American Journal of Agricultural and Biological Sciences

Editorials

An Opportunity for the Agricultural Sector: The Renewable Energy Sources

Riccardo Testa and Salvatore Tudisca

Department of Agricultural and Forest Sciences, University of Palermo, Italy

Today, among the most important issue for energy decisions by policymakers, there are security challenges and environmental impacts on climate change and economic aspects.

Since the seventies, in fact, global warming and environmental issues have had an increasing importance in international debate, attracting the attention of several scientific studies (Landi and Benelli, 2016). Many of these studies denoted that over the last fifty years the Greenhouse Gases (GHG) increased of 2 parts per million per year, having no equal in the history (WMO, 2013). This is due especially to extensive use of fossil fuels that contribute to increase the atmospheric CO_2 (Hoppe *et al.*, 2016).

For this reason, nowadays there is here a raising awareness towards both environmental issues and productive processes able to preserve the environment in the course of time so that future generations can benefit the same extent of natural resources. Having a secure supply of energy is crucial for the well-being of worldwide citizens and the economy (Olson-Hazboun *et al.*, 2016).

In this context, on the one hand the increased energy demands, on the other hand the progressive reduction of fossil fuel reserves, have stimulated the interest for development of new technologies as renewable energies.

Renewable energy, in fact, is often framed by policymakers and the media as an environmental or ‘green’ issue motivated by global climate change and the need for greenhouse gas reductions.

Renewable Energy Sources (RES), such as hydropower, biomass, geothermal, wind and solar, provide several benefits, representing a viable alternative to traditional fuels. Firstly, being not subject to depletion, they produce environmental benefits by reducing GHG emissions and increasing the health security, as established by the Kyoto Protocol. Secondly, they appear an interesting energy source for volatility of oil prices that produce fluctuations and uncertainty in the markets (Karakosta *et al.*, 2012).

Moreover, the diffusion of renewable energies occurred in the last years, is due to their reduction of costs that, despite are higher than fossil fuels, are also falling more rapidly, helping to reduce the gap between these sources of energy.

The reduction of costs occurred in the last years, is attribuible also to many energy policies aimed at reducing GHG emissions and promoting development of renewable electricity technologies (Connor, 2013).

Energy policies, depending on the Country and the renewable energy typologies, can provide direct means such as government-sponsored Research and Development (R&D), feed-in tariffs, policies that support the production of renewable electricity and renewable energy certificates (Kaplan, 2015). In this way, policymakers, drive deployment, foster innovation and encourage greater flexibility in energy infrastructure. This has attracted the interests in RES sector both of many small and medium investors and especially of large financial groups.

Due to this, RES in the last decades have had a growing impact in global electricity production.

According to the latest available data, in 2015 at least the policy of 145 countries supports application of RES and there are about 8.1 million jobs in RES sector. With a power capacity equal to 1,849 GW (up almost 9% over 2014), RES accounted for 23.7% of global electricity production, while renewable energy represented 19.2% of global final energy consumption. In particular, traditional biomass (used primarily for cooking and heating in remote and rural areas of developing countries) represented 8.9% of global final energy consumption, while modern renewables (not including traditional biomass) were 10.3% (REN21, 2016).

Therefore, in view of both the rapid diffusion and the growing scientific, technological and economic interest on the renewable sources occurred in the last years, in this issue of AJBS what opportunities RES might hold for farmers in the next future was considered.

In this context, agriculture plays a key role as, among productive sectors, represents the one with the greatest opportunities for development of RES (Chel and Kaushik, 2011).

This increasing importance of agricultural sector for RES is due mainly to the fact that being part of primary sector, agriculture lends itself to produce raw materials for energy production (i.e., biomass, biofuel, biogas), by means of Dedicated Energy Crops (DEC). DEC, in fact, may represent an interesting use of set-aside land for farmers, granting several positive environmental impacts, as well as erosion and desertification prevention of soils, nutrient and carbon supply, increase of biodiversity and landscape values (Bonner *et al.*, 2014; Pompeiano *et al.*, 2016). Besides, the large availability of land and/or farm buildings allows farmers to install Photovoltaic (PV) systems, wind turbines and other energy plants.

Another aspect is represented by the role of farm that is changed in the last years: It is passed from an exclusive productive role to a multifunctional one. In developed economies, agriculture is increasingly considered in a systemic approach, able to produce food commodities and to meet the new needs of the consumer, providing both public goods (biodiversity, agricultural landscape) and services (tourism, energy, educational services). The production of energy from renewable sources fully represents this new farm conception, respecting the environmental and landscape equilibrium of territory for the benefit of a new conception of a more-environmentally sustainable agricultural activity, reducing energy demand and contributing to sustainable management of natural resources (Mekhilef *et al.*, 2013). Renewable sources in agricultural sector, in fact, are an alternative energy source which guarantees maximum energy security while at the same time having a less disruptive environmental impact.

Finally, substantial subsides granted by energy policies and tax concessions, facilitate the rapid diffusion of RES among farmers of many countries in the world. This creates investor confidence in agricultural sector by guaranteeing rates and minimizing investor risks (Hanemann, 2012).

For these reasons, today the concept of “energy farm” is well-known: A farm that integrates its agricultural production with revenues of energy deriving from renewable sources (Schievano *et al.*, 2015).

In last years, many scientific studies have addressed the introduction of RES in farm, analyzing the environmental effects (Zona *et al.*, 2013; González-García *et al.*, 2013) or the technical characteristics of energy plants or fuels produced (Koçar and Civaş, 2013; Paska and Surma, 2014; Pompeiano *et al.*, 2016; Spinelli *et al*., 2011).

However, since economic profitability is the most important factor for farmer, several studies evaluated the economic feasibility of the introduction of RES respect to traditional crops (Styles *et al.*, 2008; Talavera *et al.*, 2010; Wolbert-Haverkamp, 2012).

The majority of them showed an economic convenience of RES, especially for marginal areas and also for energy plants that require heavy financial investments (Gasol *et al*., 2010; Schweier and Becker, 2013; Sgroi *et al.*, 2015).

So, for the farmer the energy production from renewable sources could represent an economic opportunity, both for the incentives provided by energy policies and for higher revenues that increase the farmer’s income. The revenues deriving from energy production are due to the energy sale and/or the saving generated by self-consumed energy (Schuetze, 2013). This is a very important factor in a global market, where farmers have to be able to diversify and improve their economic performances, changing their entepreneurial strategies, as well as the energy production from renewable sources.

Besides, on-farm renewable energy production could lead to a higher environmental awareness among farmers and thus more economically and environmentally sustainable agricultural practices.

However, since RES subtract inevitably surface to the agricultural land, it should be essential to maintain a right balance between energy production from renewable sources and cultivation of traditional crops used for human food or animal feed. For this reason, it would be desirable that RES do not conflict with agri-food production, but valorize marginal and/or unproductive areas.

Moreover, it has not to forget that the farmer is required to produce agricultural products and thus the production of goods and services related to agriculture have to be considered to supplement his income or reduce production costs. Therefore, RES introduction have to represent for farmer an income integration, by avoiding to cause a radical transformation of the business core from agricultural to energetic one by means of overestimated energy policies.

In this perspective, next energy policies have to encourage the diversification of farm production aimed at increase farmer’s income, without abandoning the cultivation of traditional crops.

In fact, a diversified productive portfolio could allow farmers to obtain a higher farm competitiveness, encouraging the permanence of man in the rural territory, avoiding exodus phenomena.

References

Bonner, I.J., K.G. Cafferty, D.J. Muth, M.D. Tomer and D.E. James *et al*., 2014. Opportunities for energy crop production based on subfield scale distribution of profitability. Energies, 7: 6509-6526. DOI: 10.3390/en7106509

Chel, A. and G. Kaushik, 2011. Renewable energy for sustainable agriculture. Agronomy Sustainable Develop., 31: 91-118. DOI: 10.1051/agro/2010029

Connor, P., 2013. Policies to support the growth of renewable energy sources of heat. Energy Policy, 59: 1-2. DOI: 10.1016/j.enpol.2013.05.061

Gasol, C.M., F. Brun, A. Mosso, J. Rieradevall and X. Gabarrell, 2010. Economic assessment and comparison of acacia energy crop with annual traditional crops in Southern Europe. Energy Policy, 38: 592-597. DOI: 10.1016/j.enpol.2009.10.011

González-García, S., J. Bacenetti, M. Negri, M. Fiala and L. Arroja, 2013. Comparative environmental performance of three different annual energy crops for biogas production in Northern Italy. J. Cleaner Product., 43: 71-83. DOI: 10.1016/j.jclepro.2012.12.017

Hanemann, M., 2012. Policy: Public support for clean energy. Nature Climate Change, 2: 573-574. DOI: 10.1038/nclimate1640

Hoppe, W., S. Bringezu and N. Thonemann, 2016. Comparison of global warming potential between conventionally produced and CO_2-based natural gas used in transport versus chemical production. J. Clean Product., 121: 231-237. DOI: 10.1016/j.jclepro.2016.02.042

Kaplan, Y.A., 2015. Overview of wind energy in the world and assessment of current wind energy policies in Turkey. Renewable Sustainable Energy Rev., 43: 562-568. DOI: 10.1016/j.rser.2014.11.027

Karakosta, C., M. Flouri, S. Dimopoulou and J. Psarras, 2012. Analysis of renewable energy progress in the western Balkan countries: Bosnia–Herzegovina and Serbia. Renewable Sustainable Energy Rev., 16: 5166-5175. DOI: 10.1016/j.rser.2012.04.040

Koçar, G. and N. Civaş, 2013. An overview of biofuels from energy crops: Current status and future prospects. Renewable Sustainable Energy Rev., 28: 900-916. DOI: 10.1016/j.rser.2013.08.022

Landi, M. and G. Benelli, 2016. Protecting crop species from biotic and abiotic constraints in the era of Global Change: Are we ready for this challenge? Am. J. Agric. Biol. Sci., 11: 51-53. DOI: 10.3844/ajabssp.2016.51.53

Mekhilef, S., S.Z. Faramarzi, R. Saidur and Z. Salam, 2013. The application of solar technologies for sustainable development of agricultural sector. Renewable Sustainable Energy Rev., 18: 583-594. DOI: 10.1016/j.rser.2012.10.049

Olson-Hazboun, S.K., R.S. Krannich and P.G. Robertson, 2016. Public views on renewable energy in the Rocky Mountain region of the United States: Distinct attitudes, exposure and other key predictors of wind energy. Energy Res. Social Sci., 21: 1-13. DOI: 10.1016/j.erss.2016.07.002

Paska, J. and T. Surma, 2014. Electricity generation from renewable energy sources in Poland. Renewable Energy, 71: 286-294. DOI: 10.1016/j.renene.2014.05.011

Pompeiano, A., M. Landi, G. Meloni, F. Vita and L. Guglielminetti *et al*., 2016. Allocation pattern, ion partitioning and chlorophyll *a* fluorescence in *Arundo donax* L. in responses to salinity stress. Plant Biosyst. DOI: 10.1080/11263504.2016.1187680

REN21, 2016. Renewable Energy Policy Network for the 21st Century. Global Status Report.

Schievano, A., G. D'Imporzano, V. Orzi, G. Colombo, T. Maggiore and F. Adani, 2015. Biogas from dedicated energy crops in Northern Italy: Electric energy generation costs. GCB Bioenergy, 7: 899-908. DOI: 10.1111/gcbb.12186

Schuetze, T., 2013. Integration of photovoltaics in buildings-support policies addressing technical and formal aspects. Energies, 6: 2982-3001. DOI: 10.3390/en6062982

Schweier, J. and G. Becker, 2013. Economics of poplar short rotation coppice plantations on marginal land in Germany. Biomass Bioenergy, 59: 494-502. DOI: 10.1016/j.biombioe.2013.10.020

Sgroi, F., M. Foderà, A.M. Di Trapani, S. Tudisca and R. Testa, 2015. Economic evaluation of biogas plant size utilizing giant reed. Renewable Sustainable Energy Rev., 49: 403-409. DOI: 10.1016/j.rser.2015.04.142

Spinelli, R., C. Nati, L. Sozzi, N. Magagnotti and G. Picchi, 2011. Physical characterization of commercial woodchips on the Italian energy market. Fuel, 90: 2198-2202. DOI: 10.1016/j.fuel.2011.02.011

Styles, D., F. Thorne and M.B. Jones, 2008. Energy crops in Ireland: An economic comparison of willow and Miscanthus production with conventional farming systems. Biomass Bioenergy, 32: 407-421. DOI: 10.1016/j.biombioe.2007.10.012

Talavera, D.L., G. Nofuentes and J. Aguilera, 2010. The internal rate of return of photovoltaic grid-connected systems: A comprehensive sensitivity analysis. Renewable Energy, 35: 101-111. DOI: 10.1016/j.renene.2009.07.006

Wolbert-Haverkamp, M., 2012. Miscanthus and poplar plantations in short rotation as an alternative to classical crop husbandry-A risk analysis by means of Monte Carlo simulation. Berichteuber Landwirtschaft, 90: 302-316.

WMO, 2013. Greenhouse gas concentrations in atmosphere reach new record. World Metereological Organization.

Zona, D.A, I.A. Janssens, M. Aubinet, B. Gioli and S. Vicca *et al*., 2013. Fluxes of the greenhouse gases (CO_2, CH_4 and N_2O) above a short-rotation poplar plantation after conversion from agricultural land. Agric. Forest Meteorol., 169: 100-110. DOI: 10.1016/j.agrformet.2012.10.008