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Prospects for arable farm uptake of Short Rotation Coppice willow and miscanthus in England

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HIGHLIGHTS

- Survey of English arable farms to determine attitudes towards dedicated energy crops.
- 81.6% (87.7%) of surveyed farmers would not consider growing miscanthus (SRC).
- Farm/farmer characteristics were not significant factors in energy crop acceptance.
- Wide range of reasons given for farmers decisions related to energy crops.
- Farm business objectives not found to influence dedicated energy crop acceptance.

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ABSTRACT

Biomass will play a role in the UK meeting EU targets on renewable energy use. Short Rotation Coppice (SRC) and miscanthus are potential biomass feedstocks; however, supply will rely on farmer willingness to grow these crops. Despite attractive crop establishment grants for dedicated energy crops (DECs) in the UK, uptake remains low. Drawing on results from an on-farm survey with 244 English arable farmers, 81.6% (87.7%) of farmers would not consider growing miscanthus (SRC), while respectively, 17.2% (11.9%) would consider growing and 1.2% (0.4%) were currently growing these crops. Farmer age, location, land ownership, farm type, farm size and farmer education level were not significant factors in determining acceptance of DECs. The main reasons cited for not growing DECs were impacts on land quality, lack of appropriate machinery, commitment of land for a long period of time, time to financial return and profitability. Reasons cited for willingness to grow DECs included land quality, ease of crop management, commitment of land for a long period of time, and profitability. Farmers cited a range of 'moral' (e.g. should not be using land for energy crops when there is a shortage of food), land quality, knowledge, profit and current farming practice comments as reasons for not growing DECs, while those willing to grow DECs cited interest in renewable energy, willingness to consider new crops, and low labour needs as rationale for their interest. Farm business objectives indicated that maximising profit and quality of life were most frequently cited as very important objectives. Previous research in the UK indicates that farmers in arable areas are unlikely to convert large areas of land to DECs, even where these farmers have an interest and willingness to grow them. Assuming that those farmers interested in growing DECs converted 9.29% (average percentage of arable land set-aside between 1996 and 2005) of their utilised agricultural area to these crops, 50,700 ha and 89,900 ha of SRC and miscanthus would, respectively, be grown on English arable farms. While farm business objectives were not identified as key determinants of DEC acceptance, enhanced information exchange through extension agents, providing market security and considering land reversion grants post-production are potential policy considerations.

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1. Introduction

To meet European Union targets on renewable energy use by 2020 (EU, Directive 2009/28/EU), bioenergy, including biomass, will play an important role [1]. A range of potential European bioenergy crops exists [2]; however, as feedstocks for second generation bioenergy, willow (in the form of 'Short Rotation Coppice', subsequently referred to as 'SRC') and miscanthus are the main biomass crops that are currently being considered by UK farmers. While forest residue also offers a source of bio-feedstock, it has been argued that crop biomass products will be required for a

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sustainable bioenergy industry to develop [3]. Moreover, Life Cycle Analysis indicates that these products offer the potential to reduce the environmental impact of energy production [4]. Miscanthus and SRC willow are dedicated energy crops (DECs), as opposed to crops with a possible dual purpose such as food and energy (e.g. wheat – grain and straw) and are perennial. In England, the energy crop scheme [5] was set up in 2007 to encourage farmers to grow SRC and miscanthus. The scheme provides grants that cover – in part – establishment costs; these are high in comparison to conventional arable crops [1]. The harvested biomass from both crops can either be used for power generation in the form of electricity (via combustion) or for biofuels (e.g. via lignocellulosic conversion to ethanol). However, establishment grants do not support the ongoing costs of production; moreover, this type of subsidy may not target the optimal point in the bioenergy production chain [6]. For example, supporting location-specific bioenergy plants with government backed feedstock contracts to farmers, or an annual ongoing subsidy to farmers may induce greater feedstock production than establishment grants alone. The focus of this paper is to gather information on the reasons behind farmers' decisions in relation to the production of (or lack of interest in) SRC and miscanthus, including information on farmer objectives. We do this to gauge the potential supply of SRC and miscanthus in England from arable farms. This information is important if a sustainable energy system involving these crops is to be implemented in England and if policies are to be developed to best utilise or encourage the growth of these crops.

As perennial crops, miscanthus and SRC represent a departure from normal cropping patterns on UK arable farms which are predominantly based around annual crops grown in rotation to ensure good soil and crop health and performance. SRC willow can be first harvested four years after plantation, usually by stem cuttings, and can then generally be harvested every three years after this [7]. SRC has been identified as a feasible bioenergy system from an energy perspective which additionally offers environmental benefits over conventional energy production [8]. The amount of crop harvested varies with land quality, among other factors, and yields range between 21 and 27 oven dried tonnes per hectare (odt/ha) [9]. Estimates for the lifespan of SRC range between 22 and 30 years [7,10,11]. The costs for the establishment of SRC were estimated to be £1730 ha^{-1} [9] in 2012 of which 50% will be recoverable via the energy crops scheme grants. Every three years the farmer can expect a gross margin (value of sales less variable costs of production) of circa £720 ha^{-1} if the initial establishment costs are spread equally over the 21 year lifespan of the crop [9]. Miscanthus is usually propagated by planting sections of rhizome and can be first harvested towards the end of its second year after planting. Harvesting is then carried out annually and in the UK the crop is expected to have in the region of a 20 year lifespan [7,11] although estimates for this vary between 15 and 20 years [9]. Yields within the first years of establishment will generally be lower; after approximately five years yields of 12–16 odt/ha can be achieved [12,9] although this again is dependent on land quality. The establishment costs and gross margins noted below were taken from Nix (2011), a standard source for financial information in UK agriculture [9]. The establishment costs for miscanthus were estimated to be £2,462 ha^{-1} in 2012; again, 50% is recoverable via the energy crops scheme grant. Overall, the gross margin for this crop could vary between circa £324 ha^{-1} and £632 ha^{-1} a year, with establishment costs spread over a lifespan of 19 productive years. In contrast a winter wheat crop in England will generate a gross margin of between circa £395 ha^{-1} and £869 ha^{-1} per year, depending on feed or milling wheat grade outcomes and productivity on farm, although cereal crop prices are highly variable at present. The profitability of miscanthus in relation to more conventional combinable cropping that can be harvested with a combine harvester has been compared for farming in central France; the conclusion was that miscanthus was less profitable than combinable cropping, but could be highly competitive as a diversification enterprise on farm [13]. However, the cost of production calculated as cost per gigajoule of energy has shown that SRC crops and perennial grasses can have lower production costs than annual, straw-based crops [10].

In 2011, 3000 ha of SRC and 8000 ha of miscanthus were grown in England (relative standard error 10–20% and 5–10% respectively) [14]. For SRC this represents 0.03% of the utilised agricultural area (UAA) and 0.09% of the UAA for miscanthus. This contrasts with the 36% of the England UAA dedicated to cereal and oilseed crops [14]. It has been estimated that 17% of the South East of England and 39% of the East Midlands are potentially suitable for growing DECs and that overall 3.1 Mha of England is suitable for these crops [15]. A more conservative estimate of 362,865 ha (miscanthus only) is provided by [16] where various land and yield constraints are allowed for. Yield from this area of miscanthus is estimated to be 4.56 M odt which would potentially provide 6.5 M MW h of renewable electricity for the UK or 2.4% of total electricity demand in 2005 [16]. However, at present the uptake of these crops is lower than expected due to a variety of 'barriers' to adoption. These include: the uncertainty and extent of the financial return of these crops, particularly in relation to arable crop returns [17–19]; the reliance on a limited number of purchasers for the crops and the limited alternative market opportunities [17,20]; concerns relating to security of demand for crops that require a long term commitment [21,20]; and the lack of comprehensive information for these crops that is available to farmers or, more broadly, lack of farmer knowledge [17,22]. In an Irish study the differences between SRC and miscanthus have been evaluated and it was suggested that SRC willow is perceived to be more risky than miscanthus [23]. Whilst it has been noted that there are no absolute barriers to bioenergy in the EU, it is the non-technical challenges that are more likely to hold back production of suitable feedstocks [24]. A survey of 172 farmers in Ireland, from a wide range of farm types, showed that over 70% of farmers were interested in energy crops although the authors suggested that the method of dissemination for the survey had encouraged those interested in DECs to respond [22]. A motivation for adoption was the perceived profits for DECs. A study of the behaviour of German farmers found that farmers' decisions were driven mainly by capital costs and the risk of investment, with non-financial objectives and sustainability issues being of limited influence [25]. The study also found that subsidies increased willingness to invest in bioenergy crops, as would be expected. The influence of farm and farmer characteristics in determining willingness to grow DECs has also been explored in a further Irish study [26], as well as American [27] and Swedish [28] contexts. Overall, no consistent linkages between farmer objectives, behaviours, characteristics or farm physical features are evident from the literature. However, a priori, it would be expected that the attitudes and objectives of farmers would play some role in determining their attitudes towards growing DECs.

Given the potential importance of DECs in contributing towards meeting renewable energy targets, this paper examines the objectives of, and rationale behind, farmers' decisions on arable farms relating to SRC and miscanthus and the potential supply of these crops in England from these farms. Specifically, the aim of the paper is to (a) describe the survey methodology adopted; (b) indicate the numbers of farmers willing to grow SRC and miscanthus and analyse these responses in relation to a number of farmer characteristics; (c) identify farmer attitudes, objectives and the main reasons given for growing and not growing these DECs; (d) estimate potential areas of these crops that could be grown on arable farms in England based on the survey results

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