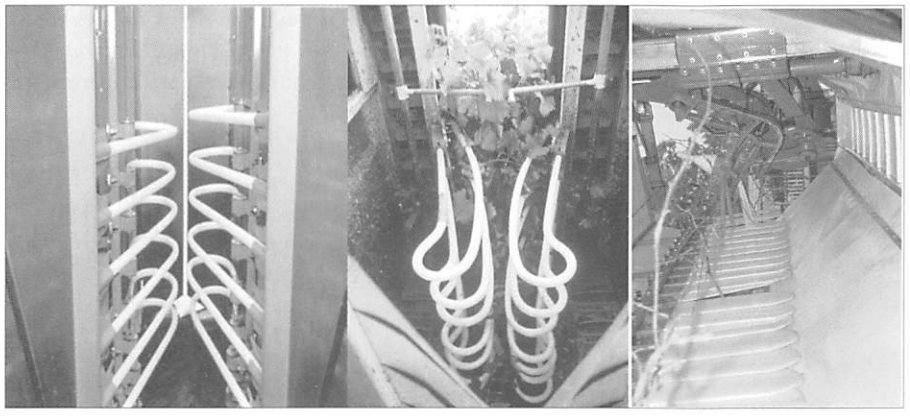


Fig. 4 Harvesting systems: left - Braud horizontal shakers; centre - Gregoire horizontal shakers; right - vertical spiked wheel shaker

Mechanical grape harvesters

The grape harvester has the task of detaching the grapes from the stalks, separating and cleaning them from leaves and other debris, and collecting and storing them in hoppers, which are emptied into trailers suitably located in the vineyard.

Grape harvesters are designed to operate by shaking the canopy either horizontally or vertically according to the grapevine training system. Table 1 lists the most suitable systems for the shaking pattern.

Horizontally shaking harvesters

Grape harvesters with a horizontal shaking pattern can be self-propelled (*Title photo*) or laterally towed by the tractor (*Fig. 3*). In both cases, they consist of two main units: an independent over-row chassis carrying the wheels; and the harvesting unit providing crop gathering, handling and cleaning functions. This unit, including the two hoppers, is mounted on its own frame, which is attached to the independent chassis.

In the self-propelled machines, the over-row chassis also carries the engine, the hydrostatic transmission, the fuel and oil tanks, the braking and steering systems, the operating platform eventually fitted with an air conditioned cab and, last but not least, the harvesting unit. Engine power normally ranges between 60 and 110 kW. The hydrostatic transmission provides forward speeds of up to 7 km/h for fieldwork (four-wheel drive) and up to 15-20 km/h for road travel (front-wheel drive). The fully hydraulic front steering system is controlled by the steering wheel and provides a maximum steering angle of 85-90°.

The straddle design and restricted width of self-propelled grape harvesters result in a high centre of gravity. They are therefore equipped with a levelling control system. Both front and rear wheels are mounted on independent lifting jacks (hydraulically driven and electrically controlled from the dashboard), allowing the longitudinal and lateral levelling and enabling the machine to operate on hillsides of up to 25-30% gradient.

Tractor towed grape harvesters are also equipped with levelling systems and require a p.t.o. power of 15-30 kW, with a tractor engine power of 45-60 kW.

The main frame of the harvesting unit in both the towed and self-propelled machines is attached below the over-row chassis, normally at only three or four points. The hydraulic and electric connections to the tractor unit are quickly detachable for ease of removal of the harvester.

The self-aligning pendular type shaker assembly is suspended from the harvester main frame by steel cables or chains or anti-vibration pads. It is guided along the row of vines by means of the vine stocks, which slide within the guideways secured to the base of the shaker assembly. Sometimes sensors are fitted at the base of the towed harvesters in order to allow the self-alignment of the machine along the row when in contact with the vine stocks. These features are very important for facilitating the operator's work, especially during long working days or night harvesting.

The first generation harvesting systems of ten to fifteen years ago, consisted of vibrating rods (made of fibre glass or similar materials) fixed to the machine only at one end. In their vibrating action, they hit the vegetation rather heavily, sometimes hitting the grapes too. This caused grape damage, juice losses and a large quantity of leaves, shredded leaves and other debris in the crop, increasing cleaning problems. In some cases, the contact of leaf components with the grape juice caused off-flavours and led to the production of significantly lower quality wines.

The new generation harvesting systems also consist of rods, but fixed at both ends and shaped in various arc forms, depending on the manufacturer. *Figure 4* shows two different configurations of the horizontal shaking bars: the Braud system (left) and the Gregoire system (centre), both patented by their manufacturers. The rods shaker bars are usually hollow, with an outside diameter of 20-35 mm. With their horizontal vibrating action, they shake the vegetation without hitting the grapes. The acceleration transmitted to the grapes causes the separation of grape-berries from the stalks.

These harvesting systems reduce the movements of the rods, as vibration frequency takes precedence over amplitude. The material used for building

Fig. 5 Hopper unloading the harvested grapes into a trailer

the rods is also patented and has to be extremely flexible and very hardwearing. It is normal for the rods to sustain wear during the operation of the grape harvester. This inherent condition occurs fairly rapidly, depending on the type of vineyard poles (iron, rough angle bars, *etc.*) and quality of the vine espalier, and on the relevant settings of the shaking system. However, when the rods become worn down to the wearing limit (indicated by the manufacturer) beyond which the rods are liable to break, they have to be replaced to avoid damaging the vines.

The machine forward speed, the shaking range and frequency, the number and the spacing between rods are determining factors in obtaining good harvesting results. Their setting depends on the type of espalier, and on the minimum and maximum height of the vegetation on the row. An incorrect setting of the above mentioned factors could cause one or more of the following problems: poor detachment of grapes; breakage of stems; poor picking of lower grapes; loss of crop on the ground; juice losses; an increased amount of debris in the crop. The setting also depends on the type, make and model of the machine. On average, the harvesting forward speed ranges from 1.5 to 3.5 km/h, the number of rods between 10 and 14 (5-7 per side), their spacing between 80 and 150 mm, their vertical distance between 180 and 250 mm, and their shaking frequency between 6 and 8 Hz. The minimum picking height is normally 200 mm from the ground. The biggest machines can cope with canopy sizes of 2.5 m high, 1.5 m wide and a 1.6 m high fruit-bearing zone.

Collection and transport of the crop to the hoppers (normally at the top of the machine with one on each side, or one on the rear) is fundamental to limit grape and juice losses. Collection and transport systems vary with make and type of the harvester. For instance the Braud system consists of two norias rotating around the shaker assembly. Each noria is made of flexible, deformable buckets (of food quality polyurethane), which are attached to two steel chains and which collect the grapes from under the vine stock, then transfer them to the conveyors. The two chains run at the same speed and in reverse direction to the forward movement of the machine. The buckets overlap at the lower part and remain

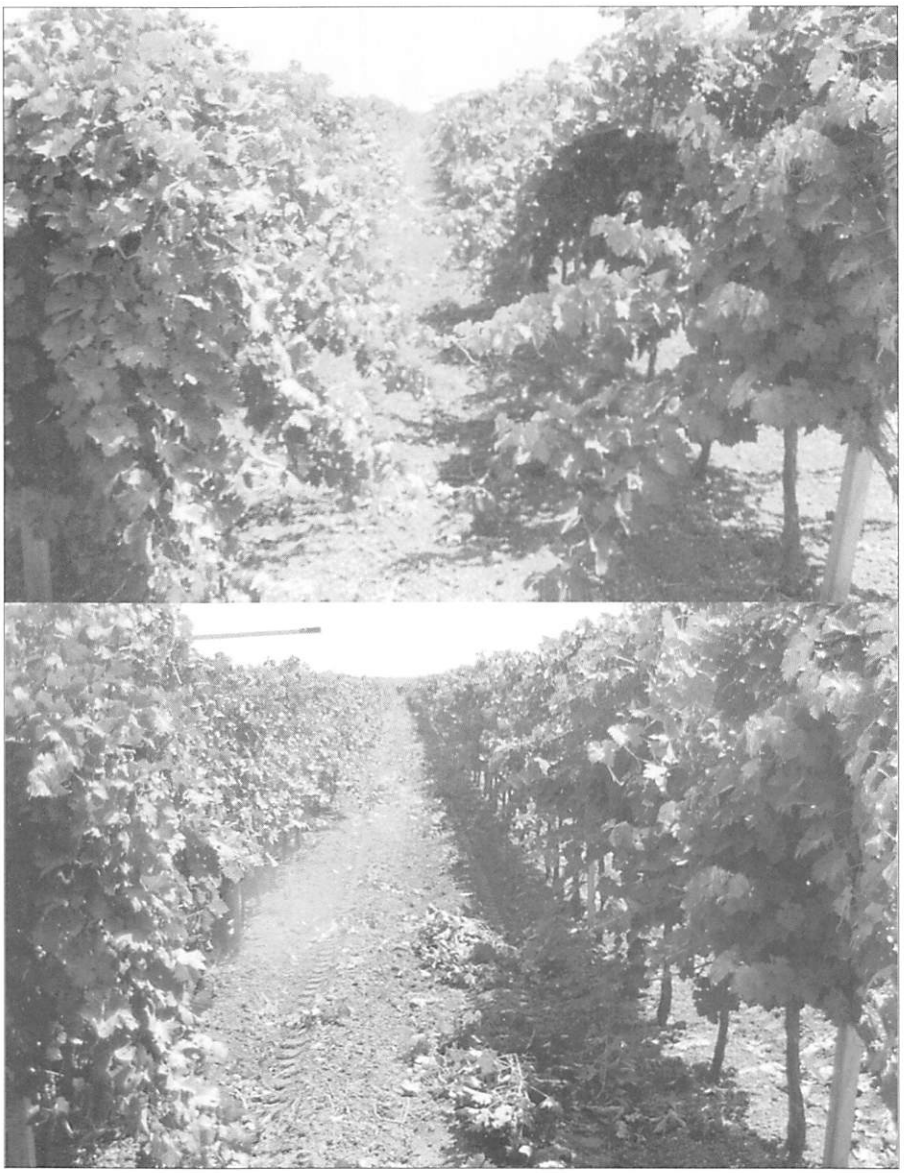


Fig. 6 Vine rows before and after topping

stationary in relation to the ground, thus ensuring a tight seal and preventing any rubbing of the buckets against the stems or the support pales. At the top of the machine, two distribution conveyors (made of stainless steel with PVC belts) collect the crop delivered by the buckets and tip it into the hoppers.

The Gregoire crop collection system consists of flexible and tightly sealed catcher tray ramps which transfer the grapes to the hoppers by means of cleated continuous conveyor belts (sealed against juice leakage).

Both the Braud and Gregoire collection systems are integrated with a cleaning system. Normally it consists of two extractor fans mounted at the end of the conveyor belts. Their task is to suck and remove leaves and other debris before the crop is tipped into the hoppers and to discharge them onto the ground at the rear of the machine. The operating speed of the extractor fans can be controlled from the driving position. Its setting is fundamental to the achievement of optimum cleaning and for avoiding grape and juice suction.

The hoppers are made of stainless steel to protect crop quality. For the same reason, the discharge conveyors are sometimes fitted with a magnet to intercept unwanted metal objects. A levelling auger located in the hopper itself ensures even distribution of the crop and optimum filling of the hoppers.

Hopper size varies with the type of machine. Average capacity goes from 800 *l* in the small trailed harvesters to 2500 *l* in the self-propelled ones. In a few cases, side conveyors discharge the crop directly into a trailer travelling by the side of the machine.

Figure 5 shows a hopper emptying the crop into a trailer. In some self-propelled machines, the independent over-row chassis carrying the engine, the operator's cab, the wheels, *etc.* is multifunctional. By simply detaching the harvesting unit, it can be fitted with specially built pruning or spraying units for carrying out winter and spring work as well.

Vertically shaking harvesters

Vertical shaking harvesters are less common because they are suitable for harvesting only the GDC or the Single curtain training systems. They can be self-propelled, trailed or side-mounted on the tractor. In the first case, the machine overrides the vine row harvesting on both sides. In the other cases, the machine travels between two vine rows and harvests only on one side. Obviously the over-row harvesters are fitted with two picking heads and two catching gondolas.

The picking head consists of a vertical spiked-wheel shaker (*Fig. 4, right*), free to rotate around its axis. The wheel has a reciprocating vertical motion (with average amplitude of 80-120 mm and frequency of 8-10 Hz), which, combined with the forward speed of the machine, results in a sinusoidal trajectory in the vertical plane. This motion causes vibration on the wires of the curtain trellis. The spiked wheel never touches the grapes directly. The grapes separate from the stalks because of the acceleration induced by the curtain shaking.

The other components of the vertical shaking harvesters (collecting, transporting, cleaning and storing systems) are similar to those described above for the horizontal shaking harvesters, the main difference being in the collecting system. The catching gondola, in fact, has the advantage of embracing and being right underneath the shaken curtain. Its lower part (made of overlapping, flexible fish scales or of catching trays) does not surround the vine stems or the trellis supporting poles. Juice leakage and, consequently, yield losses are therefore reduced.

Yield losses

Yield losses caused by mechanical harvesting are of three different types: fruit losses on the ground, fruit losses on the vine and juice losses.

Fruit losses on the ground are the grapes which drop outside the collecting system, because the shaking action is not localised, but is also transmitted to the vegetation in front of the machine. Collection losses are also caused by lack of seal in the catching system.

Fruit losses on the vine are the grapes which remain on the stalks because of poor shaking action or fast forward speed. These losses can also be caused by over-dense foliage or by incorrect positioning of the trellis poles placed too near the vine stems.

Juice losses are due to the breakage of the grapes hit by the shaking rods, to the lack of seal of the catching and transport systems, to a wrong setting of the cleaning fans which also suck the juice drops, and to the leaves imbued with juice eliminated by the cleaning system. The amount of yield loss due to juice loss is almost impossible to calculate.

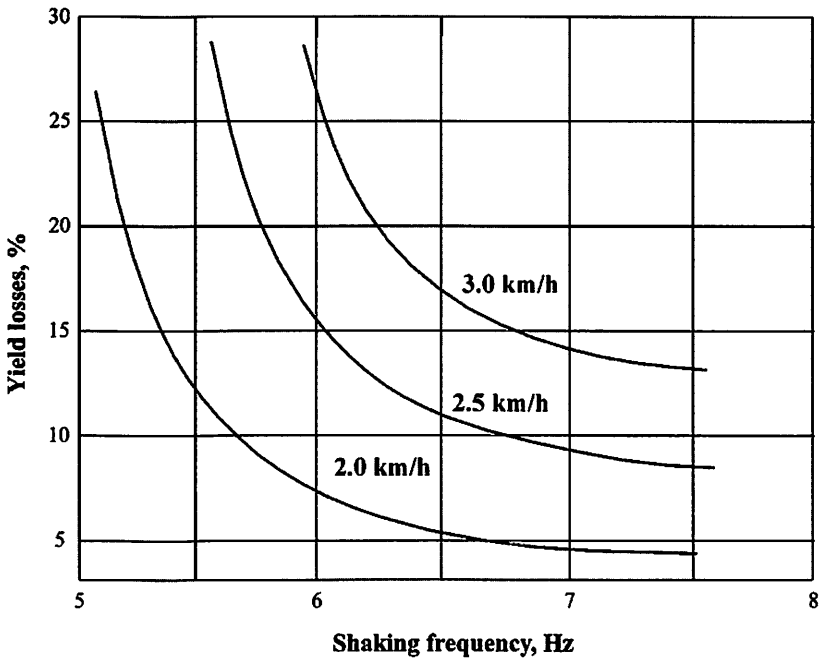


Fig. 7 Yield losses versus shaking frequency for different forward speeds of horizontally shaking harvesters

All the yield losses can be reduced by carrying out summer pruning (topping) 15-30 days before harvest, to eliminate that part of the foliage making harvesting more difficult. *Figure 6* shows two vine rows before and after the topping.

Yield losses can also be reduced by

the correct setting of all the above-mentioned machine parameters (forward speed, number and spacing of rods, shaking amplitude and frequency, fan speed, *etc.*). *Figure 7* shows a qualitative graph of yield loss behaviour, varying the shaking frequency of the rods and the forward speed of horizontal shaking harvesters.

Advantages of mechanical harvesting

Yearly labour demand in hand-managed vineyards depends on land topography, type of vine and its training system. However, total labour requirement can be estimated at between 320 and 380 man-hours per hectare per year, of which about 58-60% is for harvesting, 30-32% for pruning and 8-10% for other work (Intrieri & Poni, 1995).

One of the most important needs for a grape-grower is to harvest his crop in the shortest possible time in order to preserve its quality. Hand harvesting work productivity ranges from 0.06 to 0.3 tonnes per hour per person. Considering that the work rate of mechanical harvesters may vary between 0.20 and 0.45 ha/h (the highest values being for vertical shaking harvesters), and that their work productivity is approximately 1.5-3.5 tonnes of crop harvested per hour per person, the advantages of mechanical harvesting are evident (Pellizzi, 1996).

Mechanically harvested crops present a fairly high amount of juice. Therefore, good organisation of transport from the vineyard to the wine factory is fundamental for shortening waiting time in the field and controlling must oxidation, in order to preserve grape quality, especially with high ambient temperatures. This is one of the reasons for harvesting at night.

Several studies were carried out in California, France, Germany and Italy in the Nineteen Seventies and Eighties on the effect of mechanical harvesting of wine grapes on levels of vine debris and must and wine quality (Clary *et al.*, 1990). In some cases, research showed that mechanically harvested grapes exhibited slight oxidation and resulted in slightly higher total phenols, catechins and potassium levels. Other studies demonstrated that mechanical harvesting resulted in must containing significantly fewer rachises, lower sugar content and higher acid. In general, wine quality was not affected. Taste panellists could not distinguish consistently between wines made from hand harvested and mechanically harvested grapes.

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Chinese delegation seeks Welsh expertise

A high level delegation of Chinese environmental protection manners and academics has visited the School of Engineering at Cardiff University as part of a major fact finding mission to the UK.

The delegation was first shown the Hyder Hydraulics Laboratory which consists of a large tidal basin for studying flow, water quality and sediment transport processes in coastal and estuarine waters. Leading the research undertaken within the Laboratory and in the Environmental Water Management Research Centre are Professor Roger Falconer and Dr Binliang Lin who are acknowledged as among the world's experts on designing computer models to predict the likely effects that urbanisation and industry have on the quality of water in rivers, estuaries and reservoirs.

Among the delegation were Professor Tao Jianhua, Director of the Institute of Environmental Sciences and Engineering at Tianjin University, China, and Mr Tong Yu, the Deputy Director of the Division of Marine Environmental Management, State Environmental Protection Administration of China. Professor Falconer himself is a visiting professor at Tianjin University and a 'high-technology consultant' to the Tianjin Municipal Government advising on environmental water management and coastal pollution.

'It is an exciting opportunity for my colleagues and I within our research centre to be working on one of the biggest coastal pollution studies in the world, namely the clean up of the Bohai Sea in China,' said Professor Roger Falconer. 'It is opportune that this high level Chinese delegation of senior directors of state environmental protection agencies in China should chose to visit us.'

Following their tour of the Environmental Water Management Research Centre the delegation met with Professor Hywel Thomas and colleagues in the Geoenvironmental Research Centre who are currently looking at measures to prevent arsenic poisoning in India and Bangladesh.

Whilst in the UK the group of Chinese officials also visited Swansea Wastewater Treatment works, the Chief Executive of Hyder Consulting and were given a tour around the House of Commons by Mr Lawrie Quinn MP.

Professor Tao Jianhua, of Tainjin University in China said she was 'delighted to be visiting Cardiff where Chinese environmentalists have the highest regard for environmental water management and Professor Falconer and his team's international work in coastal pollution modelling. I am very pleased that we are working on what is one of the worlds greatest environmental challenges.'

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Autumn 2000

The Universe of Engineering

The 'Universe of Engineering' report has been produced by a joint Royal Academy of Engineering and Engineering Council working group, chaired by Sir Robert Malpas CBE FREng, and is designed to inform the debate being taken forward by the Hawley Group, formed by Lord Sainsbury. An extract from the report follows.

Executive Summary

The central role of engineering in society and the economy is not evident to the public at large nor to the media in particular; the popular perception being generally confined to manufacturing and major building works. The engineering profession is considered by many, including unfortunately many young, as a somewhat dull, uncreative, activity wholly associated with the so-called 'old economy'.

This report seeks to illuminate the main issues at the heart of this unsatisfactory situation and makes suggestions as to how they might be tackled. It will provide a background for the work of the Hawley Group set up expressly to identify and deal with those issues that are the concern of the Engineering Council. It will also be relevant to many others who are actively working to ensure the nation's future supply of high quality practitioners of engineering and their effective use, such as: the Engineering Institutions, academia, government, business, The Royal Academy of Engineering, and the Campaign to Promote Engineering.

The universe of engineering is much larger than generally supposed. Its size and range can be gauged by the following facts.

- At least half of the 1500 companies (other than purely financial) quoted daily in the Financial Times depend on engineering to be competitive, and so survive and prosper.
- One or more, in some cases all, the engineering disciplines are involved to a significant degree in eleven substantial 'application' fields that categorise the economy.
- The so-called 'new economy' was created, and continues to be created, through the process of engineering.
- Economists have added *technology* to the traditional three prime inputs to all economic activity, *labour, capital, materials*. It is the engineering process which creates technology.

For the role of engineering to be properly understood and recognised it is necessary to know what it is, and particularly how *science, engineering,* and *technology* relate to each other. The report explores this at considerable length, because of its importance, offering definitions and descriptions for adoption by the profession and by the science community. Until this happens, the public, if not the practitioners, will remain confused.

Science, engineering, and *technology* are closely interrelated and tend to overlap though each is distinct from the other.

Engineering has two components, *engineering knowledge,* the 'know what', and *engineering process,* the 'know how'. This unbundling of the word makes it easier to describe engineering more clearly and to relate it to science and technology. For example it enables the point to be made that the teaching and recognition of the engineering process does not figure as highly as it should in academia, nor in the Engineering Institutions.

A better understanding of engineering also makes it evident that *'the wider engineering community'*, the people who practise engineering, is larger than generally recognised. It comprises not only those who call themselves engineers, but all those who practise engineering, wittingly or unwittingly, in the course of their professional activities, people who do not necessarily wish to identify themselves with engineering. Reliable data on this wider community is hard to come by. The report recommends that this situation be corrected. Relevant figures follow.

- There are about 2,000,000 people in the UK who call themselves engineers. About three quarters of them have a professional engineering qualification.
- There are about 600,000 engineers with qualifications at the Chartered/ Incorporated level, some 160,000 of these are registered with the Engineering Council, and can use the titles *chartered/ incorporated/ technician* engineer as appropriate.
- There are about 620,000 members of the 34 engineering institutions nominated by the Engineering Council, though this number contains much double counting (members of more than one) and many retirees. The Institutions reckon that there are many more people who would benefit from becoming members of one of the 34 Institutions.
- There are no reliable figures even to

estimate the numbers of people whose title does not include engineer, but who practise engineering in the course of their work, *scientists, technologist, metallurgists, computer programmers,* and many more.

The Engineering Council and the Engineering Institutions are actively pursuing the objective of making themselves relevant to this wider community, not necessarily with the objective that all the people in the wider community should become either registrants of the Engineering Council or members of the Institutions. There is a recognised conflict between setting out to be both *exclusive,* where they set and maintain standards; and *inclusive,* where they aim to have wider appeal.

Academia has created, and is creating, many courses covering widespread activities directed at the modem economy. Many are multidisciplinary. Some avoid having *engineering* in their title, *design* and *technology* being preferred, as by so doing they attract greater numbers, frequently of very high quality. There are some 4000 engineering related courses at universities, higher and further education establishments. There are a further 4000 computer related courses. Of these 8000 or so, some 1200 are accredited by the Institutions on behalf of the Engineering Council. This is an issue that needs to be addressed.

Science and engineering depend on each other - and upon business process skills - for the successful conversion of knowledge and experience into something useful. They need therefore to work more closely together. Suggestions are made to this end.

The public image of engineering in the UK is poor, furthermore visibility of the profession is low and confused, and it is often difficult to gain access to information about the profession. Suggestions are made to address this unsatisfactory situation. Central to all of them is gaining widespread understanding and recognition of the relationship between science, engineering, and technology.

The Working Group urges the leaders of the engineering profession, along with leaders of the scientific community, and with the collaboration of government, actively to address the issues raised in the report. It may require mechanisms additional to those existing at present.

Letter to the Editor

Dear Editor

I felt very honoured and excited when I received a letter from the Chief Executive of the Institution of Agricultural Engineers informing me that the Council of the Institution had agreed to my being presented with the Award of Merit of the Institution. I was invited to attend the Annual Conference of the Institution on 9th May in Edinburgh and the Certificate of the Award of Merit would be presented following the luncheon. The conference, concerned with food and food safety, also looked very interesting and so I accepted the invitation with considerable enthusiasm.

When making arrangements to travel to Edinburgh, it soon became apparent that quite a posse would be travelling in the same direction from this area including Steve Parkin, Andy Scarlett, Dave Tinker from the Institute, Mrs Brenda Dwyer (to present the Michael Dwyer Memorial Award) and Derek Sutton. Andy Scarlett picked me up from home on what seemed to be a misty/foggy morning (well it was 6:30 am) and off we went to Luton. We soon met up with others in a busy checking in hall and were told that there would be some delay due to the fog. At 10:30 am in a packed departure lounge at Luton Airport we learned that the plane to take us to Edinburgh (scheduled departure 7:40 am) was still at Edinburgh and could not take off for Luton because visibility at Luton was not good enough for landing or take-off. It became obvious that conference luncheon and presentation was not going to happen for those of us still at Luton. There was some good news - we got our money back from EasyJet – but that is another story.

I was very sorry to have missed both the conference and the presentation. I have now received my Certificate of Award of Merit and would like to take this opportunity to thank all my colleagues both within the Institution and at Silsoe Research Institute, particularly staff in the Chemical Application Group at the Institute, for all their help and support that has made this award possible. Thanks to you all.

Yours faithfully
Prof. Paul C.H. Miller FIAgrE
Projects Director & Head of Process Engineering Division
Silsoe Research Institute

Long Service Certificates

50 years

Name	*Grade*	*Date of Anniversary*
John Alexander Crawford **Gibb**	CEng HonFIAgrE	27 Jul 2000
Roy Hewitt **Davies**	CEng FIAgrE	29 Sep 2000

25 years

Irenaeus Leo A **Ysselmuiden**	FIAgrE	10 Jul 2000
Alan Frank **Ball**	AIAgrE	9 Sep 2000
John Terence **Chambers**	MIAgrE	9 Sep 2000
Clive Leonard Thomas **Bound**	AMIAgrE	9 Sep 2000
Jeffery John **Sanderson**	IEng MIAgrE	9 Sep 2000
George Charles **Baxter**	IEng MIAgrE	26 Sep 2000
Paul Raphael **Pereira**	EngTech MIAgrE	30 Sep 2000
Hugh Edward Gordon **Hanmer**	IEng MIAgrE	30 Sep 2000

Our Birthplace revisited

The summer outing of the Pioneering Technology Specialist Group (PTSG) was this year to Ironbridge Gorge Museum, the birthplace of the Industrial Revolution, an important place for all engineers.

It was here at Ironbridge that Abraham Darby perfected the coking of coal and used coke instead of charcoal for the production of cast iron. This permitted the production of cast iron in such quantities that it became suitable for items of mass production. As one museum display described it, 'The plastic of the age.'

The whole museum complex is vast comprising some nine sites and so we encouraged members to start anywhere and buy a passport ticket and meet up at the Blist Hill site.

Some of the group started at the Museum of Iron (where Abraham Darby had his first blast furnace) and were able to meet John Challen. He is the curator / site manager of the museum who called in briefly to meet us and showed us round the old warehouse next to the Museum of Iron. This is due to be transformed to a 'hands on' engineering discovery centre.

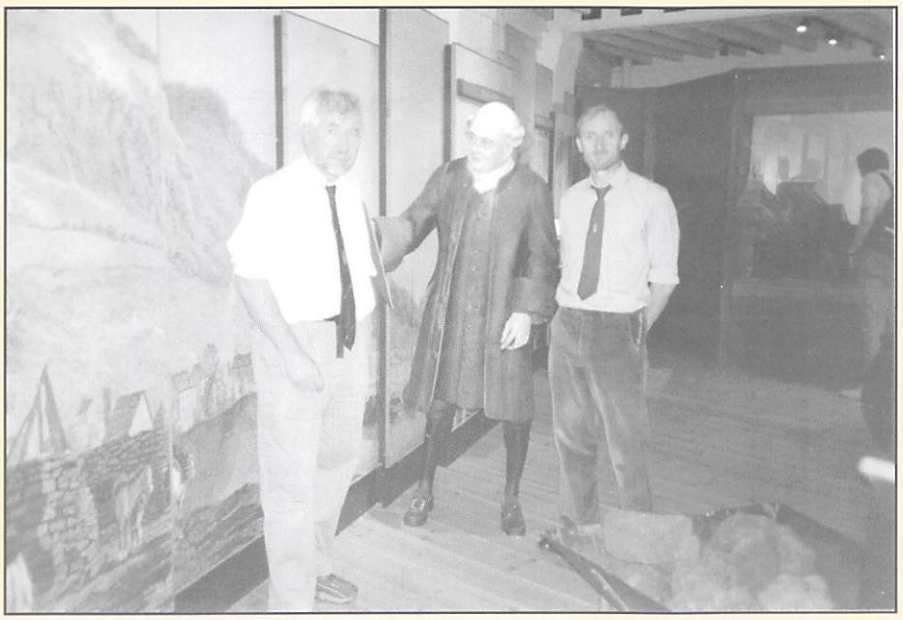
John Challen offered the museum's support to our Institution and an invitation to organise more events there. Colleagues, that offer is before you.

The small group gathering at the appointed place at Blists Hill was disappointed to find that there was a different, but nevertheless very interesting, historical talk to that expected. At the end of the day we were serenaded away from the site by a performance of Music Hall songs, a happy end to a pleasant and interesting day. At least three groups of our visitors deliberately chose to save visits on their 'passport tickets' to return later in the summer.

Next year's summer meeting (subject to confirmation) is to The Museum of Rural Life at the University of Reading where many agricultural machinery companys' records are archived.

Put Saturday June 9 in your diary for 2001 now.

William Waddilove



Abraham Darby who built the first real blast furnace in 1684 trying to catch the attention of William Waddilove standing next to John Pedley.

Agric service engineers compete

At the end of May, the two best students from each of the Scottish Colleges finishing their courses in agricultural service engineering, gathered at the Clinterty Annex of Aberdeen College to compete in the annual awards provided by the Scottish Branch of the Institution of Agricultural Engineers.

The competition, organised by Ted Kernahan of the IAgrE and Terry Southcott of Aberdeen College, consisted of five parts, *viz*: (1) inspect a used tractor and report on repairs required; (2) inspect a used baler and report on repairs required; (3) test and repair a tractor electrical system; (4) inspect, repair and report on the cylinder block assembly of a diesel engine; and (5) fabricate a box spanner for a specified nut size from steel strip.

At the conclusion of the contest, the Judging Panel found the craftsmanship of all the entrants to be of a very similar high standard so that all entrants received the IAgrE Certificate of Competence. However, the top award, the Jim Pascal Cup, Tankard and £100 for the best entrant went to: **Graham Montgomerie** (Barony College, Dumfries), runner-up for £50 was **David Palmer** (Elmwood College, Fife), third place was taken by **Jodie Ray** (Aberdeen College) for £25. The Weir Shield awarded to the college whose two students had the best aggregate score went to Aberdeen College (**Jodie Ray** and **Derek Henderson**).

David Howat, Chairman Scottish Branch of IAgrE, thanked Aberdeen College for hosting the event, the Judging Panel, the Organisers, College Lecturers who had come to support the event and, last but not least, the Competitors themselves.

Jim Pascal

Institution Membership changes

Admissions – a warm welcome to the following new members

Companion
M Y Qureshi (London)
Associate Member
W J Copeland (Co Armagh)
B J S Covell (Staffordshire)
K S Gongera (Zimbabwe)
P W R Gough (Warwickshire)
L A Ishola (Nigeria)
P A Skinner (Lincolnshire)
J L Swift (Wiltshire)
S J Tate (Hampshire)
Associate
J Cowie (Fife)
Student
J Rae (Scottish Highlands)

Transfers - congratulations on achieving a further phase of your professional development

Hon Fellow
R M Hay (Edinburgh)
Member
S G Williams (Powys)

Engineering Council

Registrations
CEng
S G Williams (Powys)
EngTech
N Elsender (Lincolnshire)

Membership movements

Mem No	*Name*	*From*	*To*
6637	R V Bhusia	Guyana	Canada
5540	J M Brook	Saudi Arabia	Sweden
4378	A J Casebow	Uganda	Hampshire
5430	K O Dunnett	Bristol	Suffolk
6758	I O Falola	Ukraine	London
5659	G A Fenton	Ethiopia	Kenya
6713	P J E Jones	Merseyside	Wrexham
3064	R D J Lacey	Argentina	Dorset
6188	R J Merrall	Bedfordshire	Worcestershire
5628	M J Povey	South Yorkshire	Gloucestershire
3185	J L Richardson	Suffolk	Essex
6214	D W Tilbury	Leicestershire	Devon
5188	L F Waldmueller	Tanzania	Germany
4709	M A Zoebisch	Syria	Thailand

Gone Away - does anyone know the whereabouts?

Name	*Last known address*
Matthew James Fishwick	9 Dale View, Chorley, Lancashire PR7 3QJ
James O'Regan	7 Sunnybraes, Gordon, Berwickshire TD3 6LN

Commercial Members

Bomford Turner Ltd
Salford Priors, Evesham
Worcestershire WR11 5SW

BSW Harvesting Ltd
Robertson House,
Perth Business Park
Whitefriars Crescent,
Perth PH2 0NX

Douglas Bomford Trust
16 The Oaks, Silsoe
Bedford MK45 4EL

Farm Energy Centre
NAC, Stoneleigh, Kenilworth
Warwickshire CV8 2LS

G C Professional Services
Highdown Cottage
Compton Down
Hampshire SO21 2AP

Law-Denis Engineering Ltd
Millstream Works, Station Road
Wickwar, Wotton-under-Edge
Gloucestershire GL12 8NB

Spencer Environmental Care and Construction Ltd
Llwyn-yr-ynn, Llandeilo Road
Gorslas, Llanelli
Dyfed SA14 7LU

White Horse Contractors Ltd
Lodge Hill, Abingdon
Oxon OX14 2JD

Academic Members

Cranfield University
Silsoe
Bedford MK45 4DT

Harper Adams University College
Newport
Shropshire, TF10 8NB

Lackham College
Lacock, Chippenham
Wiltshire SN15 2NY

Pencoed College
Pencoed
Bridgend CF35 5LG

Sparsholt College
Sparsholt
Winchester
Hampshire SO21 2NF

Writtle College
Chelmsford,
Essex CM1 3RR

Student engineers receive open day accolades

David Preece, Technical Services Manager for John Deere UK, presents the John Deere Trophy for the Top HND Agricultural Engineering Student to James Duggleby. Head of Engineering, at Harper Adams, Jim Loynes looks on

The work of top student engineers at Harper Adams University College, Shropshire, was recognised at a departmental open day last month.

Student projects and the equipment and facilities of the engineering department were put on display as part of the open day. Visitors were given an opportunity to tour the site and find out more about the Engineering teaching done at Harper Adams.

They were also given a taste of things to come, with a presentation on newly available courses including MEng and BEng (Honours) degrees in Off-road Vehicle Design and BSc (Hons) and HND Engineering Design and Development.

Nine annual awards were presented, but with many of the students either away or on industrial work placement, just three of Harper Adams cadre of winning engineers were able to step forward and collect their prizes.

James Duggleby, 23, from Driffield, East Yorkshire, won the John Deere Trophy for the top HND Agricultural Engineering student. Mr David Preece, Technical Services Manager for John Deere UK, presented the prize to him.

David Mold, 22, from Warwickshire, and **Paul Mitchell Roberts**, 24, from Norfolk were two of the five winners of the JCB Group Trophy for the best engineering projects. David received the accolade for his BSc Agricultural Engineering, Marketing and Management work, while Paul won for his BEng Agricultural Engineering project. Mr Paul Pritchard, Personnel Development Manager with J C Bamford Excavators, awarded the trophy, a miniature JCB excavator, and prize money to the winners.

Paul Mitchell Roberts also received the New Holland Limited Trophy, awarded for excellence, as the top performing final year student. Mr Mike Griffiths, Area Manager for New Holland, was present to hand over the trophy.

Other winners, absent on the open day, include **James Garner**, **Mark Kitson** and **Jonathan Webber**, the remaining winners of the JCB Group Trophy for their BEng Agricultural Engineering projects. Jonathan was also the winner of the CLAAS (UK) Student Award. And finally, **Colin Kee** was named in absentia winner of the Benford Award for the Best Final-Year Engineering Design Project.

The Engineering Department has around 160 registered students at present, and enjoys very strong links with industry. All students are involved in an industrial sandwich placement, lasting at least six months. Head of Engineering Jim Loynes said: 'We enjoy very strong links with industry, which are essential to the success of our courses.'

He also said he felt sure Harper Adams could build on that success, adding: 'I am confident that the start of a new millennium and the fact that next year is the college's centenary year, will see both Harper Adams University College and Engineering go from strength to strength.'

Pioneering Technology Specialist Group library

The PTSG has a small library of videos (augmented by a private collection) which members may borrow. Videos are available for lending to branches and members and may be borrowed for meetings or individual study.

They mainly cover subjects that are of historical or nostalgic interest recording important developments in agricultural engineering and related subjects.

There are also a number of 16 mm films. Many of these are from Massey Ferguson.

Among the titles in the library is one from a very different aspect, if you are involved in careers advice there is one film that will be of interest 'Did I say hairdressing, I meant astrophysics?' It is aimed at motivating the disenchanted young to be ambitious. It features Joanne brought up in a stereotyped 'girls don't' role who makes important scientific discoveries. This film has been produced by 'Leeds Animation Workshop'.

These titles will be useful as a resource to use in planning future meetings. Titles may be available at short notice if you have a problem with a speaker and need a subject to offer members.

Contact: **William Waddilove on 024 7654 4255 (home) 024 7654 5594 (fax) 01372 886 335 (work) or E-mail PTSG@iagre.demon.org.uk**

Engineering - a better future

Travelling to work each morning, I am impressed by the large number of engineering projects along London's River Thames developed for the start of this new century - the London Eye, the new Tate Gallery at Bankside, the Millennium Bridge, the headquarters for the Mayor for London and the redevelopment of London's Jubilee Line. I take pride in realising that the host of projects regenerating London and much of the country in this new century is largely dependent on the exceptional skills of professional engineers. The relationship with architects, designers and builders is a true partnership. We are dependent on one another for our shared successes.

I am particularly pleased that as a Chartered Engineer, I am privileged to lead an Engineering Council that begins the new Millennium ready to promote and stand up for an engineering profession which has reached probably the most challenging and exciting crossroads since the Industrial Revolution.

I have mentioned before that the work of the Activity Review - an appraisal of the continuing relevance of the Council's work - consumed much time and effort during 1999. But I am delighted to report that the Senate of the Engineering Council fully endorsed the successful completion of the Review at its last meeting in May. We are already moving forward to tackle the real problems facing the engineering profession. We have to ensure that we produce the professional engineers and technicians that both Industry and the country need; we have to ensure that professional engineers are properly valued by employers; and we have to demonstrate the massive contribution that engineers and engineering make to wealth creation and to the quality of life.

The Activity Review, as we promised, has now delivered real benefits for members of the Engineering Council. We are now in a position to serve better your needs as members on the Register. More coherently structured and more efficient, we are now able to embark on the new tasks which are essential for the protection of your interests. And our efficiencies have allowed us to continue to deliver more for less by freezing registration fees for a further year in 2001.

Our priority now is to redouble our efforts in changing attitudes and perceptions to achieve the recognition the profession deserves. I'm particularly pleased to report therefore that we have already made a start - by launching the pilot in the East of England of the profession's campaign, *Recognising Excellence*. This new campaign aims to help engineering companies develop a competitive advantage for their businesses - and their profitability - by maximising the abilities and potential of their professional engineers. Highlighting the value of professionalism to engineering employers and employees alike, the *Recognising Excellence* pilot sets out to spur East of England engineering companies into the top flight of national economic performers. The campaign is being run in close partnership with all the Institutions and will bring them direct benefits in the form of increased membership.

The pilot received its regional roll-out on Wednesday 24 May when the Chairman of Ford of Britain, Ian McAllister, showcased its potential for British business at Ford's multi-million pound Dunton research and development centre in Essex. We were delighted that Ford, as a role model organisation, endorsed the campaign, because two key strands of *Recognising Excellence* strategy encouraging engineers to adopt lifelong learning and urging them to strive for professional registration - exactly mirror Ford's philosophy to make their engineers world-beaters in their field.

Professional development is the lifeblood of high technology sites such as Dunton and this is the case with many other engineering organisations across the world.

Although many employers have recognised the important role that the professional engineering institutions, and the professional registration process, play in recognising and developing world-class engineers and technicians, there are still those that have not. They do not yet encourage or insist on professional accreditation for their engineering employees.

So although over a quarter of a million people are registered or working towards registration as Chartered or Incorporated Engineers or Engineering Technicians, and are members of professional Institutions, there are perhaps as many again who are not recognised through membership or through the registration process.

Does this matter? Of course it does: It damages and undermines the profession as a whole, by reinforcing negative perceptions of engineering as a profession and making it harder to promote it as an attractive career to young people.

By working collectively to break this vicious circle, we can do much to raise the profile of professional engineers and help develop further the competitiveness of British business. There is much more to do, but the Engineering Council - your council - is back on the front foot and leading the way in taking up this challenge.

Malcolm Shirley,
Director General,
Engineering Council

News *of Members*

Paul Wightman has been promoted to Technical Consultant with Westfalia Surge UK which is the new company name for Westfalia Lantechnik Ltd. Paul is responsible for training courses for their dealer network and the area he covers is Cheshire, Staffordshire and most of south and south-east England. Paul says that their acquisition of Surge for the American market has made Westfalia Surge the second largest dairy farm equipment supplier in the world and probably the market leader in terms of technological applications. They have recently received the order for a milking installation at Harper Adams College Farm. If any members of the Institution have an interest in milking machine research, Paul thinks that in the future there may be work with his company.

Congratulations to **Keith Dunnett** who has just completed a degree in theological studies at Trinity College, Bristol and has moved to Felixstowe to take up the post of a curate at St Mary's Church in Walton. He says that despite his new focus on the 'living water' of the Christian gospel, he is still keeping an interest in soil and water. Last summer he and his family went to Malawi where he designed and supervised the construction of an irrigation scheme for the Anglican church.

Alan Casebow has recently retired from the voluntary work he was doing with the Kiwoko Hospital Centre for Agricultural Development in the Luwero District of Uganda and returned to the UK. Alan was responsible for the development of a small dairy farm, attached to a 180 bed hospital, into the 'Kiwoko Hospital Centre for Agricultural Development'. This involved construction of farm buildings and staff accommodation on the 30 hectare farm, rain water harvesting and dairy aspects. He was also involved in reaching out to local people with the dry season seminars in agriculture and animal husbandry, and the establishment of a milk marketing scheme to help local pastoralists sell their milk at a fair price to market outlets in Kampala and locally as well as improving the quality of milk sold. Alan's wife was involved in the financial administration at the hospital.

Dr Toby Mottram says that he has decided to concentrate his efforts on his career as an engineer rather than a farmer. He has worked for Silsoe Research Institute since 1989 but has been based at the Institute for Animal Health, Compton developing robotic milking, or at the University of Bristol Veterinary School, Langford developing automatic cow health monitoring. During this period he and his wife had built up a goat farm selling nearly 100,000 litres of milk per year. In 1998, the farm had reached the stage where it was beginning to be self-sustaining but needed more time than he could give it at weekends, evenings and holidays. In the same year, their youngest child left for university and it became clear that none of their children had farming ambitions. So last year they sold the farm as a going concern and moved to Royston. Toby is now leading a small team at Silsoe Research Institute concerned with developing sensors and systems to monitor the health and fertility of dairy cows automatically and non-invasively.

Neil Gunn has left the Environment Agency and has taken up a new post with Mack Multiples as Quality Assurance Manager for Table Grapes.

Many thanks to **James Ward** for supplying a light-hearted piece of writing which he felt so accurately describes life at the coal face of agricultural engineering. The writer is Martyn Beard who is a close friend of James. They both left Rycotewood College in the early eighties and at one stage worked for different rural agricultural machinery dealerships. Martyn's career has led him to the 'high end' of R and D in the motor industry and James has ended up managing a road transport depot in Natal. They have both kept in touch, and Martyn's comments were in response to James' describing major repairs to his ancient British lawnmower, and how far they have both moved from inch and a half spanners and the workbench.

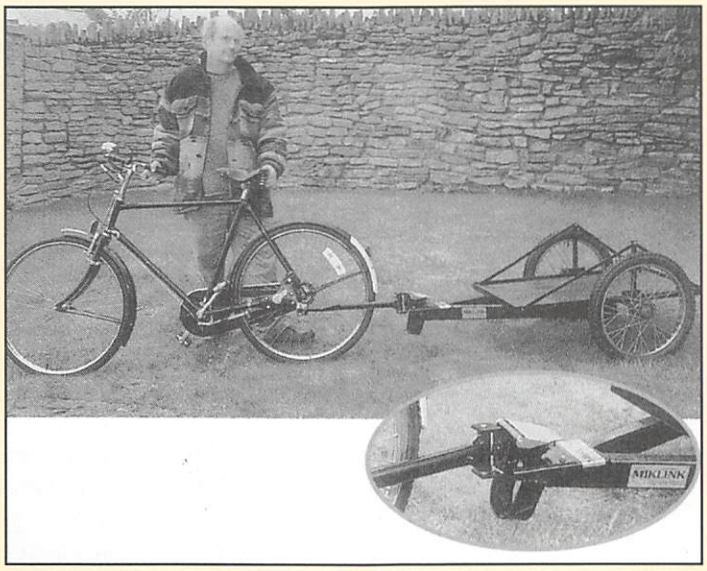
The passage reads 'Yes, I can still wield the spanner in anger, but I don't miss the grazed knuckles, frozen fingers, oil/diesel/petrol/brake fluid immersion, sheared studs, welding rust, greasy uneven floors, laying on fertiliser bags, dim lighting, engine coolant showers, welding in wellies, combine harvester internals (agricultural pot-holing), 'loose bale every 20' balers, dust and chaff, muck spreaders, valve lapping, EP90 gear oil (smelly or what!), hydraulic fluid leaks, cow dung or worse, parts order six months ago that don't fit, electrical faults (I suppose we would call them electrical challenges or opportunities now), Zetor tractors, dual clutches, farm mechanics, etc., etc. Perhaps I am getting soft in my old age.'

James says this prose brought back memories of what he calls the blunt end of agricultural engineering and that we should not forget that it forms the foundation for the academic end. He says that agricultural engineering is among the century's top achievements and that he is proud to have been a small part of it.

We are sorry to hear that **David Butler** has had to retire early from his Grain Drying and Storage Equipment business due to suffering from Adult Stills Disease. This is a connective tissue disease where the immune system attacks itself. He says that the drug therapy he has is fairly radical and somewhat toxic. David says that he now spends time painting and drawing, touring in his sportscar, gardening, DIY and enjoying himself and ensuring that he maintains his drug therapy correctly which is something he never used to do. Even so, he says that there is still not enough time in the day and he always seems to have more to do than before retiring. We hope that ongoing changes in medical science will produce some new development which will help David to continue enjoying his enforced retirement.

Congratulations to **C T Nyongo** on completing his MSc course in Water Management at the University of Dschang, Cameroon which specialised in water supply. He says that apart from the multi-disciplinary and professional nature of the Masters programme, adapted to the local environment, the course enabled him to gain an insight into the French language, as over 90% of the course was in French. He is now working in the Central Service of the Ministry of Agriculture, in the nation's capital Yaounde.

We are sorry to hear that **Harold Poole** is now permanently in a nursing home at Charmouth in Dorset but are pleased to know that he is still interested in his inventions. He has a team who are resurrecting the ox cart business under the same umbrella as the bicycle trailer. After serving an engineering apprenticeship and working in military transportation during the second world war, Harold and his wife settled in Southern Rhodesia (now Zimbabwe) and started a business manufacturing ox carts. During the 1950's Harold's factory had a workforce of 250 and built and sold 25,000 carts. With political tensions mounting, Harold and his family moved back to Britain and in 1959 he turned his attention to trailers towed by tractors. He designed and patented a coupling that enables huge tractor-trailer combinations to haul massive loads. He licensed it for international manufacture and spent many pleasant and prosperous years travelling the world, setting up joint ventures and overseeing production. Trailers to his design are used for sugar cane in Australia, oil palms in Malaysia and stone in Uganda. In 1989, whilst on business in Uganda, the Uganda Minister of Agriculture, Mrs Sekitoleko, met Harold and explained that there was a shortage of food because of transport problem. Uganda's farmers were productive people but half of what they produced simply rotted in the fields. Uganda had two million bicycles and if every bicycle had a trailer that could carry substantial loads, their problems would be over. Harold was intrigued by this but wondered why Uganda did not buy its trailers. He discovered that western bike trailers were not robust enough for conditions in Uganda. He therefore designed and developed the Miklink trailer (see photograph). This trailer is robust, can carry up to 150 kg and uses a clever coupling which transfers some of the cargo's weight to the bicycle, just ahead of the back axle. In 1993, the first batch of Miklink trailers was manufactured and sold, then Harold was taken seriously ill and the project collapsed. After this setback we now wish Harold and his team every success in developing the new business.



Congratulations to **Doug Walker** who has recently received his 50 year membership certificate. Doug became a Graduate of the Institution when he was the first lecturer in Agricultural Engineering at Shuttleworth College. He says that he had to create this department from scratch which was quite a challenge due to lack of money and space. The workshop was in a building at the back of the Shuttleworth Collection of early aircraft. After three years, Doug was invited to prepare a report for David Brown Tractors on the establishment of a proposed Training Centre for dealer personnel. The report was accepted and Doug was asked to join the company and implement his proposals. Doug worked for David Brown Tractors for ten years having various jobs and finishing up as Assistant Export Manager. He then joined John Deere and eventually became Managing Director of the Company and was responsible for the Company's activities in the UK and Ireland. On his retirement in 1993, he was appointed a Visiting Fellow at the Silsoe Campus of Cranfield University. At that time Shuttleworth College was part of Cranfield University, so the wheel had turned full circle and he was back where he started, during which time Doug has visited 45 countries on business from Mexico in the west to Japan in the east, Sweden in the north and Indonesia in the south. Doug has therefore had a very successful and interesting career, and is of course a past President of the Institution.

William Waddilove has recently left AGCO (Massey Ferguson) and has become Technical Author for the after market support group of The Cummins Engine Company. This group is based at Daventry and are responsible for looking after Cummins' engines on this side of the Atlantic. They build engines from 560 to 1500 kW, from straight 8 cylinders up to V 16 cylinders and these are used for off-road construction equipment, marine use and generators. Cummins have another seven factories in the UK. William says that he may retain some contact with AGCO as they have just agreed to fit Cummins engines into a range of tractors for use in North America.

J H W (Tim) Wilder - President 1965-1967 - has written to say that he is delighted to find that the policies of the Institution which were believed to be crucial when he was President are very much the same today. In his address, the President has stated that while he is in office the Institution will not lose its identity and will not amalgamate. The situation was remarkably similar 35 years ago, the Institution needed to increase the membership and the finances were a cause for concern. The Institution had to persuade the new Chartered Engineering Institution to make it possible for suitably qualified members of our Institution to become Chartered Engineers without having to join another organisation. It took some time and it meant rejecting amalgamations and sticking to one's guns through thick and thin but we won in the end. The proof of victory was that his name amongst others appeared in the list of suitably qualified members of our Institution entitled to put CEng after their name as a result of being members of the IAgrE. He goes on to say that he is sure that the Institution's resources, both human and financial, should be used to implement the recruitment plan described in the Presidential address and wishes it every success.

Tony Chestney

Produced by: Land Technology Ltd, Edinburgh

Printed by: Barr Printers, Glenrothes

Branch Diary

East Anglian Branch

For further details contact the Honorary Secretary.

Monday, 30 October 2000 at 7.30 pm
Venue: Brome Grange
Diesel engines for the 21st century

Friday, 24 November 2000 at 7.30 pm for 8.00 pm
Venue: Brome Grange
Annual Dinner

Hon Sec: Brian Bell Tel: 01473 890456

East Midlands Branch

For further details contact the Honorary Secretary. Meeting details are subject to review. All meetings are at 7.30 pm unless highlighted.

Thursday - Sunday, 14 - 17 September 2000
Venue: Lincolnshire Showground, Lincoln
World Ploughing Match, UK

Tuesday, 10 October 2000
Venue: N J Froment, Easton on the Hill, Stamford, Lincolnshire
Factory tour and presentation: 'Tractor testing'
Speaker: Keith Williamson, Managing Director

Tuesday, 14 November 2000
Venue: The Olde Barn Hotel, Marston, Grantham, Lincolnshire
Case Europe - The new CVX tractor
Speaker: James Barlow, Equipment Specialist

Hon Sec: Steve Watson Tel: 01400 261562

Herts and Essex Branch

For further details contact the Honorary Secretary. All meetings are at 7.00 pm.

Thursday, 16 November 2000
Venue: Writtle College
Life and times of an Agricultural Machinery Dealer

Hon Sec: Graham Higginson Tel: 01376 550246

Northern Ireland

For further details contact the Honorary Secretary.

Tuesday, 16 or 24 October 2000 at 8.00 pm
Venue: Agricultural Research Institute, Hillsborough
Fendt Vario transmissions

Wednesday, 29 November at 2.30 pm
Venue: Dunleath Estates, Ballywater
Visit - New dairy unit
Host: Jack Harris
Contact: Names to John Mawhinney

Hon Sec: J P Frost Tel: 028 9268 2484
e-mail: peter.frost@dardni.gov.uk

Scottish Branch

All meetings start at 7.30 pm unless highlighted.
Non-members welcome.
For further details contact the Honorary Secretary.

Wednesday, 11 October 2000
Venue: Moredun Institute, Bush Estate, Penicuik
Golf courses and other amenities
Speaker: David MacInroy, Scottish Grass Machinery
Diversification, agriculture to amenities
Speaker: Howard Leedale, Fenton Barns

Thursday, 2 November 2000
Venue: SAC Auchincruive
Accidents on and off the road
Speakers: Two Police Officers

Tuesday, 5 December 2000
Venue: Lomond Hills Hotel, Freuchie, Fife
Fendt Tractors
Speaker: Neil Butler

Hon Sec: G M Owen Tel: 01968 675943

Southern Branch

For further details contact the Honorary Secretary. All meetings are at 7.30 pm unless highlighted.

Wednesday, 13 September 2000
Venue: Rycotewood College, Thame, Oxon
Changes in mechanisation to suit organic production
Speaker: Jerry Harding, Soil Association

Wednesday, 25 October 2000
Venue: Sparsholt College, Winchester, Hants.
Large scale pumping and related irrigation projects
Speaker: Jeffrey G Beck, Consultant

Wednesday, 22 November 2000
Venue: Rycotewood College, Thame, Oxon
Telecommunications and the underground network
Speaker: David Stephenson, Ryecotewood College

Hon Sec: O J H Statham Tel: 01296 623736

South East Midlands Branch

For further details contact the Social/ Visits Secretary. Some events require pre-booking.

Thursday, 12 October 2000 at 4.00 pm
Venue: Assemble at the farm
Visit - Barton Hill Farm, Streatley, Beds
Speaker: Brian Shaw
Contact: Branch Secretary - names by 9 October

Tuesday, 31 October 2000 at 8.00 pm
Venue: Cranfield University
Tractor transmissions
Speaker: Lee M Sykes, Technical Director, Ricardo Midlands Technical Centre

Monday, 13 November 2000 at 7.30 pm
Venue: Silsoe Research Institute
Industrial materials from crops
Speaker: Ian Bartle, ACTIN and LINK 'Competitive Industrial Materials from Non-Food Crops'

Monday, 11 December 2000 at 7.30 pm
Venue: Cranfield University
Whole body vibration
Speaker: Paul Brereton, HSE

Social/ Events Sec: Chris Saunders Tel: 01525 863000
e-mail: c.saunders@cranfield.ac.uk

West Midlands Branch

All meetings start at 7.30 pm, unless highlighted. Location plans are available on request - please contact the Branch Secretary. You are advised to confirm the details on the day, especially if travelling long distances, by contacting any Committee Member.

Tuesday, 17 October 2000
Venue: National Grid, Coventry
Thwaites dumper trucks - technological developments
Speaker: Richard Whately, Thwaites
Contact: Tony James, Anthony Johnson

Monday, 13 November 2000
Venue: Warwickshire College, Moreton, Morrell
The role of the Farming and Wildlife Advisory Group
Speaker: Michael Outhwaite, FWAG
Contact: Mike Sheldon

Monday, 11 December 2000
Venue: Ashchurch, Gloucestershire
Visit - Dowty Seals
Tour Guide: John Woodlock, Dowty
Contact: John Pedley

Hon Sec: M C Sheldon Tel: 01926 318333

Western Branch

For further details contact the Secretary.

Wednesday, 18 October 2000 at 2.00 pm or 7.00 pm
Venue: Wroughton Science Museum, Wroughton, Swindon
Tour of vintage agricultural machinery (2.00 pm, followed by pub meal) and:
60 Years in farm machinery (7.00 pm)
A lifetime story from humble farmworker to setting up the first John Deere dealership in UK.
Speaker: Don Macmillan

Wednesday, 15 November 2000 at 7.30 pm
Venue: Lackham College, Chippenham, Wilts.
Advances in Sheet Metal Manufacturing
Presentation on recent factory investment in manufacturing machinery
Speaker: Dr R K Mitchell, Carrier Bulk Material Handling Ltd, Braintree, Essex

David Mehaffy Tel: 01380 722361

Wrekin Branch

All meetings start at 7.30 pm.
All technical meetings will be held at Harper Adams University College, Edgmond, Newport, Shropshire.
For further details contact the Honorary Secretary.

Monday, 9 October 2000
Tractors - the next hundred years
Speaker: Valtra Tractors (UK) Ltd

Monday, 20 November 2000
Power to the people: small-scale combined heat and power and its benefits
Speaker: Talbott's Heating Ltd

Monday, 11 December 2000
The Wrekin Branch Young Engineer's Challenge
A team quiz show which will delve into the depths of knowledge of young engineers from within the Wrekin Branch area, and come up with a winning team

Hon Sec: Denis Cartmel Tel: 01785 712690
e-mail: dcartmel@forgecomm.freeserve.co.uk

New professional engineering body is announced: The Society of Operations Engineers

An engineering 'marriage' takes place on 1 September, when The Institute of Road Transport Engineers (IRTE) and The Institution of Plant Engineers (IPlantE) join to form The Society of Operations Engineers (the Society). A recognition of the changing needs of engineering, this new professional engineering body will be an effective voice promoting the importance of operations engineering for business and society as a whole, as well as providing a natural home for engineers and technicians aiming to build a career in this vital area of engineering.

Almost three years' courtship, debate and negotiation culminated earlier this year in a decisive 'yes' vote from the memberships of both the IPlantE and the IRTE. Both these bodies continue as 'professional sectors' of the Society which, as the sixth largest professional engineering institution, has the weight to influence the world of professional engineering to the benefit of the public as well as its members. Chairman of the Engineering Council, Dr Robert Hawley welcomed the arrival of the Society stating: 'The Engineering Council welcomes the creation of The Society of Operations Engineers. This is a timely and forward-thinking development. It will be good for all those engaged in the widening field of operations engineering. Equally important, it will help to ensure that the organisation of the profession is better matched to the needs of business and the market place.'

The creation of The Society of Operations Engineers is a recognition that traditional engineering disciplines are becoming blurred. Industry, and society as a whole, needs the margins between professional technicians and engineers able to embrace a widening range of operations related activities, and these professionals need the support of a more broadly based body to help them build a career in this fast changing area.

The first 'outing' for the Society was to the IRTE's Scottish truck show TRUCKSCOT 2000 in Glasgow, in August. There will be a formal launch at the RAC Club in London on 31 October.

Graham Edwards

Three of the latest 4WD Trantors with various cab options; the open cab model for Developing Countries alongside other Trantors with the air-conditioned, three seater cab framed with the rollover protection structure (ROPS)

From conventional 'ploughing-first' tractors to 'transport-first' Trantors – two decades of radical design

Graham Edwards MSc was the Director of the Cell Manufacturing System Research Group at UMIST, Manchester, and visiting Professor of Manufacturing Systems at INSEAD, France, when he and one of his research students set up their company to create, design and develop a new kind of tractor. Stuart Taylor's SERC funded statistical study of the use of tractors on large UK farms indicated the need for a tractor that placed transport above ploughing in its design. Twenty seven years later, the development continues and Graham explains the reasoning that follows from 'statistics' to 'trailers, speed, linkage and p.t.o. work' - not from 'ploughing first' with its heavy, slow, drawbar pull connotations.

In recent years, the company has moved its focus from the relatively small UK tractor market to the large markets of India, Turkey, USA and Eastern Europe and have adopted an approach which accentuates transfer of technology and manufacturing under licence in countries with great potential.

A new model range is being shown to Trantor's loyal band of 350 plus UK customers this summer and the company is making a gift of shares (one for each year of Trantor ownership) to commemorate 25 years of British tractor development at a time when most British-owned tractor firms have folded, merged or been taken over.

Graham Edwards is Chairman of HST Developments Ltd, Lion House, Coach Road, Astley, Manchester M29 7BQ Trantor is the registered trade mark of HST Developments Ltd; e-mail: Trantor@btinternet.com

Introduction

At Manchester, UK, in 1972, some research indicated that farm tractors designed for ploughing at up to 10 km/h were mainly used for transport at up to 32 km/h. Some years later, statistics from Madras, India and Yemen (Middle East) seemed to show that the Manchester findings were more significant when viewed from a worldwide perspective.

The amount of transportation differs from country to country, region to region and farm to farm as the chart (*Fig. 1*) shows. Of course, companies, such as John Deere and New Holland cannot easily accept such radical findings because they make massive R&D investments in the status quo. It is, however, a fact that the sale of 'ploughing tractors' for transport work has been part of the sales pitch of the majors for many years.

Indeed, it is the sugar estates that show best how New Holland-Ford (NH) and John Deere have been providing tractors of a very sub-optional kind and causing sugar estates to use more fossil-fuels (about 10%-30% more) than necessary.

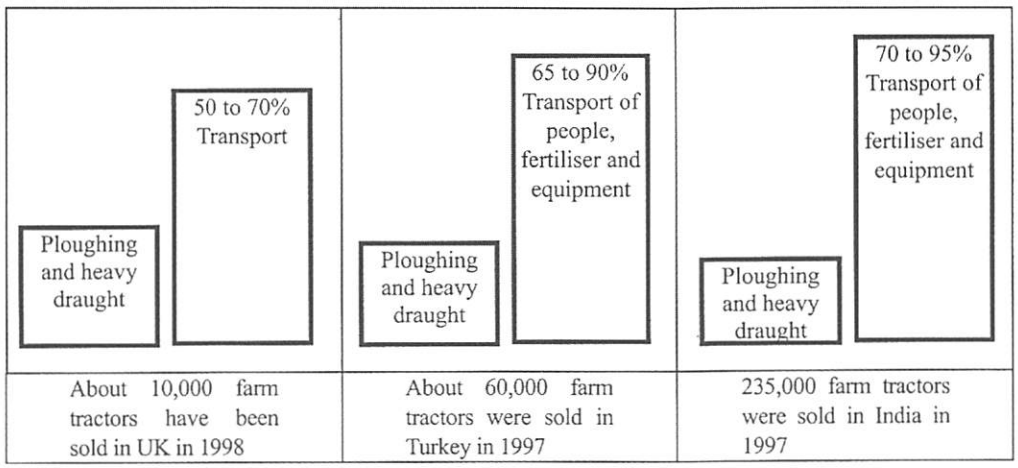


Fig. 1 Transportation operations as a proportion of total tractor use

Design specifications – the sugar industry

Tate and Lyle are well known in the sugar industry, in which India is the world's largest producer. Outside India, they invariably request that tractor manufacturers provide a special and different specification of tractors (designed on the 'ploughing-first' principle) for their transport work. Appendix I shows a typical specification for an 80 kW sugar cane transport tractor which requires that the manufacturer to take some things off and put some things on the conventional 'plougher'! (Note: p.t.o. blanked off; no brakes on front tractor wheels; hydraulics removed; and front weights requested to hold the front of the ploughing tractor down and to increase, not decrease, fuel consumption!)

Whilst the majors, such as John Deere, NH and Agco-MF, have moved on in recent years and added one higher gear to increase speed a little, they have not gone far enough and still not placed a braking system of truck standard (with front wheel brakes and compressor) on to their tractors and their trailers. Ford (NH) dealers in South Africa, however, have pointed the way to the manufacturer who has taken little notice. The publication, Sugar Cane Agriculture (1985) reports work conducted on the large C G Smith Sugar Estates: 'During the process of selecting a suitable haulage (transport) tractor, the inadequacies of the standard gearbox ratios became evident. They were overcome by fitting a 12 speed gearbox with improved ratios'. It is reported that the new gearbox gave a 7.9% improvement in fuel efficiency and a 20.9% improvement in tonnes moved per hour.

New and different tractors

Whilst the Intrac and the MB Trac are the two most well-known different kinds of farm tractor in Europe, neither of them can be properly defined as a transport tractor. The Bell Hauler, designed and made in South Africa, however, can be termed a transport tractor and has been extensively used as such on sugar estates and in mines. The South African Sugar Association Experimental Station stated in their report 'Comparison of Sugar Cane Haulage Tractors' (February 1984): 'The Bell 1756 Hauler with 118 kW engine power provides the cheapest way of hauling 24 t of sugar cane over 20 km if the crop can be handled by one unit'. The Bell Hauler is clearly a development from the 'ploughing tractor' and is rugged, tough and somewhat primitive, by European standards, from the driver's point of view. It has been widely accepted by sugar, timber, construction and mining companies in recent years in a transport role.

Another development, designed primarily for transport, is a British design called the Trantor - TRANsport TracTOR. This comparatively new development has a revolutionary approach to design as all the Trantor tractors have their own chassis, their own design of transmission, a unique three seater cab and three suspension systems for front axle, rear axle and hitch plus linkage. Braking on all wheels is standard, as is the fitment of a compressor to give air support to all wheels and to the trailer.

The Trantor Series 2 tractor pulling the 4 t Trukspec trailer loaded with 14 t of topsoil. The whole combination travels at 65 km/h

'Transport-first' tractor developments in the UK

In the UK, the Trantor transport tractor developments began with the belief that the Land Rover and farm tractor could be combined into one vehicle. Two early prototypes were driven at over 100 km/h for suspension, tyre and braking 'trials'. (The April 1978 Power Farming article

by Norman Lucas introduced readers to these early developments). The Trantor was thought by some to be an attempt to produce a British Unimog for British farmers. This was not the case, because the Unimog, like the MB Trac, was not designed for unbalanced trailers, as anyone placing a heavy, laden, unbalanced trailer, with lots of weight on the drawbar, on a Unimog will know. The most significant difference between the Trantor and the Unimog, as far as transport is concerned, is the unique suspended Trantor hitch and the position of the hook on the tractor *i.e.* near to the driver and under the rear axle!

The prototype 41 kW Trantor at harvest time in 1973; designed to pull a bigger trailer than a Land Rover but travel at Land Rover road speeds

The Trantor has been developed over 20 years: it has become slower and more like a conventional tractor with an excellent p.t.o.; and it has retained its low weight, all round suspension and air assisted brakes. It is a 'transport-first' tractor and not a 'ploughing-first' tractor. Whereas Henry Ford found '1700 other than ploughing duties', for farm tractors, the Trantor design team searched for '1700 other than transport jobs' for their tractor and steadily developed the Trantor product range to encompass more of them and so conduct more farming work.

The design approach to the Trantor 'transport-first' tractor development, was launched from a different starting point. Whilst Mercedes Benz has moved from a 'short 4WD truck' (Unimog) to a 'systems tractor' (MB Trac), MF, John Deere and New Holland have hardly moved from the basic 'plougher' but have added some minor haulage improvements. The Trantor was developed from the prototype (1973), which looked like a Land Rover with big rear wheels, through Series 1 Trantors (1980) as a 'road haulage tractor' with limited field work capability, to the series 2 'high speed, light fieldwork tractor' with excellent p.t.o. and 4WD!

Future possibilities for ploughing tractor development

Whilst the developments of ploughing tractors for transport work continue, they are now close to the limit of their possibilities. Future improvements are likely to be associated with three different developments *i.e.* transmission, brakes and suspension.

Transmission

The German based tractor companies have transmission options which increase the road speed of their farm tractors (at the maximum engine speed of about 2,000 rev/min) from 32 km/h to 40 km/h. Fendt, Deutz and MB Trac publicity and 'informed comment' indicates that each company is conscious of the need for higher road speeds and of each other. Transport is considered sufficiently important in Germany for each manufacturer to observe: 'Our road performance, if you choose our options carefully, is much the same as other German farm tractors'. The transmission work in South Africa by MF (Fedmech) and Armstrong Motors (Natal) with Ford transmissions and Perkins Engines, indicated that the speed was increased from about 32 km/h maximum speed to about 37 km/h. All the German tractor firms offer an option giving 40 km/h and legislation may soon be introduced in Europe to create 50 km/h and 80 km/h tractor speeds.

Brakes

The braking systems on tractors seem to be on the point of some kind of change. In France and Germany, 'air over hydraulic' is becoming more and more common as trailer loads on big farms have increased. The 'Natal Fords' are similar to this but the air seems only to be added for the braking of the rear tractor wheels and all those of the trailer. Whilst the Scottish Institute of Agricultural Engineering (SIAE) produced a considerable amount of work dealing with tractor stability of hills, they were unable or unwilling (!) to consider the significance of front wheel braking and trailer braking on hills; whereas in South African studies, greater emphasis was given to tractor and trailer braking on hills.

Suspension

Whilst there can be no doubt that suspension is an important element in farm haulage systems, any suspension that has been adopted has usually been placed on the trailer and not upon conventional 'ploughing tractors'. Renault tractors of France (1996) announced the placing of suspension under their cabs and spent £1.8m on it! Mercedes Benz, set the pace in 1975, by introducing a front suspension on to all of their MB Trac models and Fendt has followed this on some more conventional tractor models. MB Trac users in the UK have reported that this product is worth the extra cost, over conventional non-suspended ploughers, because of its comfort. Most German tractor trailer photographs show balanced trailers rather than the unbalanced ones used in France, Britain and other EEC countries. The balanced trailer is much less manoeuvrable but does not suffer from the 'drawbar bounce problem', associated with the British type of unbalanced trailer. Ploughing centred tractor designs suffer badly from 'drawbar bounce' and front end weights, which should be unnecessary for transport work (to keep fuel costs lower) are often added to compensate!

Table 1 Examples of transport activities

Task	*Operation*
1	'Ploughing tractor' carries plough to field and ploughs the furrow
2	'Ploughing tractor' carries sub-soiler to field and soil engages
3	'Ploughing tractor' carries power harrows to field and prepares seedbed
4	'Ploughing tractor' carries Dynadrive to field and works in ground;
5	'Ploughing tractor' carries seed to field and carefully drills
6	'Ploughing tractor' carries spray tank from farm to field and sprays
7	'Ploughing tractor' pulls slurry tanker to field and spreads
8	'Ploughing tractor' transports fertiliser to field and carefully spreads
9	(A) 'Ploughing tractor' bales hay; (B) another 'plougher' tows the flat-bed trailer
10	(A) 'Ploughing tractor' cuts grass; (B) another 'plougher' tows the silage trailers

The roles of transport tractors on European farms

The designers of 'transport-first' tractors needed to adopt a careful, studious approach and had to recognise the important differences of user (type of farm, different crops, size of unit, *etc.*), different tractor use profiles (how much time is spent on which tasks), as well as the technical features required (and not required) for each farm task.

In the case of a sugar transport specification (Appendix I), the transport tractor is clearly 'nothing but a transport tractor'. In Britain, the large Holbeach Farm Potato Co-operative (14 farms) and the Shrewsbury-based potato growing and merchant organisation, Scott-Newman, both have work profiles sufficient to find lots of work for transport tractors and both have used 'transport-first' tractors with at least two trailers per tractor. These organisations also use 'ploughing-first' tractors and, like the South African sugar estates, choose a 'horses for courses' buying and using strategy.

How is the 'transport' role defined?

The essential problem is: What actually constitutes transport? Since the reader must judge, it seems reasonable to take a few examples (Table 1).

In the first case of ploughing in task (1) of Table 1, depending on the size of farm (distance between plough store and field to be ploughed), the 12 hour working day of the farmer is probably 90% concerned with ploughing and 10% with transporting himself, to and from refreshment, and his plough to field and store. The ploughing job is slow and so are the tasks for sub-soiling and deep Shakerating in task (2), power harrowing in task (3), and Dynadrive work in task (4); and in all cases, the transport work is substantially less than the slower field work.

Sub-soiling and other heavy soil-engaging tasks have much the same transport to fieldwork time relationship. For drilling in task (5), the work in the field can be conducted at higher speeds (compared to ploughing) and is a precision task. The hoppers have the nasty habit of emptying; and hence the drill has to return to the seed storage point to be re-filled. Rich farmers might have another 'ploughing tractor', or fork lift truck at the ready with a seed hopper or trailer to fill the seed drill.

For spraying in task (6), slurry spreading in task (7), and fertiliser spreading in task (8), the work profile, as to the relationship between transport and fieldwork, moves more and more towards transport. The 'ploughing tractor' driver may ask himself if he is spending as much time in the field as he is out.

In tasks (9) and (10), the need is for the tractors on the transport duty to keep up with the harvester. As the technology improves, the combine, grass cutter and baler produce more output per hour. The 'ploughing tractors' on transportation, have to keep up with the increased performance. They cannot go quickly. They are not safe enough, nor can the driver hold the unsuspended tractor on field or track at speed. There is only one conclusion on most farms. Use another, slow, 'ploughing-first' tractor in the transport role! This means another person, and another tractor and *none* of the tractors are designed for efficient transportation!

Spraying - is this fieldwork or transportation?

It is clear that spraying has become a highly specialised activity and there are few who will not have noticed that the MB Trac is often used for spraying and is very frequently used by contractors, the CSC of Scotland using over 30 such machines. Another trend in the UK has been for lower ground pressure (LGP) vehicles to be used for spraying, largely because the heavy 'ploughing-first' tractors damage the ground. In the USA, the farming pick-up truck is frequently used. Whilst these developments are modern, they do seem to demonstrate some kind of strange logic when considered together.

A 2WD Trantor Series 2, 72 kW, working with a Lely power harrow on a Yorkshire farm

Firstly, the MB Trac is quite a heavy tractor and has to be so, to be as good at ploughing as it undoubtedly is. It is used because it can be made heavier still by adding a massive 2000 litre spray tank. With tank and booms, the complete rig becomes even heavier than most conventional 'ploughing tractors' with their tanks. The soil is thus more easily damaged by compaction.

Pick-up trucks and LGP vehicles are light and fast. They are faster than tractors because they have road transport

transmissions and sometimes have some form of suspension on the axles, or between the tank and the vehicle. This allows them to cover more ground more quickly. The MB Trac has some suspension too, but it sprays at normal, slow, 'ploughing tractor' speeds and it is certainly a slow, heavyweight tractor.

The design characteristics of pick-up trucks (LGP vehicles) and MB Trac, both of which are very popular for spraying, could hardly be more different. Why are they both so popular? The MB Trac is used because it can carry more weight (on its platform) than conventional ploughing tractors, even though it is too slow and too heavy when compared to the LGP vehicles! The LGP vehicles are used because they are fast, suspended and light.

Some tractor design illogicalities

In Table 1, there are 10 examples of tractor and transport work. Ploughing and sub-soiling in tasks (1) and (2)) require characteristics from the tractor that are epitomised by traction theory. The requirement is for big wheels, lots of weight and pulling power at a range of different but closely connected, slow speeds in the range 4 and 8 km/h.

Power harrowing in task (3) is p.t.o. driven and can be conducted efficiently with either a 'ploughing tractor' or a 'transport-first' tractor with live p.t.o. Whilst the transport tractor, if it had suspension on both axles, is slightly faster, it is only marginally so. Any substantial advantage is largely one of comfort in the field and on the road.

The Dynadrive for task (4) is ground driven and requires less traction than for ploughing and sub-soiling in tasks (1) and (2), but greater field speed gives improved performance 'through the ground' and breaks up the soil more. Should a well-designed 'transport-first' tractor be used for this duty, the performance could be as much as 30% better. The transport tractor would need suspension on both axles to achieve such a marked improvement.

Drilling in task (5) is similar to that for the Dynadrive in task (4) in that substantial traction may be required but the task can be conducted much more quickly if a 'transport-first' tractor is used rather than a 'ploughing-first' tractor. There is a substantial re-filling role which is also a transport task. Whilst comfort is a benefit from suspension, improved fuel efficiency may also result from the transport-focused transmission. The major benefit from a well-designed and fully suspended 'transport-first' tractor should be the increase in the out-of-field re-filling speed and the in-field operational speed.

Spraying in task (6) demands characteristics which are quite the opposite to those for ploughing in task (1), as explained earlier in the Spraying Section. Higher speed from water to field, a vast increase in speed and comfort in the field (of 100%!) and improved fuel consumption of 40% can be achieved by a well-designed transport tractor, with suspension affecting linkage, p.t.o. and platform, and used with a mounted or trailed sprayer.

Slurry spreading in task (7) focuses upon the mixed or livestock farm where the task is similar to that of the transport tractor on spraying and the traction performance may also be critical due to the need to spread on wet grass or hillsides. Whereas the specification of the sugar cane transport tractor in hot countries usually focuses on harvesting sugar cane when it is not raining, the slurry spreading task is likely to be conducted during inclement weather. A four-wheel drive 'transport-first' tractor should be ideal for this work. For many farmers, more than 50% of the time on this task is not in spreading but in transportation and re-filling! Using a transport tractor for slurry spreading can increase the efficiency of tractor, driver and tanker by over 40% as the work study, conducted under Percy Moss of Severn Trent Water Authority, in UK, shows.

Fertiliser spreading in task (8) calls for a fast, suspended, 'transport-first' tractor of light weight to skip over the soil, not to damage it, but capable of precision work and high accuracy. The transport tractor with light weight, suspended axles and live p.t.o. can do the trick at a greatly improved performance over slow, heavy 'ploughers'. The increased performance in the field can be as much as the 30% reported by the John Fleming Farms Company of Pagham, Sussex, UK. The out-of-field increased performance is close to 50% better.

Tasks (9B) and (10B) are support tasks to the harvesters. The tractors are used either to drive the harvester or to pull the trailers. With self-propelled harvesters, the tractor needs only to be a 'transport-first' tractor! When the tractor is operating the harvester, the power and efficiency of the p.t.o. is critical and so is the range of slow speeds on the tractor. Some 'ploughing tractors', such as Renault, are very good at the extremely slow speed necessary for particular carrot harvesters, as Tinsleys of Holbeach, UK know only too well! The technical requirements of slowness, heavy weight and p.t.o. power may be valuable characteristics when filling the trailer. They are not beneficial characteristics required to get from the field to the processing factory or the store!

The lighter weight 4WD Trantor 'transport-first' tractor just completing work in the field and returning to the water source at speeds far in excess of that possible with 'ploughing-first' tractors.

Summary

A marked distinction can be made between:

1. *heavy, slow,* unsuspended 'ploughing-first' tractors with

Table 2 Innovation in the farm tractor world

Tractor manufacturers	*World tractor market in power ranges, kW*						
	15-22	*23-30*	*31-50*	*51-70*	*71-100*	*101-120*	*121 +*
Main manufacturing countries India 260,000 per year, Germany 16,000 per year, Turkey 40,000 per year, Italy 45,000 per year, UK 50,000 per year, France 12,000 per year.	India China	India Turkey	India Turkey Serbia Russia Romania Belarus Japan	Italy UK France Germany Russia Serbia Romania Belarus	USA UK France Germany Finland Italy	USA UK Germany	USA
Main manufacturers of primitive tractors Little change or innovation is expected in these countries for 5 years (minimum innovation)	India China	India Turkey	India Turkey Serbia Russia	Russia Belarus Romania Serbia			
Main manufacturers of conventional 'ploughing-first' tractors with modern features (incremental innovation) Synchro, change on the move gearboxes, safety cabins, 40 km/h speeds, electronic draught control, Agco, NH, Deere, Same, Landini, Kubota, Renault		Japan Italy	Japan Italy	Italy UK France Germany	USA UK France Germany Finland Italy	USA UK Germany France	USA
Tractor manufacturers making unusual improvements to 'ploughing tractors' Cab suspension 40 km/h front axle suspension					Renault of France Fendt of Germany		
German designers Systems tractors considered to be future shape of farm tractors (1972-1999) (innovation and invention)				Intrac by Deutz Xylon by Fendt MB Trac by Mercedes Benz	Xerion by Claas		
The world's first fully suspended tractor British designer considers that the world of tractors needs a 'transport-first' tractor able to work more speedily on roads and in fields *e.g.* spreading, spraying (revolutionary invention)			Trantor prototype	Trantor Series 1 Trantor Series 2	Trantor Javelin		
Fully-suspended 'ploughing-first' tractors JCB Ltd picks up Trantor's fully suspended transport tractor ideas and develops the Fastrac range					Fastrac range of tractors produced in UK		

excellent independent p.t.o.'s and lots of low gears – the traditional 'ploughing tractor'; and

2. *lighter, faster*, suspended, 'transport-first' tractors with excellent independent p.t.o.'s, with some high road gears and some low field gears - new designs of 'transport-first' tractors.

No research and product development makes sense without determining who will buy new tractor types and where, in the market, these new product types will fit. In Table 2, taken from an unpublished article 'Innovation in The Farm Tractor World', the various new developments in farm tractors are placed in the context of the market segments in the world of tractors.

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Appendix I A typical specification for an 80 kW sugar cane transport tractor and trailers for the Tate & Lyle managed estates

1. General	Approximately 80 kW wheel driven tractor for infield and road transport. For use with a transfer type cane trailer.
2. Engine	Approximately 80 kW flywheel power diesel engine. Naturally aspirated. Heavy duty air cleaner with pre-cleaner and service indicater. Exhaust silencer with rain cap. Dual fuel filters with sediment and watertrap.
3. Electrical system	12 volt system with alternator. Heavy duty dry charged battery. Full road lighting system with headlights and sidelights. One rear worklight. Wiring and rear mounted electrical socket.
4. Transmission	Heavy duty plate clutch. Mechanical transmission with a minimum of 8 forward and 2 reverse speeds. Differential lock. PTO blanked off.
5. Steering	Power steering with manual operation and brakes possible when engine stopped. Powered brake system with oil immersed disc brakes operating on rear wheels. Mechanical parking brake.
6. Wheels and tyres.	Heavy duty rear wheels, either forestry or cast type. 18.4/15-30 with tread pattern and compound suitable for infield use and road transport of up to 15 km on gravel roads. Wheel track to be suitable for 1.5 m row spacing and should not exceed 2.4 m over the outside of the tyres.
7. Instrumentation	To include: engine speed and hourmeter; engine oil pressure gauge; water temperature gauge; fuel gauge; ammeter or charge warning light.
8. Hydraulics	Not required.
9. Rear Axle	Tractor will operate with a weight transfer trailer of the type that transfers weight in front of the tractor rear axle. Supplier to state maximum static load that can be superimposed on tractor rear axle so that the axle is not overloaded. This figure should be that which could be imposed on the tractor equipped to this specification and with operator.
10. Additional equipment	ROPS frame cab with canopy. Front weight frame with a set of weights. Heavy duty radiator guard. Operators suspension seat. Toolkit and locking tool box. Rear light socket for attachment of trailer plug.
11. Alternative	Torque converter clutch with powershift. Equipment transmission. Note: It is essential that engine braking is retained. Extreme service air cleaner system (Donoclone System or similar).
12. Finish	To be finished painted in manufacturers standard gloss paint.

TRANTOR® is the Registered Trade Mark of HST Developments Ltd.

New careers pack promotes careers in land-based industries

A colourful and informative pack promoting careers in land-based industries has been mailed to more than 5,000 careers offices, schools, sixth forms, colleges and universities throughout the UK. The pack, 'Careers in Land-based Industries', is designed to appeal to both young people seeking new careers and others considering a career change.

Produced by Lantra National Training Organisation with funding from the Department for Education and Employment, the pack contains a map that outlines the various work-based and academic qualification routes people can take, whatever their level of experience. There is also a section on National Traineeships and Modern Apprenticeships.

At the back of the pack are 10 fact sheets, each covering an industry or career area. They give detailed information about specific careers in the land-based sector, describing the skills needed, possible entry routes and where to get further information. Case studies from students and people established in their careers provide added insight into the opportunities available.

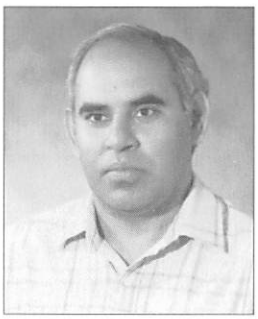
Lantra's development manager Debra Costley said: 'This pack provides an introduction to the exciting, rewarding and varied career opportunities in the land-based sector. We hope that people of all ages will find the case studies inspiring and the information useful as part of their own career planning.'

The pack has been well received by Lantra's industry groups. Jim Marshall of the National Trust and chairman of the landscaping industry group said: 'This is the first time a single brochure has been available containing information on the full-breadth of land-based careers. Its clear and simple qualifications route map will be helpful to both those seeking a career and employers responsible for staff development.'

Contact: **Jane Lewis, Lantra National Training Organisation, Lantra House, NAC, Kenilworth, Warwickshire CV8 2LG. Tel: 024 7669 6996 E-mail: nto@lantra.co.uk**

Tractor manufacture and utilisation in India

A report of the presentation by Professor Gajendra Singh, Asian Institute of Technology to the IAgrE/ICE/TAA joint seminar 'The Tractor Factor - Ploughing a Road out of Poverty' held at the Institution of Civil Engineers in November.



The global spotlight on tractor manufacture certainly in terms of unit volume seems to be swinging away from the USA, UK and Western and Eastern Europe towards India and China where growth in the number of producers and the total volume in recent years have been impressive. Professor Singh's presentation provided an interesting insight into the current situation and the forecast for the future as well as a fascinating description of the history of the Industry from its early beginnings in the 1940's.

The Indian tractor industry

1945 to 1960

War surplus tractors and bulldozers were imported for land reclamation and cultivation in mid 1940's. In 1947, Central and State Tractor Organisations were set up to develop and promote the supply and use of tractors in agriculture and, up to 1960, the demand was met entirely through imports (Table 1). There were 8,500 tractors in use in 1951, 20,000 in 1955 and 37,000 by 1960.

1961 to 1970

Local production began in 1961 with five manufacturers producing a total of 880 units per year. By 1965, this had increased to over 5000 units per year and the total in use had risen to over 52000. By 1970, annual production had exceeded 20000 units with over 146000 units working in the country.

1971 to 1980

Six new manufacturers were established during this period although three companies (Kirloskar Tractors, Harsha Tractors and Pittie Tractors) did not survive. Escorts Ltd began local manufacture of Ford tractors in 1971 in collaboration with Ford, UK and total production climbed steadily to 33000 in 1975 reaching 71000 by 1980. Credit facilities for farmers continued to improve and the tractor market expanded rapidly with the total in use passing the half million mark by 1980.

1981 to 1990

A further five manufacturers began production during this period but only one of these survived in the increasingly competitive market place. Annual production exceeded 75000 units by 1985 and reached 140,000 in 1990 when the total in use was about 1.2 million. Then India - a net importer up to the mid-seventies - became an exporter in the 80's mainly to countries in Africa.

1991 to 1997

Since 1992, it has not been necessary to obtain an industrial licence for tractor manufacture in India. By 1997, annual production exceeded 255,000 units and

Table 1 Production, sale and population of tractors in India

Year	*Product-ion*	*Import*	*Export*	*Sale*	*Tractor 'park'*
Up to 1946	0	4,500	0	4,500	4,500
1947-51	0	4,000	0	4,000	8,500
1952-56	0	12,500	0	12,500	21,000
1957-60	0	16,000	0	16,000	37,000
1961	880	2,997	0	3,877	39,000
1962	1,414	2,616	0	4,030	41,000
1963	1,983	2,346	0	4,329	43,000
1964	4,323	2,323	0	6,646	47,000
1965	5,673	1,989	0	7,662	52,000
1966	8,816	2,591	0	11,407	62,000
1967	11,394	4,038	0	15,432	76,000
1968	15,466	4,726	0	20,192	93,000
1969	18,093	10,478	0	28,571	118,000
1970	20,099	13,300	0	33,399	146,000
1971	18,100	19,739	0	37,839	176,000
1972	20,802	1,000	0	21,802	210,000
1973	24,425	1,000	0	25,425	228,000
1974	31,088	793	0	31,881	256,000
1975	33,252	1,100	0	34,352	287,000
1976	33,146	2,920	0	36,066	319,000
1977	40,946	0	0	40,946	356,000
1978	54,322	0	0	54,322	406,000
1979	62,275	0	0	62,275	462,000
1980	71,024	0	0	72,012	526,000
1981	84,137	0	0	79,467	594,000
1982	63,155	0	0	65,776	644,000
1983	75,872	0	0	76,545	701,000
1984	84,876	0	0	82,390	754,000
1985	75,550	0	0	76,817	798,000
1986	80,369	0	0	80,670	841,000
1987	92,092	0	0	92,092	911,000
1988	109,987	0	0	109,987	996,000
1989	121,624	0	0	121,624	1,085,000
1990	139,831	0	458	139,373	1,190,000
1991	150,556	0	583	149,973	1,304,000
1992	144,350	0	1,174	143,601	1,407,000
1993	138,770	0	1,498	138,057	1,491,000
1994	164,841	0	3,038	164,309	1,593,000
1995	191,329	0	3,454	191,196	1,712,000
1996	221,689	0	3,719	220,941	1,853,000
1997	255,327	0	7,000	250,378	2,038,000

the national tractor park had passed the two million mark. India has now emerged as one of the world leaders in wheeled tractor production.

1997 to 1999

Five new manufacturers have started production since 1997. In 1998, Bajaj Tempo, already well established in the motor industry, began tractor production in Pune. In April of the same year, New Holland Tractor (India) Ltd launched production of 53 kW tractors with matching equipment. The company is making a $US 75 million initial investment in a state of the art plant at Greater Noida in Uttar Pradesh state with an initial capacity of 35000 units per year. Larsen and Toubro have established a joint venture with John Deere, USA for the manufacture of 26-49 kW tractors at a plant in Pune, Maharashtra and Greeves Ltd will produce Same tractors under similar arrangements with Same Deutz-Fahr of Italy. Looking to South American export markets, Mahindra and Mahindra are also developing a joint venture with Case for tractors in the 45-150 kW range. Total annual production is forecast to reach 300,000 during the current year.

The Industry today

Tractor manufacture is now firmly established in India and is highly competitive with rapid advances being made in technical design and quality with increasing attention to export markets. Of the 16 companies that began operations before 1990, six are considered major manufacturers - Eicher, Escorts Ltd, HMT, Mahindra and Mahindra, PTL and TAFE (Table 2). Five of these were set up with foreign collaborators and one (Punjab Tractors) with indigenous know-how. Mahindra and Mahindra has emerged as the largest manufacturer producing 68,000 units in 1997, followed by TAFE, Escorts Ltd and Punjab Tractors with 49,000, 48,000 and 40,000 units, respectively. Sales in Northern and Western India are forecast to remain strong whilst the market in the southern states is likely to grow more rapidly along with export sales. However in some states such as the Punjab, future sales will be mainly replacement of existing stock as densities of as much as 82 tractors per 1000 ha have been reached. The average size of tractor in the country is currently 26 kW which, following trends in other parts of the world, seems likely to increase steadily to around 34 kW by 2020; by which time, the total tractor population may have increased from the present two million to five million, with annual production up to 320,000.

Table 2 List of tractor manufacturers, their collaborators and the year of commencement of production

	Manufacturer	*Collaborator*	*Year*
1	Eicher Tractors Ltd.	Gebr, Eicher Tractorenfabrik, West Germany	1961
2	Gujarat Tractors Ltd./Tractors and Bulldozers Ltd.	Motokov-Praha, Czechoslovakia	1963
3	Tractor and Farm Equipment Ltd.	Massey Ferguson, UK	1961
4	Escorts Ltd.	Moloimport Warazawa Zaklady Mechaniczne Ursus, Poland	1964
5	Mahindra & Mahindra Ltd./ International Tractor Co. of India Ltd.	International Harvesters, UK	1965
6	+Escorts Tractor Ltd. / Escorts Ltd. (Farmtrac Division)	Ford, UK	1971
7	Hindustan Machine Tools Ltd. (Central Sector PSU)	Motokov-Praha, Czechoslovakia	1971
8	*Kirloskar Tractors Ltd.	Klochner-Humboldt Deutz, Germany	1974
9	Punjab Tractors Ltd. (State Sector)	CMERI, India	1974
10	*Pittie Tractors Ltd.	Own know-how	1974
11	*Harsha Tractors Ltd	Motoimport, Russia	1975
12	*Auto Tractors Ltd.	British Leyland, UK	1981
13	** Haryana Tractors Ltd. / Pratap Steel Rolling Mills Ltd.	Own know-how	1983
14	VST Tillers & Tractors Ltd.	Mitsubishi, Japan	1983
15	*United Auto Tractors Ltd.	Uzina Tractorul, Romania	1986
16	*Asian Tractors Ltd.	Own know-how	1989
17	Bajaj Tempo Ltd.	Own know-how	1997
18	International Tractors (Sonalika) Ltd.	Own know-how	1998
19	New Holland Tractor (India) Pvt.	New Holland Tractors, Italy	1999
20	Larsen & Tubro Ltd.	John Deere, USA	1999
21	Greaves Ltd.	Same Deutz-Fahr, Italy	1999

*Currently not in production +Now producing Farmtrac tractors
** Have been producing small quantities on "On & Off" basis

Power tillers

By comparison with other parts of South East Asia, demand for power tillers in India has been slow to take off. However, the current population of around 66,000 units with an average size of 8 kW is expected to rise steadily to around 300,000 units by 2020, with annual production reaching over 50,000 units.

Tractors are used mainly on owner's land but contract (custom hire) work is increasing steadily. The use of tractors for non-farm tasks is also increasing steadily and Prof. Singh showed examples including: transport of people, raw materials and construction materials for roads and buildings; mounted loaders and earth moving and grading blades; back-hoes, irrigation and drainage ditch diggers; pto driven pumps, compressors, post hole augers for forestry and fencing; and mounted or trailed hydraulic platforms for telephone and power line maintenance.

(For further information on tractors in India see Dr G. Singh's (no relation) paper in *Landwards*, **55**(1), 17-25)

DHS

The role of enterprise development in the provision of rural infrastructure services in developing countries

Malcolm Cutler

The previous speakers have ably demonstrated the uses and roles of tractors and other agricultural based equipment in agriculture and road maintenance in two developing country scenarios. This shows the potential, through the use of such equipment, to increase both farm productivity and improve rural infrastructure. However, as we all know, in developing countries most farmers and rural entrepreneurs do not have the income to purchase such expensive equipment.

In the past, many of the tractors and equipment found in developing countries, particularly Africa, have been provided through direct aid from international donors. In most cases, lack of sustainable business opportunities and little or no care and maintenance, has resulted in them being quickly consigned to the scrap heap. If local people are going to benefit from the introduction of such equipment, therefore, new ways have to be introduced to help ensure both their affordability and their long term sustainable use. Fortunately there is now a growing realisation in the international donor community that the private sector can positively contribute to their development programmes.

In this short paper, I would therefore like to illustrate the potential for new Public - Private Sector Partnerships (*i.e.* donors and the private sector working together to promote growth in developing countries). The benefits may include the introduction of new business initiatives, together with enterprise and business development programmes, that can strengthen the private sector, leading to increased job opportunities, income generation/flow and help to improve living standards and reduce poverty, in rural areas.

Malcolm Cutler is Managing Director, FSD Development Services Ltd, and presented this paper to the annual IAgrE/ICE/TAA joint seminar 'The Tractor Factor - Ploughing a Road out of Poverty', held at the Institution of Civil Engineers in November, 1999.

Entrepreneur and business development

Why do we need entrepreneur and business development?

Rural areas often provide few business opportunities and many of the entrepreneurs and businessmen/women are unaware of how to run a modern and sustainable business. Therefore, if *only* business opportunities are introduced, the local entrepreneurs will not have the capacity to take advantage of them. Conversely, if we *only* upgrade the capacity of the entrepreneurs, *i.e.* through training, their hopes will be raised and the training will be largely wasted as there are no business opportunities or jobs, a 'catch 22' situation. Therefore, it is essential that the introduction of business opportunities and entrepreneur development go hand in hand.

I would like to give an example from Ghana as to how entrepreneur support can assist in business development. In Ghana, my company has helped to implement and manage an enterprise development programme, EMPRETEC, on behalf of the UK Department for International Development (DFID). One of the early applications that the programme received was from a local entrepreneur who ran a small tyre repair business and had managed to attract donor funds and acquire some new tyre retreading machinery. However, he did not know how to assemble it nor could he raise the money from local banks for working capital, *e.g.* tread rubber. He then enrolled on the EMPRETEC training course for entrepreneurs. This not only taught him business and management skills, but also provided him with assistance with approaching the banks for finance and short term technical assistance through BESO (British

Executive Services Overseas). As a result of this assistance, the equipment was ready for operation within 6 weeks and the banks had the confidence to lend him the required working capital. Within weeks, his company was fitting tyres onto British High Commission vehicles and subsequently the company has gone from strength to strength.

Another example is an NGO in Kenya which is training farmers in conservation farming techniques, introducing simple business and financial training and organising local markets where the farmers sell their 'conservation quality' - often pre-packed - produce.

You can see from these examples that, given appropriate business training, access to finance and technical assistance, entrepreneurs (who are not necessarily good businessman) can develop their business and management skills and thereby provide jobs which lead to increased incomes and higher living standards. I must stress that although subsidised, the entrepreneur has to contribute to the costs of the services provided, thus learning the first lesson in business - nothing worthwhile comes for free!

In order to assist the private sector and specifically local entrepreneurs to successfully expand, assistance largely financed through the public sector, *i.e.* donors, needs to be given in the following areas.

- **Entrepreneur/Business Training**
  - Financial management, marketing and quality
  - Delegating, building teams and people management
  - Business planning/strategy and business plan production
- **Business Support Services**
  - General business advice and support
  - Legal and accounting support
  - Financial support, *i.e.* links with banks and other financial institutions
  - Mentoring, *e.g.* through larger local businesses
  - Peer support, *e.g.* through local business clubs, mutual guarantee schemes
  - Communication, *e.g.* internet facilities, business references library
- **Technical Training and Support**
  - Provision of short term expertise in *e.g.* production, marketing, finance
  - Longer term management support
  - Market access
- **Labour Skills Development**
  - Expanding businesses need an increasing pool of skilled labour and 'middle' management. The facilities therefore need to be in place to train local people, who previously may not have had employment experience, in accepted employment practices, *e.g.* time keeping, loyalty and honesty, as well as the skills required by all business, for example secretarial, bookkeeping and general administration.
- **Local Enterprise Support Infrastructure**
  - As the number of businesses in an area grow, there will also be a need for independent support services which are businesses in their own right, *e.g.* financial services, which understand the needs of small businesses, secretarial/copying/communication services, accountants, lawyers and consultants.

Business and employment creation

As stressed at the beginning of this paper equipping entrepreneurs with business and management skills will be largely wasted unless the opportunities are available to put their new-found skills into practice.

Where business opportunities do exist, entrepreneurs often *either* do not have the money to pay for the equipment needed to deliver the services *or* the customer, although wanting the service, cannot afford to pay for it. Both of these restrictions are commonplace within rural communities in many developing countries. Many people would argue that this is a situation that can only be changed by the people themselves, through their own endeavours. Whilst I would not necessarily argue with this, time is not on their side, with the result that living standards continue to fall and poverty increases.

In the past, the public sector has been very suspicious of business and its profit motive. There is, however, a fresh wind blowing through the donor community which now recognises the need to develop partnerships between the private and public sectors through which new business opportunities can be generated, resulting in increased rural employment and incomes.

Previously those governments/donors, who recognised the need for business development, often introduced enterprises that were inappropriate to both a particular region and people, *e.g.* in Tanzania. This resulted in a high proportion of business failures, the destruction of people's ambitions and the waste of taxpayers money. *A positive alternative would be the introduction of businesses which not only build on existing rural enterprise skills such as farming and agricultural contracting and utilise local labour, but which also enable people to upgrade their own, mainly agricultural enterprises, through widening the use of agricultural equipment.*

Taking the greater use of tractors, power tillers and other machinery as an example, their use in both the agricultural sectors and in the maintenance of the rural environment could generate additional opportunities to increase rural incomes. At the present time, tractor usage in developing countries is very low, due largely to the low levels of income in the agricultural sector. However, it is widely accepted and proven that their use could greatly improve agricultural production and productivity. *Therefore, there is a need to introduce other, compatible, opportunities which could broaden the use of these tractors and allied equipment and provide local entrepreneurs with the potential income base to enable them to purchase them in the first instance.*

Such an opportunity could develop through the wider use of agricultural tractors and equipment in local road maintenance and construction, power/telephone line laying and the construction of water storage/distribution and sewerage services, as examples.

If local entrepreneurs were given the necessary entrepreneur and business development support and encouraged to deliver these services, *sustainable enterprises could be created.* As I will later explain, an all-important component of these services is that they are based on fixed contracts.

Many schemes involving road maintenance and construction are already financed by donors so the additional costs of involving and equipping local entrepreneurs to enable them to provide services to these schemes, would be relatively low. In many countries, there are also existing donor funded enterprise

development programmes *e.g.* Mwazi Khali in Kenya, which could be used to deliver the enterprise development component. Therefore, the 'kick starting' of local enterprises, to provide services to the new business initiatives in the region, need not necessarily result in excessive cost to the donors.

However, the introduction of new business initiatives will only be successful if the entrepreneurs also have access to the relevant financial and technical facilities.

Sourcing business finance

As we are well aware, most banks are not known for their generosity towards small and medium sized businesses (SMEs), particularly those in rural areas. This is understandable, given their lack of collateral and, in many cases, credibility. However, new business initiatives will provide the local entrepreneur with fixed contracts, which will help to give the banks the confidence required to finance the purchase of the necessary equipment. Where there is still a problem because of the lack of collateral, especially for the purchase of larger equipment, other financing sources such as leasing need to be explored, together with a combination of donor based guarantees and/or mutual guarantee schemes *i.e.* guarantees provided by a group of people.

Smaller entrepreneurs, such as individual farmers, could still find it difficult to afford expensive capital equipment, so additional enterprises renting equipment and providing service facilities also need to be encouraged.

Equipment supply and support

These new initiatives will provide additional sales opportunities for equipment manufacturers and suppliers, however, their support over and above simply selling their products is essential if the new initiatives are to be sustained. In particular, manufacturers and importers must assist with:

- providing the right product, built for the use and conditions and ensuring local staff are competent in advising the buyers;
- ensuring efficient and affordable service and spares parts back up;
- working with donors and local financial institutions to provide practical and flexible finance packages; and
- working with local manufacturers in order to offer affordable additional equipment, *e.g.* trailers, grader blades, *etc.*

In addition to the direct benefits to the local community, that will result from the introduction of new business initiatives in the area, new employment and agribusiness opportunities will also develop.

Employment opportunities

The local enterprises 'kick started' by the new business initiatives will provide additional employment opportunities for local people through a number of different channels.

- Direct employment will increase by the local enterprises, *e.g.* local labour, drivers, *etc.*
- As the money earned filters through into the local economy, more jobs will be created, either directly related to the new enterprises *e.g.* equipment service and supply, or in the consumer sectors *e.g.* shops, food stalls.
- There will be greater local skills usage.
- The presence of new jobs in the area will give people more incentive to actively seek work and training and to stay and work locally.
- New jobs will be created which women can undertake.

Agribusiness development

As a result of the new business initiatives, new equipment and increased business knowledge will be introduced. The local entrepreneurs, *e.g.* farmers and contractors, will also be able to use this equipment and business understanding, to improve local farm production and productivity. This will have a direct effect of raising not only their incomes, but also increasing the amount of money circulating within the local economy.

Conclusion

Rural economies, especially in developing countries, are stagnating due to lack of business opportunities and investment and need to be 'kick started' if they are to survive and grow. Neither the public nor the private sector can solve this problem on its own. Therefore, it is suggested that new public-private sector initiatives, as discussed in this paper, will help to broaden the commercial opportunities for rural entrepreneurs whilst, at the same time, equipping them with the business and technical skills to take full advantage of these opportunities.

Such initiatives could contribute greatly to sustainable employment and increased incomes in rural areas and, in turn, would have a direct effect on reducing poverty and raising living standards.

Cambridge business nets international media prize

A multi-national video and multimedia award has been won by TWI, the Abington research company once known as the Welding Institute.

The winning entry, TWI's multimedia programme *Welding Fume Tutor,* was devised to enlighten staff, engaged in a welding environment, of the hazards of welding fume.

The Andre Leroy medal is named after the one-time director general of the French Institut de Soudure and until recently was awarded for excellence in film and video programme production related to the subject of welding. In recent years the scope of entries has been broadened to embrace multimedia programmes.

The award was made at the annual assembly of the International Institute of Welding, held this summer in Florence, Italy.

The citation acknowledged the efforts of a multi-faceted production team led by Graham Carter, TWI's welding fume specialist, Martin Bourton and Linda Godden on the multimedia side and the photographic and video work of Brian Smith, Simon Condie and Roy Smith.

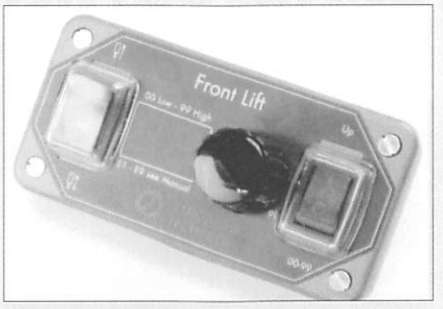
The award was accepted at the IIW opening ceremony, held in Florence's magnificent Palazzo Vecchio, by TWI's Editor of Television, John Dadson.

Electronic Position Resume system

The Zuidberg Electronic Position Resume (EPR) system from Lynx Engineering has been developed to provide a more accurate and simplified operation of front linkages. In brief, the system has three main functions.

Firstly, it allows the linkage to be precisely set so it will automatically maintain one of 99 fixed positions. Secondly, a simple toggle switch can be used to raise and lower the linkage at the headland, the linkage automatically lifting to a fixed lift out height or working height. Finally, the system allows the operator to switch the lift rams between single or double-acting.

The EPR system provides a digital readout numbered from zero to 99. This is used to accurately indicate the linkages exact position. In work, the linkage is adjusted to maintain its correct operating or lift out height via a rotary control knob on the integrated control and display unit



Simplified front linkage control from Lynx

in the cab. The linkage position is always indicated as a position number on the display to provide an accurate reference for the operator. Once set, the linkage is controlled via the raise and lower switch.

The EPR system offers a number of advantages. The ability to set a fixed lift height, for example, can be used to eliminate the risk of damaging the PTO shaft by operating it at too steep an angle as an implement is raised. This feature enables drive to powered equipment to be maintained during a headland turn.

By simply pressing the raise and lower switch, the operator also knows the EPR system will lift or lower the linkage, at a controlled speed, to pre-set settings. This reduces operator fatigue and can help boost productivity.

The EPR system is suitable for use with double-acting Zuidberg front linkages fitted to tractors with closed centre hydraulics and load sensing pumps. Available as either a dealer installed retrofit kit, or factory supplied with a new front linkage system, the system is priced from £1,026.

Contact: **Nick Ewbank, Lynx Engineering, Wharf Works, Long Buckby, Northampton, NN6 7PP. Tel: 01327 843215. Fax: 01327 844341**

Rate Rite ATV spray rate controller - economic and accurate

ATV spray rate controller from C-Dax

Purpose designed for use on ATV's with 12 V sprayers, the C-Dax Rate Rite spray rate controller from Tri-Ag will automatically maintain spray application rates at varied working speeds. Compatible with all makes of 12 V trailed and rack mounted sprayers, the Rate Rite works in a similar way to units used on full-scale sprayers.

The Rate Rite is a critical advance. Existing ATV sprayers work at a fixed application rate, regardless of forward speed. By automatically adjusting the sprayer so it accurately reflects changes in speed, the Rate Rite will help ensure all applications are consistent. This is extremely difficult to achieve with current ATV based spraying system.

The potential benefits the Rate Rite offers are clear. Under and over application of chemicals is largely eliminated, with both environmental and economic benefit.

Of equal importance, the Rate Rite will help ensure an ATV sprayer can match the accuracy of a conventional broad acre sprayer.

Another key feature of the Rate Rite is its ease of use. The operator selects the application rate, and the Rate Rite will then maintain that output relative to the ATV's forward speed. This is of particular benefit when working on undulating land where it is difficult to maintain a constant speed.

Standard features include a digital speedometer, hectare meter, operating pressure and distance meter plus automatic or manual control. The Rate Rite is supplied in a kit complete with controller and all necessary fittings. This includes a wheel sensor that can be attached to the ATV or trailed sprayer wheels. Retail price from C-Dax dealers, £425 plus VAT.

Contact: **Mervyn Hutton, Tri-ag Ltd, Eleven Mile Lane, Suton, Wymondham, Norfolk, NR18 9LR. Tel: 01953 605151. Fax: 01953 607818.**

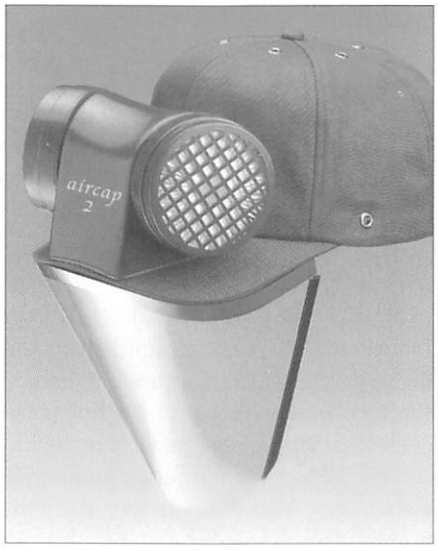
New Aircap 2 - protection from dust and most other airborne particles

Following the success of the first Aircap, Bradwest Safety are pleased to announce the release of their new and improved Aircap 2 - a lightweight and comfortable positive-pressure respirator with a head-weight of only 300 g, providing a continuous flow of purified air to the user whilst protecting from dust and most other airborne particulate pollutants.

Aircap 2 has a new type of advanced technology turbo-fan which draws the ambient polluted air through a pair of highly efficient and easy-change modern filters which remove the microscopic particles, even those invisible to the naked eye. The resulting clean air is then blown across the face and breathing zone and behind a lightweight visor at a rate of 170 l/m. This provides the wearer with a pleasant stream of clean and cooling air without any breathing resistance. This enhances comfort, thus user acceptance and protection. The positive pressure which is maintained behind the visor, prevents dust and other pollutants from entering the breathing zone.

The new Aircap 2 complies with European Standard EN 12941:99 - TH1

A modern styled battery compartment



with on/off switch is provided which holds readily available 'C' size cells. The battery compartment can be carried in the pocket or worn on a belt using the fitted clip provided. High grade alkaline type cells will provide some 30-40 hours running time. An alternative battery compartment, but fitted with re-chargeable cells and supplied complete with matching charger, is also available.

Another option for the new Aircap 2 adds 'Bump and Scratch' protection for the head. Normal colour scheme for Aircap 2 is green with black trim and the general appearance is that of a fashionable baseball cap. Aircap 2 is fully adjustable for most adult head sizes. The standard version of Aircap 2 is available at an attractive RRP of under £82.00 carriage paid (+VAT).

The versatility and competitive pricing of Aircap 2 will lead to numerous applications where users require protection combined with comfort at a sensible price. Some example applications include: agriculture and poultry production, plastering, grinding, sanding, pharmaceuticals, protection from allergies, asthma, woodworking, protection from pigeon lung, DIY and hobbyists, and numerous other applications where dust and pollution is a problem in the workplace or at home.

Contact: **Bradwest Safety Company Ltd, 39 Grenville Close, Burnham, Slough, SL1 8HQ. Tel: 01628 660908 Website: www.aircap2.com**

Tinsley Wire and McArthur's go green with the Forestry Commission

The Forestry Commission has signed a quarter of a million pound deal with agricultural distribution company McArthur's to supply its full requirement of fencing products from leading agricultural fencing manufacturer Tinsley Wire, the majority of which will be from its unique 'green' range.

The 12 month contract, which has the option to extend it by a further two years, will involve the supply of over 500,000 metres of stock fencing, barbed wire, rabbit netting and coil wire which will be used to protect forests nationally.

Sales and marketing director James McArthur said: 'We are delighted with the new contract. In this very competitive market the fact that the largest landowner in the country has chosen fencing from Tinsley Wire is testament to the quality of the product and the service we offer. Our efficient distribution service and competitive pricing, means the Forestry Commission is assured of the best value for money package available.'

The galvanised green coating, which will be widely used for the Forestry Commission contract, gives Sentinel and Rylock products an extended life span by delaying corrosion, thus ensuring attractive fencing for many years with the minimum of maintenance.

The McArthur Group have been involved in the distribution of goods to agricultural and builders merchants for over 150 years. With a network of branches throughout the UK, the group is renowned for its efficient service and the high quality of its products.

Fencing brands stocked by McArthur's include Green Rylock Stockfence, Sentinel Wire Netting, Green Rypoint and Sentinel Barbed Wire, Rylock and Sentinel Staples together with Sentinel Badger and Horse Fencing.

Contact: **Paul Frost, Tinsley Wire - Agricultural Division, PO Box 119, Shepcote Lane, Sheffield S9 1TY. Tel: 01142 560001. Fax: 01142 244570.**

Monitoring moisture content in the millennium seed bank

Millennium Seed Bank case study

The Royal Botanic Gardens (RBG) is using a Dewmet cooled mirror dewpointmeter from Michell Instruments to monitor the equilibrium relative humidity (ERH) levels, and therefore, moisture status of seeds stored in the Millennium Seed Bank. An important conservation and research facility, the Millennium Seed Bank will house live seeds from an anticipated 10% of the world's plant species, enabling them to be stored long term in a state of suspended animation.

Sponsored by the Millennium Commission, Orange plc and the Wellcome Trust, the Millennium Seed Bank has been established in response to the increasingly important role that seeds are playing in the conservation and use of wild plants. Extending the service offered by the RBG's existing seed bank, the new centre will prioritise the storage of those species, mainly from the tropical drylands, that are currently under threat due to human developments and deforestation, with the final aim of collecting and preserving around 25,000 plant species by the year 2010.

As a further benefit, information gleaned from analysis of the seeds will be incorporated into a comprehensive central database that, subject to agreements, will be used to publicise the contents of the seed bank to university departments, agricultural institutes and non-governmental organisations working in the developing world.

In practice, seed samples collected from field trips or supplied by scientists specifically for storage, are separated from the seed cases, dried to 15% relative humidity and deep frozen for storage in air-tight aluminium and glass containers at -20°C. The low moisture content and temperatures slow down the rate at which the seeds lose their ability to germinate, preserving the species for hundreds, and in some cases thousands, of years.

To ensure that the seeds remain viable during storage, conditions are carefully monitored and a number of seeds of each type are periodically extracted and tested for germination to confirm that they are still alive. Michell Instruments' cooled mirror dewpointmeter, Dewmet, has been specially modified to provide direct analysis of the ERH of the seed samples, both prior to and during storage.

Dewmet provides a high accuracy of ±0.2°C dewpoint and 0.1°C gas temperature across a measurement range of -50°C to +85°C dewpoint and -40°C to +90°C ambient temperature. Combined with a fast response speed of 1°C per second and zero drift, Dewmet ensures that relative humidity readings remain accurate over time.

Keith Manger, Laboratory Manager at Kew's Seed Conservation Department comments, 'The Millennium Seed Bank is an important resource in conserving the world's plant species and offers us both an insurance service should other conservation techniques not be successful and a valuable information resource. We chose to use a Michell hygrometer in the Seed Bank as our previous Michell equipment had always functioned reliably and efficiently.'

'The company proved to be very supportive, modifying the instrument specifically to meet our requirements, and Dewmet has assisted us in monitoring the moisture status and stability of our seed collection during long term storage since our purchase of the bank in 1996. Potentially, Dewmet also provides us with a tool for the precise measurement of seed moisture status in research studies of the role of water in seed survival.'

Contact: **Michell Instruments Ltd, Nuffield Close, Cambridge CB4 1SS. Tel: 0800 9754770. Fax: 01223 426557. e-mail: info@michell.co.uk Web site: www.michell.co.uk/michell**

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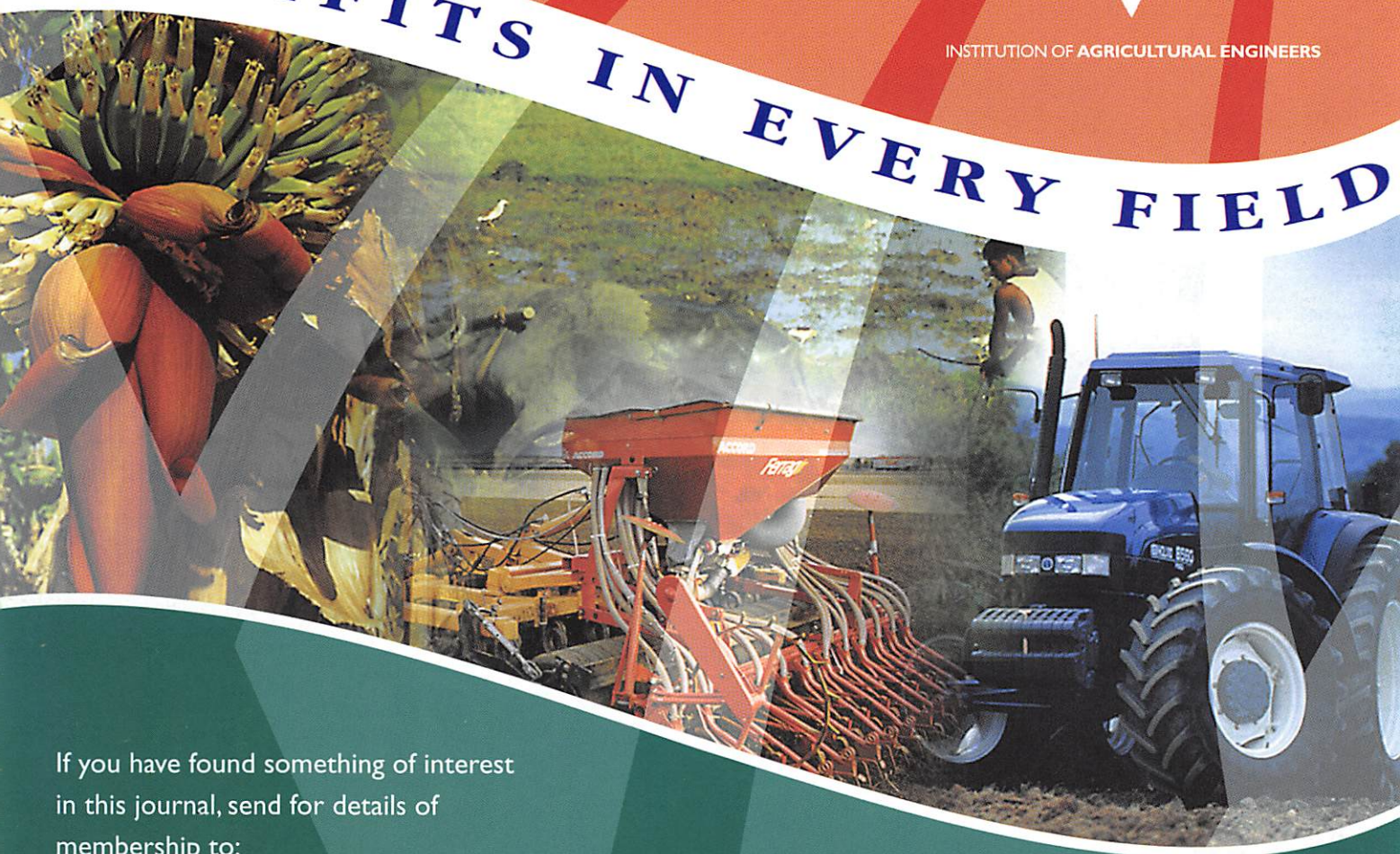

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