Renewable and Sustainable Energy Reviews 80 (2017) 789–800

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Perennial energy crops vs. durum wheat in low input lands: Economic analysis of a Greek case study

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ARTICLE INFO

Keywords:
Miscanthus
Arundo
Poplar
Break-even budgeting
Renewable energy

ABSTRACT

A key challenge internationally is the design of policies that will result in the substitution of conventional energy sources with renewable energy sources. The European Union has set a legally binding target of 20% final energy consumption from renewable sources by 2020 but not all EU countries have been successful in meeting interim targets towards that goal. On the other hand, even if interim goals have been achieved, economic, social, and environmental considerations might threaten a country's ability to meet the 2020 goal without jeopardising other key economic goals. This is the case, among other countries, of Greece, where decision-making is governed by the economic recession and the austerity measures implemented to counter the debt crisis. This article studies the potential of three perennial energy crops, miscanthus, arundo and poplar, to play such a role in the region of Karditsa, Greece. According to our results and considering the option of farm gate delivery, sample farms generate on average positive gross profits from all three energy crops. The highest is generated by arundo, followed by poplar and at a much lower level miscanthus. The present study shows that Arundo, under certain conditions, can partially replace durum wheat in low input lands, without distorting the food trade balance of the country. While this research does not focus on environmental issues, results suggest that substituting arundo for durum wheat can have a beneficial effect in nitrate-polluted regions since arundo requires far less fertilizers. The relevant policy mix is analysed, discussed and outlined as a nexus of interrelated incentives provided by policy makers and the market.

1. Introduction

The Renewable Energy Sources (RES) Directive (Directive 2009/28/EC) of the European Union has set a legally binding target of 20% final energy consumption from renewable sources by 2020 [1]. To achieve this target, EU countries have committed to reaching their own national targets for renewable energy; these range from 10% in Malta to 49% in Sweden. Additionally, each of the EU countries is required to have at least 10% of their transport fuels come from renewable sources by 2020. All EU countries have adopted national renewable energy action plans stating what actions they intend to take to meet their renewables targets. These plans include sectorial targets for electricity, heating and cooling, and transport; planned policy measures; the different mix of renewable technologies they expect to employ; and the planned use of cooperation mechanisms. Nineteen EU countries have achieved their interim targets and are even projected to exceed the EU 2020 target (e.g., Austria, Estonia, Denmark, Germany, Italy, Lithuania, Romania, Sweden) [2]. Yet, other Member States, such as France, the Netherlands, and the United Kingdom have been less successful in meeting their national goals and, consequently, in moving towards the EU target of 20% [3]. A recent evaluation of the progress each country has made towards the RES goals reveals that the most important barriers in achieving these goals relate to the political, economic and environmental framework, the existence and reliability of a general RES support scheme, access to finance and the remuneration level of existing support schemes and land availability [4].

Most southern European countries are facing significant challenges. Spain, for example, did not meet its National Renewable Energy Action Plan (NREAP) 2012 and growth in the renewables heat and cooling sector needs to accelerate [4]. Portugal, although has met the less ambitious interim target 2011/2012, it has missed its NREAP 2012 target. Even more so, the renewables heat and cooling share has even decreased between 2010 and 2012 and this trend needs to be reversed. At the same time, Italy, while very successful in meeting its NREAP targets, still needs to accelerate the development of the renewables heat and cooling sector [4].

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http://dx.doi.org/10.1016/j.rser.2017.05.263
Received 9 September 2016; Received in revised form 3 March 2017; Accepted 29 May 2017
1364-0321/

Greece, the focus of this paper, has achieved both its national renewable energy action plan (NREAP) 2012 target and the interim target for 2011/2012. This positive outcome can be attributed partly to the rapid drop in economic growth that the country is currently experiencing as a result of rapidly contracting national consumption [4]. The economic crisis of Greece may indeed generate opportunities and challenges for the renewable energy. One such opportunity has been the increased demand for renewable, lower-cost energy, particularly from households which cannot meet their heating needs due to the very high price of electricity and oil used in conventional heating systems [5,6]. Demand for wood pellets has increased considerably and many households abandon their old, oil consuming heaters in favour of heating systems based on pellets [7]. Yet, Greece is a net importer of pellets and thus increased demand threatens to make trade deficit even higher than the current one [5,6]. Thus it is extremely important to assess whether there is room for developing a local bio energy supply chain that will be mainly based on locally grown, low-cost feedstock.

Although the Greek NREAP deploys a market incentive scheme, mainly based on feed-in tariffs and establishment subsidies for the bio fuels industry, the risk of the local industry being unresponsive to policy incentives is very high [8]. Equally challenging is the extremely limited access to risk capital for making required investments. Further, local communities in the country are highly concerned about land use and environmental issues perceived to be or actually emerging as a result of moving from food to energy crop production and the establishment of bio-power plants [9,10]. During times of severe economic crises one might expect to observe an attenuation of environmental concerns among local populations. Yet, recent empirical findings suggest that local societies in Greece are against investments in alternative forms of energy generation when it comes to their region or farm [e.g., [11]]. Although the services provided by the siting of such investments are widely considered beneficial, in practice, they are often strongly opposed by local communities. This phenomenon, also known as not-in-my-back-yard (NIMBY) behaviour poses great challenges for policy makers seeking to promote renewable energy sources [12]. Therefore, the recovery of the country's economy should not at any cost hinder society and the environment.

Moreover, diesel oil prices have increased substantially in Greece during the economic crisis, as a result of higher fuel taxes introduced by the government. Diesel oil is used as fuel in both central heating and transportation and, until recently, national social policies had kept the price of diesel oil used in heating much lower than that of oil used in transportation. However, under the second Greek Memorandum, the prices of diesel oil for heating and transportation were equalised. The higher diesel oil prices coupled with shrinking household budgets forced thousands of families across Greece to replace diesel with other energy sources for their heating needs during the winter of 2012–13. Among these alternative energy sources, old wood-burning stoves and fireplaces are seeing a revival, creating a profitable market for sellers of firewood. Forest managers fear that in the light of a weakening forest ranger service, illegal logging will be almost impossible to control, especially during the weekends, when most illegal logging takes place [13].

It should also be noted that, despite the significance of biofuels for reducing GHG emissions and the acquisition of energy efficiency in Greece, some biofuels might require more energy to produce than the energy they offer (e.g., the case of Germany). A recent report of the EC's Joint Research Centre reveals that green projects based on biofuels may have devastating impacts on the EU's biodiversity [14]. It is estimated that as a result of EU biofuel targets, about 85 per cent of biodiversity will be damaged across 17,000 square kilometres of natural habitats that risk being converted to farmland. Natural habitats will not be protected under current EU legislation for biofuels and it is likely to contradict EU's commitment to reverse biodiversity loss by 2020.

Therefore, policy makers are faced with a very challenging question: can they find the right policy mix that includes incentives for farmers and the industry and, at the same time, implement mitigation policies to address local community and environmental concerns, and promote the use of certified pellets? To make things even more perplexing, these goals should be achieved with scarce resources during an era of economic crisis.

This paper addresses these issues by studying the conditions, under which selected energy crops might become the basic input for local bio energy supply chains. We focus on the region of Karditsa, a promising agricultural area in central Greece, and on a representative sample of local farms. We study how attractive three perennial energy crops are for farmers, relative to durum wheat, the main crop cultivated in low input lands in the case study region. The selected energy crops are miscanthus, arundo, and poplar and their dry matter, biomass, is mainly intended for the production of solid biofuels (e.g., pellets[1]). These energy crops can be cultivated in low input land (e.g., arundo and miscanthus in non-irrigated land and poplar in land without fertilization). Perennials have lower pesticide and fertilizer requirements, so they can appear more attractive to farmers than annual crops.

We estimate energy crop supply curves as in Styles et al. [15]. Supply curves for different energy crops can be used as a decision-making tool by all interesting parties within a biomass-oriented supply chain; biomass producers can use them to decide on the economic feasibility and efficiency of a suggested energy crop, while industrial players may use them to determine contract prices that ensure long-term availability of inputs. However, we move one step further by also estimating the impact on trade balances associated with cultivating a biomass crop instead of a food crop. We calculate the net effect on the trade balances of both the food crop and the final energy product, namely, pellets.

This research informs energy and agricultural policy making by also taking into account and addressing undesirable side effects (e.g., trade deficit in wheat). It turns out that, under plausible assumptions, Arundo can potentially replace part of the durum wheat without jeopardising the country's positive trade balance in durum wheat. Our results are also of help to policy makers in other European regions with similar characteristics, as well as in countries going through turbulent economic times.

The remainder of the paper is structured as follows: Section 2 provides an overview of energy crop production and markets across Europe, with an emphasis on Greece. Section 3 presents information on the case study region while Section 4 describes the methods and data used, as well as the assumptions made. Section 5 focuses on the analysis of collected farm data and Section 6 presents and discusses the results. Section 7 concludes the paper.

2. Energy crops across Europe: overview and context

2.1. The EU context

The EU RES Directive, RED (2009/28/EC) lays out a roadmap for all member states to increase their share of renewable energy consumption to 20% of total energy consumption by 2020. According to 2011 data, the renewable energy sector contributes 13% to the total energy consumption in EU-27 [16]. Among EU-27 member states, Estonia is a good example of an achiever as regards the share of energy from renewable sources by 2020. On the contrary, the UK is the least efficient member-state in meeting the national target [16].

Biomass provides already the largest share of renewable source of energy globally [17]. The role and contribution of energy crops to the bioenergy sector is gradually being recognised as an important one

[1] These perennial energy crops can also be cultivated for the production of other types of biofuels. (e.g., bioethanol).