Organic Farming and the Energy Crisis: Saint or Sinner?

Lois Philipps and Helen Bently-Fox

***Abstract* - Food production systems are partially responsible for contributing to elevated levels of greenhouse gases in the atmosphere due to the heavy reliance on fossil fuels and will continue to do so for the foreseeable future. Organic farming systems, however, strive to work so far as possible within closed systems, which attempt to use appropriate technologies and scarce resources sparingly. Drawing data from recent case studies this paper examines how close modern UK organic farming can come to these ideals. The paper will conclude with recommendations for the organic farming sector to deliver a food production system that will be required to operate within tighter economic, social and environmental constraints in the future.[1]**

Introduction

Currently the Sheepdrove Organic Farm (SOF) farm energy audit identifies leakages in the whole farm system and not each individual enterprise. It has been suggested that the energy input into the arable enterprise can be reduced. In particular the tractor fossil fuel consumption and the grain drying operations are identified as the major inputs. This study will provide a benchmark for the energy cycle in the arable/forage enterprise which can then be used to provide a model for any energy saving techniques that can be applied. Energy savings will increase the profitability of the arable enterprise. Alternative energy sources will reduce the carbon footprint of SOF. These do not necessarily increase or decrease the profitability of the arable crop but will assist in the aim of SOF to be a closed farm system. This study is year specific to 2003/4 arable rotation. The objectives of the project were: to analyse the on farm energy inputs into the average of all crops per hectare; to put figures to the inputs and to identify significant inputs within the enterprise; to identify possible energy saving techniques and potential alternative sources of energy.

Materials and Methods

The arable enterprise for harvest year 2004 was analysed. The crops and their required operations were put into a flow chart and the rotations listed as eight potential rotation permutations. The activities for management of each of these eight different options were recorded. Relevant information such as tractor make, model, hp, operation speed, etc., was then collected for each option. The distance for each field from the compost site, the main farm buildings and the grain drier were calculated and the number of kilometres travelled for various operations were calculated.

The energy inputs for each crop were then calculated. The most recent data was used to take into account the improvements in engine technology and the changes to tractors such as air conditioning in cabs, etc. Where data gave a range, the median was taken. Where there was no data, similar operations were identified and the figures for that operation were used. Where there were multiple operations at one time but only figures for individual operations were given then the two figures were added. If either operation was a range the lower value of one of the operations was taken to allow for less mass in the overall operation. Where the figures were found and how they were manipulated was put into the comments for each cell of the spreadsheet. Areas of high-energy use were identified.

The indirect energy used was not considered. The indirect energy includes the energy used in the production of the equipment used, the energy needed to repair it over an average lifespan and the transportation of the equipment from the production plant to the farm. This would require a much more detailed study of the farm.

Results

The rotations are described in Table 1. A number of differences in operations and thus energy inputs were identified. The first is between crops that are first crops after a fertility-building period and the crops that have had a crop in the previous cropping period. The first crops after a fertility-building period do not require compost and were identified as **R1** and those after a previous crop were identified by **R2**.

The second is between spring and winter crops. Both crops are inspected monthly but winter crops are in the ground for 11 months and spring crops only for 7 months. Therefore the letters **S** and **W** were used to identify between the two different season crops.

The third difference is between crops that are under-sown and those that are not. The major input is the sowing of the under-sown crop. The letter **u**

Lois Philipps is with the Elm Farm Research Centre, Hamstead Marshall Newbury Berkshire RG20 0HR, UK (lois.p@efrc.com).
Helen Bently-Fox was with Holme Lacey College (hbf5@hotmail.com).

was used to identify those rotations that were under sown.

The forth and final difference is between beans and other crops. Beans have a number of different activities, most notably: they are not Cambridge rolled, they are spring harrowed and they do not have straw as a product. The letter B identified these.

Table 1: The different rotations for the 2003/4 season

	Options							
	1st cereal after ley				**2nd and subsequent arable**			
	Winter cropping	Spring cropping			Winter crop	Spring crop		
Rotation	**R1W**	**R1S**	**R1Su**	**R1SB**	**R2W**	**R2S**	**R2Su**	**R2SB**
Previous crop 2002/3	Conversion fertility building grass clover ley				Previous crops include forage, WW, SB, S Beans			
Crops 2003/4	WW	SW	SB	SB	WW	SB	SO, SW, SB	S Beans
Undersown	N/A	N/A	RC	N/A	N/A	RC	WC, RC, Peas	N/A

The energy uses for the different activities were calculated and ascribed across the rotations, (Table 2) using Bridges and Smith (1979) and Audlesy (2004).

Table 2: Energy used for activities in each rotation type for Sheepdrove in MJ/ha

Crop Management	MJ/ha for each activity against the Rotation								Average
Rotation Type	**R1W**	**R1S**	**R1Su**	**R1SB**	**R2W**	**R2S**	**R2Su**	**R2SB**	**MJ/ha**
Soil improvements	0.00	0.00	0.00	0.00	377.60	377.60	377.60	377.60	188.80
Ploughing	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00
Cultivation	236.00	236.00	236.00	236.00	236.00	236.00	236.00	236.00	236.00
Seed transport	188.80	188.80	188.80	188.80	188.80	188.80	188.80	188.80	188.80
Sowing	165.20	165.20	165.20	165.20	165.20	165.20	165.20	165.20	165.20
Rolling	188.80	188.80	188.80	0.00	188.80	188.80	188.80	0.00	141.60
Undersowing	0.00	0.00	708.00	0.00	0.00	0.00	708.00	0.00	177.00
Inspections	9.54	7.64	7.52	40.95	7.73	27.19	27.19	6.67	16.80
Combine	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00	1,534.00
Post harvest cultivation	236.00	236.00	236.00	236.00	236.00	236.00	236.00	236.00	236.00
Grain transport	188.80	188.80	188.80	188.80	188.80	188.80	188.80	188.80	188.80
Clean storage area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Test sample for moisture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dryer	972.23	972.23	972.23	972.23	972.23	972.23	972.23	972.23	972.23
Cooling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Baling	377.60	377.60	377.60	0.00	377.60	377.60	377.60	0.00	283.20
Bale transport	424.80	424.80	424.80	0.00	424.80	424.80	424.80	0.00	318.60
Loading and unloading	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grazed or silage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total energy used per hectare (MJ)	6,056	6,054	6,762	5,096	6,432	6,451	7,159	5,439	6,181

The activities that created the highest energy demand were ploughing and combining accounting for 1,534 MJ/ha per operation and grain drying accounting for 972 MJ/ha.

CONCLUSIONS

Reducing energy use for ploughing and harvesting requires a closer look at the vehicle operations. The tractors and combine harvester both require the use of fossil fuel ie diesel. There are two issues: firstly, reducing fuel use, secondly replacing the fossil fuel with an alternative fuel from a renewable source.

The continuous flow grain dryer uses a combination of diesel and electricity. The diesel could be replaced by bio-diesel if SOF wishes to reduce their carbon footprint. Reusing heat lost through the exhaust fan or exploring alternative energy generation sources such as a wind turbine or a biogass plant are other alternatives for reducing reliance on fossil-fuel energy.

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