

Bio-energy and rural development: findings from a comparative study in Central, Eastern and Southern Europe

Axel WOLZ¹, Gertrud BUCHENRIEDER², Richard MÁRKUS³

¹Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO), Theodor-Lieser-Str. 2, 06120 Halle (Saale), Germany, (e-mail: wolz@iamo.de)

²Universität der Bundeswehr, Faculty of Politics and Social Sciences, 85577 Neubiberg, Germany

³University of West Hungary, Faculty of Agriculture and Food Sciences, Mosonmagyaróvár, Hungary

Abstract

Rising energy prices for fossil fuels, the unreliable supply of energy imports during the last winters and European Union (EU) policies have stimulated national awareness and political action on bio- and renewable energy (RE) among all European countries. In the agricultural policy discussion, RE has been advocated as a way to more rural prosperity. Among the new member states (NMS) of the EU, the share of RE is already slowly increasing. Yet, among the candidate and pre-candidate countries (CC/PCC) the discussion has just started. In both sub-regions an expansion of rape seed cultivation and, to a smaller extent, of the production of wood pellets could be observed. However, overall its impact on agricultural income and employment seems to be marginal up to now.

Key words: bio-energy, agricultural development, rural development, Central, Eastern and Southern Europe

Introduction

Since early mankind, people have relied on bio- and renewable energy (RE) to facilitate life. People made use of wood and, later on, of wind and water. However in our days, the interest in RE started more seriously when the limits and environmental risks of fossil and nuclear energy became evident. RE was advertised, not only as a way out of the limitations of fossil and nuclear energy but also as a driver of rural prosperity, particularly for the European farmers.

In our analysis we follow the definition of EUROSTAT which defines RE as the sum of specific forms of energies, i.e. hydropower, wind energy, solar energy, biomass and wastes and geothermal energy. Biomass and wastes cover organic, non-fossil material of biological origin, which may be used for heat production, electricity generation and/or as a source of fuel. They comprise wood and wood waste, biogas, municipal solid waste and biofuels. Liquid biofuels mainly cover bioethanol (ethanol produced from biomass) and biodiesel (diesel produced from biomass or used fried oil). Hydropower covers potential and kinetic energy of water converted into electricity in hydroelectric plants (Eurostat, 2009a).

We will focus on the use and expansion of biomass production for bio-energy, particularly of its “modern” forms, i.e. wood pellets and briquettes, municipal solid waste, biogas and biofuels and its impact on agricultural and rural development in the region. The more “traditional” forms of bio-energy, i.e. the use of firewood although still of high importance, will be touched only briefly in this analysis.

Role of RE and bio-energy in total energy supply

The use of RE in the various countries in total energy demand in 2007 varies quite a bit (Table 1). Among the NMS¹, there are Malta and Cyprus with a very small share on the one side, and Latvia with more of one third of RE in total energy demand on the other. All the other countries rely on RE to some extent, for instance Bulgaria with a share of 4.9% and Estonia with 12.4%. Hence the reliance on fossil fuels and nuclear energy is quite high. With respect to CC/PCC², the picture looks quite different. For three countries, namely Bosnia & Herzegovina, Montenegro and Albania the share of RE comes up to one fourth or, even, one third of total energy demand. With respect to the other five countries the share comes up to 8% and 11%. Subsequently, a first conclusion can be drawn: RE has a certain share in total energy demand, but in most countries it is not yet very important. In addition, RE is more important in the CC/PCC than in the NMS. When looking at former Yugoslavia, the share is again between 8% (Croatia) and 11% (Kosovo). Just Bosnia & Herzegovina and Montenegro show higher shares with about one third and one fourth, respectively.

Table 1. Share of renewable energy in total energy demand (%), 2007

	NMS	CC/PCC
important: > 10%	LVA (37.7), EST (12.4), ROM (11.8)	BIH (32.5), MON* (25.0), ALB (24.2), KOS (10.7)
somewhat: 5 - 10%	SVN (9.9), LTU (8.9), SVK (5.4), CZE (5.2), HUN (5.2), POL (5.1)	TUR (9.5), SER (8.3), MAC** (8.1), CRO (7.9),
modest: < 5%	BUL (4.9), CYP (2.4), MLT (0.2)	

Notes: * 2006; ** 2005;

Source: EUROSTAT, 2009b and Country Reports, 2009

When looking at the share of bio-energy to total RE, i.e. “traditional” (fire wood) plus “modern” forms (wood pellets and briquettes, biogas and biofuels), it becomes evident that in most countries of the region this source is the most dominant one (Table 2). Particularly, among the NMS this source is very important. Only the small states of Malta and Cyprus cannot rely on bio-energy significantly due to climatic reasons. In these two countries, solar power has become the major source of RE. In the CC and PCC the use of bio-energy is important, but not that dominant as in the NMS. In most of these countries the most important alternative source of RE is (large-scale) hydropower. With respect to the states of former Yugoslavia, there is no clear picture. While bio-energy makes up about one fifth of total RE in Montenegro and Serbia, it is almost the only source of RE in Kosovo. The major reason seems to be the availability of (large-scale) hydropower which in general forms the only alternative form of RE among these countries.

Table 2. Share of bio-energy of total supply of renewable energy (%), 2007

	NMS	CC/PCC
very important: > 90%	EST (98.6), POL (94.9), LTU (94.2), CZE (91.9), HUN (91.7)	KOS (95.4)
important: 50 - 90%	LVA (86.7), BUL (71.5), ROM (70.4), SVN (61.3), SVK (59.8)	BIH (66.3), MAC* (54.3), TUR (52.3)
modest: < 50%	MLT (34.5), CYP (16.9)	CRO (49.8), ALB (44.9), SER (22.5), MON** (20.9)

Notes: * 2005; ** 2006 Bio-energy comprises traditionally wood and the modern forms are wood pellets and briquettes, municipal solid waste, biogas and biofuels.

Source: EUROSTAT, 2009b and Country Reports, 2009

As discussed above, the “traditional” forms of biomass have been used as a source of bio-energy since early mankind. At this stage, we want to deduce ‘what is the share of “modern” forms of bio-energy to the total supply of bio-energy, i.e. the share of biofuel, biogas and municipal solid waste?’ Here, a sharp differentiation between the countries of the region can be made (Table 3). In some countries it takes up a relatively high share while in others it plays no role at all, so far. In a few states of Central and Eastern Europe (CEE), the production of “modern” forms of bio-energy has increased during the last years and has become relatively important. While Malta is a special case (here most used cooking oil is refined to biodiesel), some Central European states show shares amounting to 10% or more. However, these states are focusing on different

¹ The NMS comprise Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, Slovenia, Malta, Cyprus, Bulgaria and Romania.

² The CC comprise Croatia, Macedonia and Turkey. The PCC comprise Serbia, Bosnia & Herzegovina, Montenegro, Kosovo and Albania.

sources. Slovakia is focusing on biofuel, while the Czech Republic is diversifying its sources relatively equally on biofuel, municipal solid wastes and biogas. Hungary is predominantly making use of municipal solid wastes and Poland is focusing on biofuel and biogas, so far. Among the other NMS, only in Lithuania (biofuel) and Slovenia (biogas) the modern forms of bio-energy are of some marginal relevance. With respect to CC/PCC the “modern” forms of bio-energy are of no or just of a very modest relevance, so far. Just Serbia (biofuel), Croatia (biofuel and biogas) and, to a very small extent, Turkey have just started in producing these “modern” forms of bio-energy. All other CC/PCC are still in the planning phase in taking up the production of “modern” forms of bio-energy.

Table 3. Share of “modern” forms to total supply of bio-energy (%), 2007

	NMS	CC/PCC
important: > 8%	MLT (100), SVK (17.7), CZE (11.9), HUN (11.0), POL (8.6)	-
modest: 2.1- 8.0	LTU (4.5), SVN (3.6)	SER (3.1)
marginal: 0.1 - 2.0%	LVA (1.5), EST (0.8), ROM (0.6), BUL (0.3)	CRO (1.6), TUR (0.6)
not at all	CYP	MAC*, BIH, MON**, KOS, ALB

Notes: * 2005; ** 2006 The “modern” forms of bio-energy comprise wood pellets and briquettes, municipal solid waste, biogas and biofuels.

Source: EUROSTAT (2009b) and Country Reports 2009

In conclusion, it can be stated that, at this stage, the “modern” forms of bio-energy in total national energy demand are still marginal. In a few countries, i.e. Slovakia, Czech Republic, Hungary and Latvia, they just meet about half a percent of total demand. In another group of countries the share of “modern” forms of bio-energy is between 0.2% and 0.4%, i.e. Lithuania, Poland, Slovenia and Malta. In the remaining countries which have taken up “modern” forms of bio-energy production, the share just comes up maximally to 0.1%, i.e. Estonia, Romania, Bulgaria, Serbia, Croatia and Turkey.

Impact of bio-energy production of agricultural and rural development I: Statistical data

While, for the time being, the modern forms of bio-energy are still in the start-up phase, almost all countries are optimistic that this form of energy production will have a positive impact on agriculture and rural areas. In general, all reports emphasise that the potential employment and income effects of biomass production could be enlarged. It is difficult to assess statistically the size of area cultivated by energy crops as, in general, they can mostly be used for human consumption and as animal feed as well. However, concerning the cropping patterns not many changes could be observed up to now. Hence, we will rely on two proxy indicators:

(1) In many countries the area under rape seed cultivation has expanded rapidly during the last years (Table 4). While rape seed is also used in human consumption, we understand this rapid expansion also as an (indirect) indicator for the growing importance of bio-energy among farmers. While other crops are also used for bio-energy production, e.g. cereals including maize and sunflower, the area under cultivation with respect to these crops did not change much during the last years. Hence, these crops seem not to influence bio-energy production substantially up to now. The expansion in the cultivation of rape seed is seen by most farmers as a new source of income. Among the NMS, rape seed production also seemed to have been encouraged by the subsidies for energy crops under the EU. Among CC/PCC the increase of rape seed cultivation is not that impressive as in NMS. If there is limited national demand, rape seeds are, in general, exported to neighbouring countries, e.g. by Estonia. Also among the states of former Yugoslavia, rape seed production is just starting to be enlarged. But the increase of the share of rape seeds in the crop rotation brings also a couple of repercussions to the farmers which have partly contradictory effects:

- improvement of crop rotation leading to an increase of the yields of cereals (Latvia, Slovenia),
- reduction of fertilizer applications (Latvia) while others claim an increase in fertilizer and pesticides needs (Slovenia),
- decrease by fixed machine costs due to better utilisation (Latvia). However, rape seed cultivation requires special technical know-how and special machines, hence specific additional investments, and
- reduction of soil erosion during winter season (Slovenia).

Table 4. Change of rape seed area under cultivation, 2000 - 2007 (ha)

	2000	2007
NMS		
Lithuania	0	124,800
Latvia	6,900	99,200
Estonia	28,800	73,600
Poland	437,000	797,000
Czech Republic	325,000	338,000
Slovakia	n.a.	153,831
Hungary	121,838	223,579
Slovenia	122	5,358
Bulgaria	9,500	54,000
Romania	68,000	87,700*
CC/PCC		
Croatia	10,000	13,000
Turkey	82	10,700
Serbia	6,300	12,900
Bosnia & Herzegovina	0	1,578

Note: n.a. = not available; * 2005; MLT, CYP, MAC, MON, KOS, ALB: no energy crops

Source: Country Reports 2009

There are just a few figures about the share of area under energy crops. Four reports provide national figures; i.e. in Lithuania, Latvia and Czech Republic their share comes up to about 5% and in Slovakia to about 3.3%. In six countries no energy crops are grown at all yet; besides Malta and Cyprus these are Macedonia, Montenegro, Kosovo and Albania.

(2) The rising demand on bio-energy has not only first implications on agricultural production and cropping patterns, but also on the use of wood. However, when looking in more detail at modern forms of wood energy production and use, the information available is even more scarce. Some information about the production of wood pellets and briquettes as modern forms of wood energy is available. This is summarised in Table 5. A few countries reported that there is no pellet or briquette production from wood and wood waste. The major reasons seem to be that either there is no wood available (e.g. Malta), or no investments in this source of bio-energy had been made due to high initial costs, so far (e.g. Bulgaria, Romania, Montenegro, Kosovo and Albania). In a number of country reports no information has been given, hence it is not known whether there is any pellet/briquette production at all. Just Macedonia and Serbia report that pellet production had been taken up recently, but no figures had been given.

Only a few countries provided some figures. But they show that pellet and briquette production are rapidly increasing. Particularly, entrepreneurs in the Baltic States and some Central European countries are investing in this source of bio-energy. However, when producing wood pellets/briquettes, it does not necessarily mean that these “modern” forms of bio-energy are used in the respective countries. Particularly, the Baltic States as well as Croatia and Serbia report that almost the whole production is exported. Bosnia & Herzegovina exports about one third of the national production. In this way, it can be concluded that “modern” forms of wood energy start playing a more prominent role in the analysed countries, but this source of bio-energy is not predominantly used in domestic markets, but is seen as an attractive export product. Due to the limited data availability, it is impossible to estimate the share of this “modern” form of wood energy in total wood energy demand of the respective countries.

Although biomass production for bio-energy is still in its infant shoes, all NMS but also more and more CC and PCC are setting RE targets which require higher production volumes of biogas and biofuel. However, more or less all country reports emphasise a severe social repercussion: While in almost all countries of the region small scale farming predominates, rape seed production is, in general, taken up by larger farms (agricultural holdings) only. But also the reports on Bosnia & Herzegovina and Kosovo where no energy crops are grown for the time being, stress the fact that energy crop production might be a potential source of income for large farmers only. A certain minimum size for cultivating these crops (in terms of area and economic size) seems to be necessary. As small scale farmers in the region are reluctant to organise themselves in order to increase economies of scale and their bargaining power, they are also not acceptable as input providers by (potential) biogas and biofuel producers. The country reports just mention two cases that tried to overcome this disadvantage: (1) In Latvia one cooperative was established in 2000 promoting rape seed production. It is also investing in a biodiesel production plant which became operational in 2009. (2) In

Croatia, a rape seed producer association has been established, recently. However, in both cases no more information has been provided. Similarly, in many countries of the region large shares of forestry land is owned by farmers and other private individuals. Their plots, in general, are quite small. Hence, it is doubtful that many of them can provide enough wood for pellet and briquette production in an economically viable manner.

At this stage, it can be concluded that, although the data availability is quite limited, the expansion of bio-energy production had a very modest impact on the agricultural and forestry sectors. The only measurable change is the expansion of the cultivated area under rape seed and the expansion of wood pellet and briquette production. The area under other (potential) energy crops did not change much during the last years. Similarly, in many countries the area under fast growing trees has been expanded but from a very low level and statistical data had not been available.

Table 5. Change in the production of wood pellets/briquettes in NMS and CC/PCC, 2000 - 2007 (tons)

	2000	2007
NMS		
Lithuania	270,000	547,000
Latvia	287,000*	461,000
Estonia		377,000**
Poland	20,000***	350,000
Czech Republic	20,900*	102,000
Slovakia		68,000
CC/PCC		
Croatia	≤2,000	41,000
Bosnia & Herzegovina	3,200*	22,000
Macedonia		just started
Serbia		just started

Note: * 2005, ** 2006, *** 2003; HUN, SVN, CYP, TUR: no information; MLT, BUL, ROM, MON, KOS, ALB: no production

Source: Country Reports 2009

Impact of bio-energy production of agricultural and rural development II: Experts' assessment

The major arguments for promoting the expansion of bio-energy can be summarised as follows: it provides new sources of employment and income not only for the agricultural sector but for the rural areas in general. Since the statistical evidence is not available, we relied on experts' assessments in the respective countries. In each country up to ten national experts on RE were asked to assess the employment and income effects of bio-energy in their respective countries. These experts were randomly selected among scientists and administrators. However, while there had been a rough common outline of key questions, their statements presented below just provide a glance and are not representative, statistically. In the following, we will focus on two major dimensions: First it is looked at the impact on the agricultural and forestry sectors in specific and, second, on rural development in general.

In a first round, the national experts had been asked whether they would see any employment and income effect in agriculture and forestry with the expansion of biomass production for bio-energy. Their answers were summarised in the national reports on a Likert scale between 0 (not at all) up to 5 (very high). The national findings are summarised in Table 6. In general, the experts only anticipated a modest employment effect or no effect at all if bio-energy production is expanded in their respective countries. Concerning bio-energy as a potential source of income the experts, in general, are a bit more optimistic, particularly in Latvia, Serbia, Bosnia & Herzegovina and Turkey but these effects seem to be small and mostly concentrated on larger farms and forestry owners.

Table 6. Assessment of the impact of bio-energy on employment and income in the agricultural and forestry sectors by national experts

		High (4-5)	Somewhat (2-3)	None (0-1)
Employment	NMS		EST (3), HUN (3), SVN (3), POL (2), CZE (2)	LVA (1), MLT (1), CYP (1), BUL (1), ROM (1)
	CC/PCC	TUR (4)	SER (3), BIH (3)	CRO (0), ALB (0)
Income	NMS	LVA (4)	EST (3), CZE (3), SVN (3), ROM (3), CYP (2)	POL (1), HUN (1), MLT (1), BUL (1)
	CC/PCC	BIH (5), TUR (4); SER (4)		ALB (1), CRO (0)

Note: LIT, SVK, MAC, MON, KOS: no data

Source: Country Reports 2009

Besides an impact on the agricultural and forestry sectors in particular, the promotion and expansion of bio-energy production might have also an impact on the rural economy in general. Most of the newly established biomass processing plants are already or will be located in the rural areas, with the exception of municipal solid waste plants which might have good prospects in mostly urban areas. The country reports mention that there might be employment and income effects in building and servicing bio-energy processing plants in the rural areas. Again, the national experts had been asked how they assess the role of bio-energy in rural development and whether they anticipate employment and income effects in the rural areas if biomass production will be expanded in their respective countries. The findings are summarised in Table 7.

Table 7. Assessment of the impact of bio-energy on rural development by national experts

		High (4-5)	Somewhat (2-3)	None (0-1)
Employment (non-farm)	NMS	EST (5)	LVA (3), CZE (3), HUN (3), POL (2), SVN (2), MLT (2), CYP (2), BUL (2), ROM (2)	
	CC/PCC	TUR (4), BIH (4)	ALB (3), SER (2)	CRO (0)
Income (non-farm)	NMS	EST (5), ROM (4)	LVA (3), CYP (3), CZE (2), HUN (2), SVN (2), MLT (2), BUL (2)	
	CC/PCC	BIH (5), TUR (4), SER (4)	ALB (2)	CRO (0)

Note: LIT, SVK, MAC, MON, KOS: no data

Source: Country Reports 2009

According to experts' opinion, bio-energy plays a limited role in rural development, so far. They just see a limited employment and income potential within the rural areas. While experts in Estonia, Turkey, Bosnia & Herzegovina and, to some extent, in Serbia and Romania are quite optimistic, Croatian experts are extremely pessimistic. However, national reports are short of providing any rationale for their opinions. If at all, it is referred to national programmes, including Rural Development Programmes 2007-2013 where some financial support for the establishment of bio-energy plants is available. In this way, it can be concluded that some modest impact with respect to employment and income will be expected due to an expansion of bio-energy production, but the impact is very vague. Just in Slovakia and Bosnia & Herzegovina a first estimation with respect to employment effects has been conducted. In Slovakia, it is assumed if the broader RE-targets will be met by 2020, about 5,000-6,000 additional jobs will be created. In Bosnia & Herzegovina it is estimated if the country can use just half of its natural potential, about 5,000 new jobs will be created. But, in total, it is doubtful whether bio-energy production in specific or RE production in general will stop the rural-urban migration pattern observed all over the region.

Finally, based on the modest statistical data and the expert' assessments, it can be concluded that the cultivation of energy crops in general and of rape seed in particular does not, in general, create any employment and income effects for most (small scale) farmers in the region. If any, they will be modest and will reduce the outmigration rate of farmers. Income effects seem to be observed among larger-scale farmers. This is reflected by the observation that, if farmers engage in biomass production, these are the bigger ones.

Conclusions

The promotion of RE and bio-energy has become a political top priority among almost all over Europe. At this stage, the supply of "modern" forms of bio-energy is still at its infancy. All EU member states, including NMS, have adopted national targets aiming at expanding the shares of RE. Some CC/PCC have started to do the same. These targets have to be met by 2010 and 2020, respectively. Since RE, at this stage of development,

is economically not competitive with fossil fuels, EU and most national governments in the region are prepared to provide financial incentives in promoting RE. Bio-energy makes up a significant share of total RE and a further expansion is envisaged. The expansion of RE in general and bio-energy in specific seems to depend on three major factors:

The economic potential, or financial resources, of the respective country is almost a precondition in promoting the production of bio-energy (i.e. for electricity, heat and/or fuel production) since they are not economically competitive, so far. Without state subsidies, the production would be in a pilot stage only and would play no role at all in meeting total energy demand. Due to co-financing a large part of that burden is taken over by the EU with respect to the NMS, but nevertheless a certain share has to be financed by national budgets and/or consumers. So the expansion of bio-energy production is restricted by the available financial resources. Otherwise, interested entrepreneurs are frightened off by the high initial investment costs and the not cost-covering market prices.

The natural conditions of the respective country favour one source of bio-energy over another one. Countries in Northern and Central Europe are more favoured in producing biomass than countries in Southern Europe due to more favourable precipitation patterns. Besides annual crops they can make use wood and wood products on a larger scale than the dryer and hotter regions in Southern Europe. In this way, we conclude that while a mix of various sources of bio-energy production might be desirable, regions will ultimately specialise in those sources which are best adjusted to the respective natural conditions.

Finally, social repercussions of bio-energy production become evident in most countries of the region. Most of them are dominated by small-scale farming and small scale forestry ownership. In order to produce needed biomass for processing a certain minimum size seems to be a pre-requisite. Hence, most farmers and forestry owners cannot participate in this new type of farm and forestry activity. A way out might be a better organisation of interested small-scale producers in self-help groups or cooperatives, but most farmers of the region are still reluctant in joining these types of organisation. In this way, most country reports conclude that the employment and income effects of an expansion of bio-energy production among the agricultural and forestry sectors as well as in rural regions in general will be very modest.

Recommendations

All country reports acknowledge the fact that RE and bio-energy production is and will remain an important political issue for the years to come. In general, the need of expanding RE is accepted by the respective societies. Concerning a future expansion of RE and bio-energy production, the following recommendations can be deduced.

It is no surprise that the call for more financial resources has been listed at first stage in most country reports. More financial support is needed for meeting the RE targets in time (adopted by almost all countries of the region), i.e. the construction of bio-energy processing plants and their integration into existing energy systems.

While some financial support seems to be available in most countries analysed, almost all country reports emphasise the need to “make more” out of it. On the one side, there is a lack of a consistent and long-term oriented policy which is supposed to give strong guidelines to potential investors. On the other side, many reports complain about the high administrative barriers and “red tape” that potential investors face if they want to go into energy production. Various ministries and administrative levels are involved when deciding on licences and financial support. This procedure should be streamlined and simplified for potential investors.

In general, the debate about RE in general and bio-energy in specific is restricted to experts and insiders. Public participation is weak. In many reports it is demanded that the general public should be better involved and public knowledge about energy and RE in general and bio-energy in specific should be increased.

A number of reports complain that there is no clear link between public support in expanding RE, including bio-energy, and the need to achieve competitiveness over time. In general, RE as such is already seen as a good development. What is missed is an exit strategy once RE pays for itself without public support anymore.

As discussed above small scale farmers and forestry owners have just a limited option in participating in bio-energy production. There is a need that a higher share of farmers and forestry owners will participate in bio-energy production in the future. This can only be accomplished if these groups are better organised.

There is a need in better and more reliable data about the use of the respective sources of RE. While at national level information is already sketchy, it is often missing at regional and household levels.

Note

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