Bioeconomy's relevance in rural development

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Abstract

In this paper the author focuses on the bioeconomy's importance in the development plans and paths through an analysis of the most relevant literatures. After that it is included, how could contribute the new field of "sustainable economy" to open new opportunities for agriculture and rural development, which is very needed in most of the European countries as well as in Hungary. The paper starts from the analysis of the most relevant policy documents of the European Commission which is followed by an evaluation of the relevant national policies of Hungary. In next session it tries to interpret the relevance of integration bioeconomy into the rural development plans, and paper is finished with an actual and approximate potential analysis for bioeconomy in Hungary.

Keywords: bioeconomy, sustainable development, rural development, Hungary.

Introduction

It is nowadays a fact that we have to face the climate change in the next decades. This is the reason why mitigation and adaption is in the main focus of Europe Strategy 2020, which means on the one hand we have to avoid the heightening of the climate change and try to shift our existing economy to a low-carbon economy and on the other hand we have to adopt and try to minimise the negative effects of the changing climate. Humanity can be assisted in the shifting to a better future by renewable energy sources (RES) but an accurate mixture and utilization must be reached for s sustainable path to reach this.

From the agricultural side a shift is also needed and the Common Agricultural Policy (CAP) has the opportunities to promote public goods through support measures, both directly and indirectly. For example, climate change can be mitigated by reducing energy inputs and enhancing soil organic carbon, which also improves soil fertility. The post-2013 CAP aims to promote "*improvements in energy efficiency, biomass and renewable energy production, carbon sequestration and protection of carbon in soils based on innovation*" (EC, 2010c). Likewise, "*Mitigation action should relate to both limiting emissions in agriculture and forestry from key activities such as livestock production, fertilizer use and to preserving the carbon sinks and enhancing carbon sequestration with regard to land use, land use change and the forestry sector*" (EC, 2011; also EC, 2012e).

This shows a close relationship between agriculture and a shift to a (more) sustainable path of the economy. Regarding to the injustice of the markets, the Farmers need also support measures "*in adopting and maintaining farming systems and practices that are particularly favourable to environmental and climate objectives, because market prices do not reflect the provision of such public goods*" (EC, 2011). Such public goods can be provided by agro-ecological methods, which therefore warrant greater support measures. Biomass based energy production can provide an extra to reduce external energy inputs and also can realise a considerable surplus on the income side of the farmers by marketing of "wastes" and producing valuable energy sources for further processes. The surplus in incomes could contribute to rural development in its own through its multiplicator role, but bioeconomy has also a couple of additional effects locally by the processes which create a high value added to the wastes.

As the Federal Ministry of Education and Research of Germany summarised in *National Research Strategy BioEconomy 2030, Our Route towards a biobased economy* in 2011:

> *"The concept of the bioeconomy covers the agricultural economy and all manufacturing sectors and associated service areas that develop, produce, process, handle, or utilize any form of biological resources, such as plants, animals, and microorganisms. This spans numerous sectors, such as agriculture, forestry, horticulture, fisheries and aquaculture, plant and animal breeding, the food and beverage industries, as well as the wood, paper, leather, textile, chemicals and pharmaceutical industries, and aspects of the energy sector. Biobased innovations also provide growth impetus for other traditional sectors, such as in the commodity and food trade, the IT sector, machinery and plant engineering, the automotive industry, environmental technology, construction, and many service industries."*

Bio-based economy

Bioeconomy's reveal in relevant policy documents of the EU

Sustainable energy was for first time promoted by European Commission, which was started to improve the utilization of RES. The concerning goals are clearly included in Europe Strategy 2020, the European Union's ten-year growth and jobs strategy which was launched in 2010. Based on the assessment of the national renewable action plans, the importance of sustainable usage of biomass cannot be more questioned: biomass based energy will contribute to the fulfilment of the 2020 targets by 56.7%. This means that 56.7% of the 20% RES share by 2020 will arise from biomass. Hence, sustainability and biomass potential estimations are getting more and more attention, and from this comes that recently the Commission – referring to the indirect land use change – has proposed to cap the first generation biofuels share in 5% in favour of the advanced biofuels and electric transport by providing multiple counting. (EC, 2010a)

As the production of biomass for advanced purposes necessarily correlates with agriculture and forestry as being key providers, the CAP after 2013 addresses the issue of sourcing biomass. Bioeconomy is an opportunity to increase the employment and use agricultural products locally parallel. Therefore, the EU agricultural policy should facilitate the supply of wastes, residues and non-food raw materials for the purposes of the biomass-based energy supply. The CAP recognizes that biomass utilisation contributes to EU objectives on renewable energy, bioeconomy and decarbonisation, as well as the rural economies benefit from the sustainable biomass utilization. The new CAP has six priority areas around the "*innovation, environment and climate change*" issues, and one of these is the "*resource efficiency, low carbon and climate resilient agriculture*" containing the focus area renewable sources of energy. (EC, 2010c)

As it can be seen from the above introduced aims of the European Commission, research and innovation are the key components of the cross-cutting nature of RES as well as the biomass-based economy. It means to address inter-connected societal challenges – including food security, natural resource scarcity, fossil resource dependence and climate change – in a comprehensive manner, while also achieving sustainable economic growth. On the ground of this, the European Commission published *Innovating for Sustainable Growth: A Bioeconomy for Europe* in 2012. This strategy gives great importance to the bio-economy concept, so it is worth reflecting on what the concept really means. The term bio-economy (synonymous with bioeconomy) is used already

on its own, as well as in conjunction with other terms like e.g. Knowledge-Based Bio-Economy (KBBE). (EC, 2010b)

Regarded to the Strategy, an action plan was also published, with the name of *Innovating for Sustainable Growth: a Bioeconomy for Europe*, which aims to reach a more innovative, low-emissions economy which reconciles demands for sustainable agriculture and fisheries, food security and the sustainable use of renewable biological resources for industrial purposes, while also ensuring biodiversity and environmental protection. (EC, 2012c).

Realizing the bioeconomy's impact on tackling societal challenges and at the same time enabling sustainable growth, the communication calls for the following actions in the framework of the Bioeconomy Action Plan: investments in research, innovation and skills; reinforced policy interaction and stakeholder engagement for a coherent policy framework; and enhancement of markets and competitiveness in bioeconomy (knowledge based information flow, logistics, demonstration, standards). The bioeconomy will also contribute to the Commission's Europe 2020 goal on moving to a low-carbon economy by 2050 and to the flagship initiatives "*Innovation Union*" and "*A Resource Efficient Europe*". (EC, 2012a).

Basically, there are two cornerstone fields of which developments and further R&D&I are necessary to the transition: agriculture and biotechnology. There is growing pressure on agriculture that, besides delivering food and feed, in a complex and sustainable approach it should make by-products also marketable. Biotechnology, especially white biotechnology dealing with industrial conversion processes, is inevitable to turn biomass feedstock into a range of value added products.

Innovating for Sustainable Growth: A Bioeconomy for Europe and the Bioeconomy Action Plan 2012 are set up around three main pillars: (Schmid et al., 2013)

- investments in research, innovation and skills aimed at ensuring substantial EU and national funding, in synergy with the Cohesion Fund and CAP, as well as private investments;
- reinforced policy interaction and stakeholder's engagement, through the creation of a Bioeconomy Panel, a Bioeconomy Observatory and regular Stakeholders Conferences that will contribute to enhancing synergies and coherence throughout the whole value chain;
- enhancement of markets and competitiveness in bio-economy sectors by a sustainable intensification of primary production, a cascading use of biomass and waste streams as well as mutual learning mechanisms for improved resource efficiency

Relevant Hungarian policy documents concerning bioeconomy

Policy drivers are captured by the key relevant Hungarian policy papers concerning at least one of the many aspects of the bioeconomy have been identified and are introduced shortly here. Noteworthy, the case of bioeconomy as a whole cannot be found in any of them, which probably because of the complexity of the field. In our opinion bioeconomy could have a more important position in the relevant strategies, more dominantly in the R&D and rural development strategy. Currently, there is no dedicated strategy or policy framework on the creation of the Hungarian bioeconomy, and more importantly due to its complexity the responsibilities (agriculture, R&D, biomass, energy…etc.) are not set clear and interfaces are not provided.

Hungary's Renewable Energy Utilization Action Plan

The Renewable Energy – Hungary's Renewable Energy Utilisation Action Plan, 2010-2020 is based (REAP) on the EU directive of 2009/28/EC (renewable energy). It details how Hungary intends to achieve the binding target of 13% by 2020, moreover to exceed it to 14.65% in terms of renewable energy ratio of final energy consumption. Regarding biomass use, – which is the largest fraction of renewables in order to meet the target – the document puts it in a wider complex of agriculture and rural development as well as introducing the term green economy. It states that the use of biomass for energy purposes, based on the favourable agroecological conditions of the country and taking into account sustainability criteria (especially the protection of biodiversity and soil quality), can contribute to the retention of agricultural jobs and to the creation of new ones.

The use of organic resources from animal husbandry (biogas) for energy purposes can enable productive waste management, increasing the competitiveness of the sector. The use of by-products and other solid wastes from agriculture and forestry (e.g. by-products from crop-lands, cuttings from orchards and vineyards) for local energy purposes and their conversion into endproducts will result in additional income for farmers and producers, and can significantly reduce the need of communities for fossil energy sources.

National Energy Strategy 2030

The National Energy Strategy 2030, approved by the Hungarian Parliament in 2011, contains the element of the renewable energy action plan, but also introduces new measures for the biomass based solutions. This is the establishment of bipolar agriculture, possessing the required market-oriented flexibility enabling it to shift between food production and energy-geared biomass production, encouraging, by the cultivation of energy crops, the gradual conversion to arable land of areas unsuitable for food production at the required efficiency, which are therefore currently left uncultivated.

The strategy also recognizes that biomass and wastes are also potential industrial base materials, available for use in a number of areas of a fast developing biotechnology-based economy. It enables the production of pharmaceutical and fine chemical products by biotechnological processes considerably reducing the GHG emissions of industrial manufacturing processes and products. This statement is a clear development compared to the strictly energy orientated approach for biomass resources. Furthermore, the advanced biofuels production techniques and other biomass based solutions are also pictured as driving forces for "greennovation" and potential contributors to economy with the provision that the required training, industrial and innovation knowledge base is developed.

Darányi Ignác Plan

As most important source of Hungarian rural development goals and paths the Ministry of Rural Development adopted the Darányi Ignác Plan – Framework Programme for the Implementation of the National Rural Development Strategy (2012-2020) in 2012. It fits into the EU and national policies (e.g. reviewed above) and aims to reverse unfavourable processes predominant in the countryside. The vision is based on to deliver sustainability, viable agricultural and food production and values of rural life. Along with this vision, the strategy defines the objectives and

principles of the country's rural development policy and provides a framework for the implementation of the relevant programmes and measures. The main Strategic Goals are:

- Preserving the natural values and resources of our lands.
- Diverse and viable agricultural production.
- Food security and food safety.
- Ensuring the existential bases of the rural economy and increasing employment in rural areas.
- Strengthening rural communities, improving the quality of life of the rural population.

As it can be seen, many of the main goals are directly or indirectly connected to the bioeconomy, but in the strategy there is no direct contact established between advanced biomass processing and rural development.

Although the strategy highlights the major problem in the agribusiness, namely the products have predominantly lower added value due to lack of the further processes, and it names as a preferable strategy to increase the added value, the strategy deals neither with the idea of the bioeconomy nor the advanced biomass technologies delivering opportunities for by by-products valorisation. The locally produced renewable energy is contained in more parts of the strategy as an important factor of the rural development, but it is connected more to the wood utilization and only one time to the organic residues and wastes. There are more opportunities to use agricultural by-products, organic residues and wastes as valuable feedstock is many processes, today it is a must to use the available technology to produce tradable products in addition to energy.

The Plan names 7 focus areas in Hungary, which need effective interventions to reverse the negative processes of their currently development's directions. Two from these focus areas are threatened by very negative social as well as economical processes and have peripheral localization: *"The Cserehát Programme"* and "*The Ormánság Programmes*" (Figure 1.)

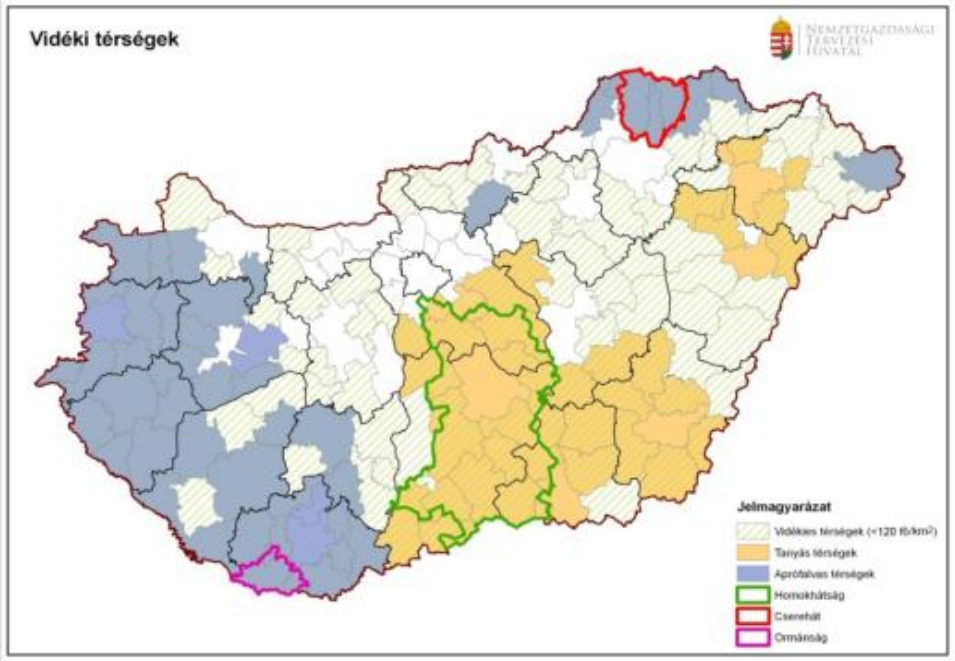

Figure 1. *Rural areas in proposal of the National and Regional Development Concept (2013) Ormánság is outlined by pink and Cserehát by red.* ***Source:*** *Rural Development Programme 2014-2020 v. 3.0*

As Figure 2. shows, in both of this threatened areas can be found arable lands with less fertility. It means, where the most people (with Hungary's highest rates of under skilled population and unemployment) are available to work in the agricultural sector, the capabilities make it not suitable for them. From the author's view the bioeconomy would be a suitable opportunity to indicate such processes in these areas, which can contribute to invert the local difficulties by a complex local value chain of the currently unutilized resources from both the human as well as the environmental side.

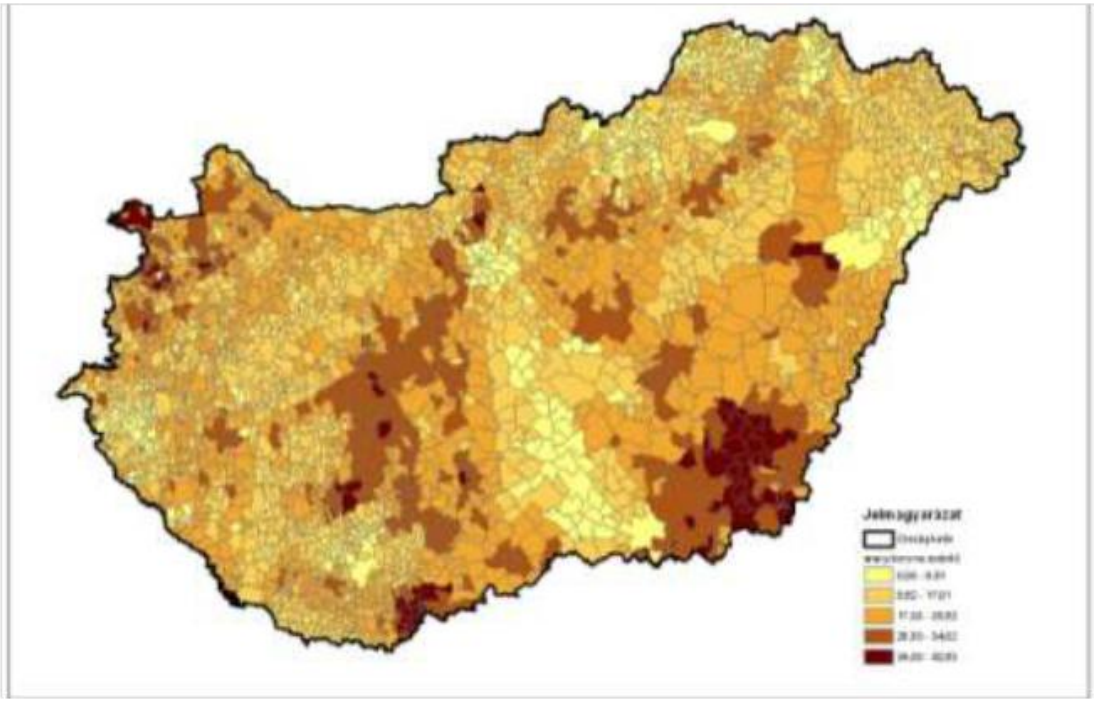

Figure 2. *Golden crown value of arable land.* ***Source:*** *Rural Development Programme 2014-2020, v. 3.0*

Bioeconomy's relevance in rural development

Multifunctional agriculture – the first pillar of the bioeconomy

As a multifunctional activity, agriculture has a fundamental role in the economy, especially in the bioeconomy by producing food as well as delivering public goods and services. European national governments seem unlikely to restore their previous role as leading investors in agricultural research. Therefore new structures and partnerships are needed for the direction and delivery of public agricultural research that reconsider the public goods aspects of the knowledge and technology outputs required. (Schmid et al., 2013)

As Technology Platform Organics (2011) describes this: "*The creation of a green low-waste production chain, that is also able to secure food supply in the context of climate change and growing population can span from improved management systems that minimize inputs at the land/sea level and throughout the supply chain. Farmers' collective knowledge of natural resources, ecological processes and product quality, can be used as a basis to minimise dependence on external inputs and gain societal support. Shorter agro-food chains based on*

consumers' trust and greater proximity to producers can also be seen as a basis of a low-waste production chain, whilst addressing consumer demands for high quality food, taking into account animal welfare."

From this aspect, multifunctional agriculture presents a new, spreading and sustainable way for improving agriculture. (European) agriculture is nowadays under pressure and needs transition. The present paradigm is questioned and efforts are made to rethink agriculture: on the hand a trend of smart specialization can be identified which means trying to increase productivity of agriculture; and on the other hand the agro-ecological movement asking for more ecological principles and an increased social role for agriculture. Multifunctionality could fulfil the gap between these two on first sight contradicting views; which means that one should recognize the different roles that agriculture can and has to play in society going from food production, but also provider of biomass for the biobased-economy as well as provider of a number of public and thus by definition non marketable goods: food security, food safety, biodiversity, landscape maintenance, water retention, flood control, energy production, social care, etc. (Van Huylenbroeck, 2013)

The multifunctional paradigm calls for an agriculture which is efficient and competitive in all these functions depending on regional conditions, markets and demands. Multifunctional agriculture can therefore be an engine of exploring new markets and of regional development. This also fits in the bio-based economy and the new role of agriculture and the use of biomass in an economy which needs to become less dependent on fossil fuels and resources (Figure 3.).

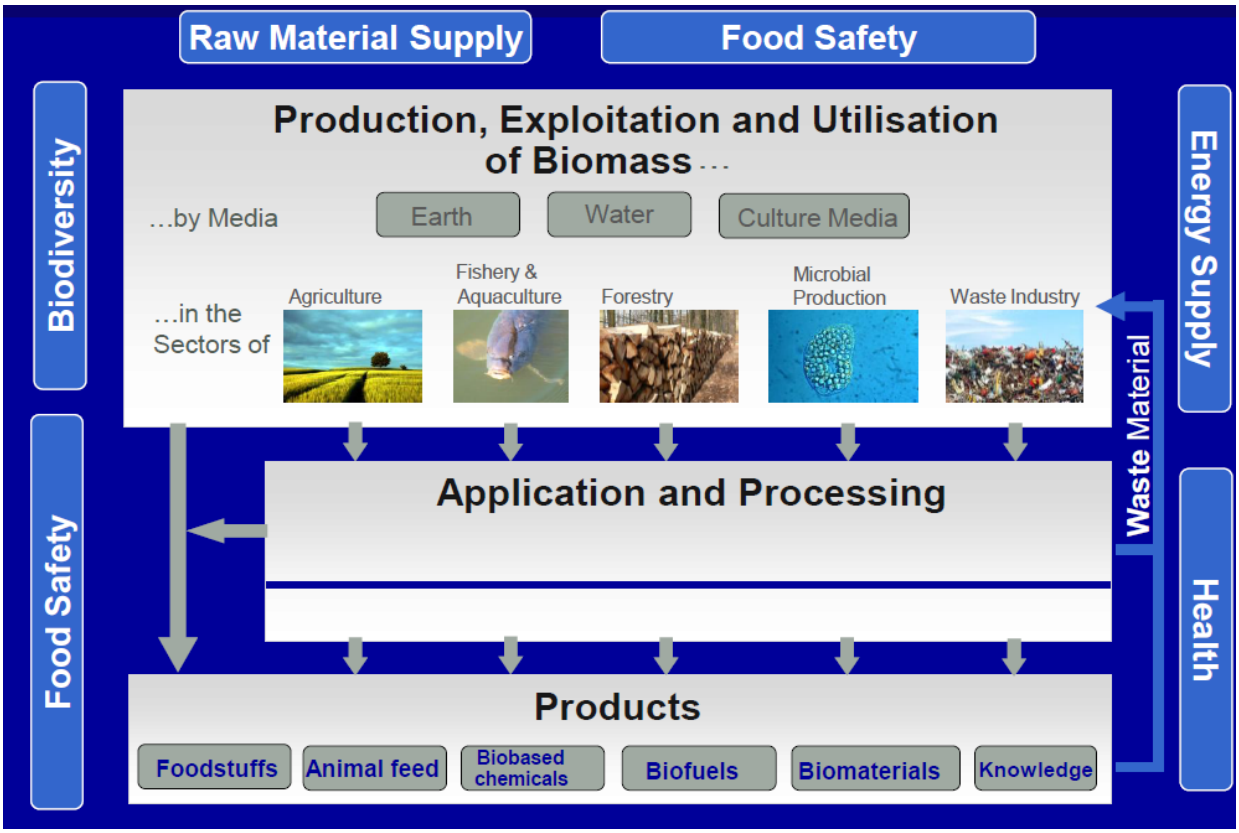

Figure 3. *Role of biomass in the bio-economy.* ***Source:*** *Van Huylenbroeck, 2013*

In this view biomass is produced in different media and processed using up-to-date technologies (platforms) to different products. In such a bio-based economy there is more attention for closing global and local loops, carbon neutral production, re-use of materials and so on. Agriculture has in such an economy an important role to play not only as biomass provider but also as provider of safe and healthy food, as waste sink and reuse, in taking care of the non-harvested biomass (biodiversity, genetic pool) and in providing rural amenities (Van Huylenbroeck, 2013).

Rural development and bioeconomy

As the European Commission summarized: *"The bio-economy can significantly contribute to the future development of rural and coastal areas because it will promote both supply and demand actions with regional dimension, such as the creation of supply chains for residues and waste as feedstock for bio-based industries, setting up of a network of small-scale local biorefineries or developing aquaculture infrastructures"* (EC, 2012c).

This aim could be supported by future Cohesion Policy as well as by the reformed CAP. Both in Pillar I and Pillar II of a revised CAP there will be more possibilities to support the sustainable production of biomass for purposes other than food and feed. Examples are coupling farmers' area payments for specific desired products for energy or material use with specific sustainability requirements (Schmid et al., 2012).

To what degree new biomass processing and bioenergy plants will create new employment and income will depend on policies, which could favour either more large-scale centralized businesses or else more decentralised systems with stronger involvement of farmers. Along the latter lines, a bio-economy more oriented to public goods could create additional opportunities for rural development, such as by:

- Enhancing the landscape value and quality of life in rural areas as basis for other agricultural activity such as agro-tourism and eco-tourism, including its economic value for rural development.
- Supporting green-care entrepreneurship: Green care refers to the utilisation of farms – farm animals, plants, gardens, forest, and landscape – as a base for promoting mental and physical health and quality of life for a variety of client groups.
- Linking agriculture with energy production by recycling bio-waste at farm level, thus reducing input costs and GHG emissions.
- Building short food-supply chains that remunerate farmers for agro-ecological methods.
- Enhancing resilience of bio-diverse agro-food systems through in-built protection from threats of epizootic disease.
- Creating attractive employment for professionals in the field of agriculture, horticulture, food processing and nursing services.

The bioeconomy can directly link innovations to the economic growth, which is a very important factor. In order to increase productivity whilst maximising the efficiency of resource use and minimising the impact on the environment, innovation is needed not only in scientific research and technological development, but also in all areas of the bioeconomy. This has to involve many stakeholders – in particular farmers, foresters, fishermen, advisory services – and all industries involved in the supply chain, as well as consumers and society at large. The potential for

innovation and therefore for greater economic development of entire industries and sectors, thus restricting the bio-economy.

Farmers, processors and other actors throughout the food chain are experimenting regularly and are generating innovations, as they have done since agriculture began (Hoffman et al., 2007). Farmers bring experience from their lifelong work on one complex farm experiment, which includes a largely tacit body of knowledge. This requires the utilisation of group approaches, and encouragement of producer ownership of the problems and solutions. These experiments in social innovation take many forms – e.g. community supported agriculture, short food-supply chains, and territorial labels – bringing consumers closer to producers, especially through better knowledge of agro-ecological production methods. Public knowledge systems are needed to help promote those innovations and thus the public goods that they generate (Levidow et al., 2012).

Only when there is cooperation among producers and all other actors along the supply chain will the European bio-economy fulfil its potential. Involving all levels of supply chains in the knowledge-base could lead to a better-managed system addressing the problems set out in the EU Bioeconomy Action Plan. Farmers and SMEs have been a major source of innovation and knowledge in the food and farming sector in the past. Their potential to drive innovation for the future needs to be recognised and supported and can be utilized locally.

Available materials and potentials for the bioeconomy

Even though many potential estimations are available for this wide spectrum of feedstock, there is quite consensus that agricultural residues hold an enormous unused potential by means of volume and energy content (despite the different methodologies, boundaries, input data and frameworks resulting in relatively large deviation). The main feedstock groups are also possible by providing examples relevant for Hungary of raw materials:

- Agricultural residues:
  - hay residues (straws – wheat, oat, rice, rye, barley –, corn stover and cob;
  - manure;
  - unutilized compostable materials (e.g. grass, loppings).
- Forestry residues: bark, wood chips, logs.
- Industry organic wastes (solid and liquid):
  - wood industry: from sawmills and timber mills, paper and pulp side streams;
  - food industry: dairy by-products, fruit and vegetables processing, vegetable oil production, slaughter house waste.
- Energy crops (as a surplus for use underutilized agricultural areas):
  - wood crops: poplar, willow;
  - hay crops: miscanthus, switchgrass, reed canary grass, different types of reed;
  - sugar crops: sweet sorghum.
- Municipal solid waste (especially the organic part).

Municipal solid waste is also available in large in landfills, but it has to be taken account that its amount, homogeneity and composition (included toxic compounds as well) are different from the source areas. By utilizing municipal waste this material can also be turned to value added product

and improve its material and energy input-output ratio (e.g. in life-cycle analysis – LCA), as well as financial balance.

In order to provide an insight into the possible amount of agricultural residues available, a recent study of the Joint Research Centre of the European Union is used. Monforti et al. (2013), carried out the geographical assessment of potential bioenergy production in the EU-27 from residues of straw and residues available from eight crops (wheat, barley, rye, oat, maize, rice, rapeseed and sunflower). The method applied considers competitive uses from farming and the environmental constraints by retain a minimum ratio of residues in soils. As results, it was found that on average (EU-27) 42% of produced residues could be sustainably collectable. There are also geographical differences in Europe, the most of the residues collectable sustainably was found for Hungary (46%) followed by Italy, France, Germany, Austria and Poland. Considering the competitive uses after collection (as ratio of the collected amount) on average 83% would be left as available amount (in case of Hungary it was found to be 96% also ranked as the highest).

AEZ (applied agro-ecological zones) methodology is used for global regional and national assessments of agricultural potentials enables assessments of potential productivity of forest tree species. AEZ follows an environmental approach; provides a standardized framework for the characterization of climate, soil and terrain conditions relevant to crop and forest species production; uses environmental matching procedures to identify limitations of prevailing climate, soil and terrain for assumed management objectives. This high potential for energy crops is also supported by the fact that large area of land (pastures) is available without limiting and jeopardizing the food and feed production (Figure 4.).

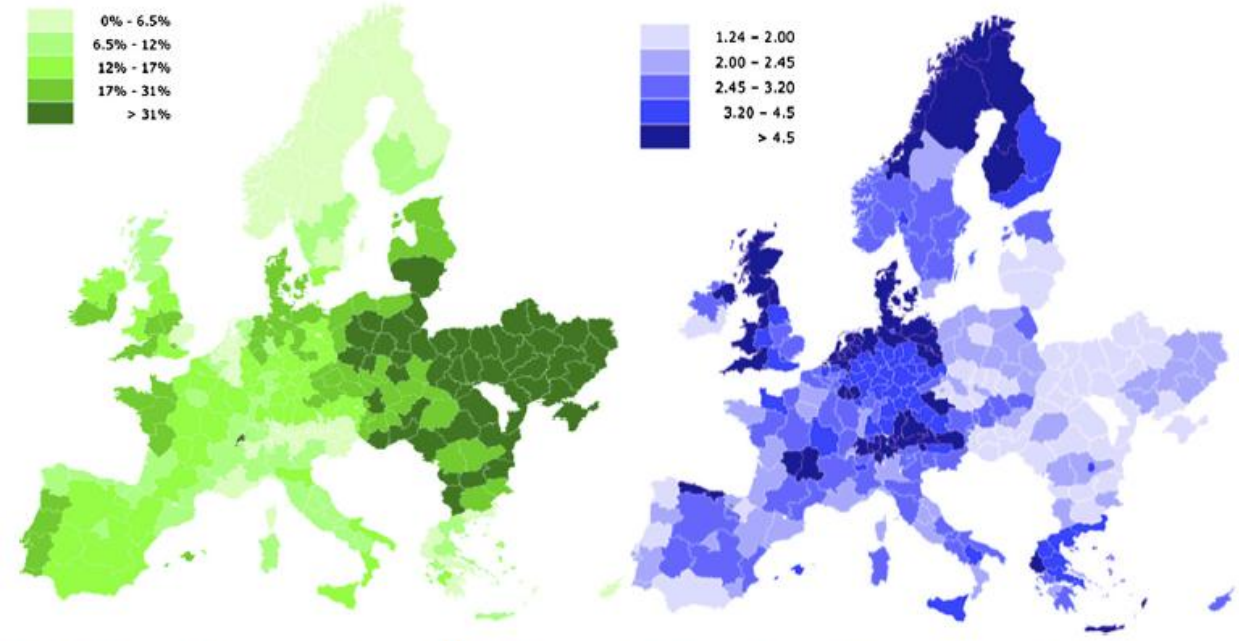

Fig. 8 – The 'surplus' land potentially available for the production of biomass by 2030 (left, green shades indicate the amount of surplus land as a percentage of the total land) and the production costs for woody crops in 2005 (right, blue shades indicate the production costs of woody crops in € GJ^{-1}) together indicate favourable locations for the production of biomass. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Figure 4. *Lands available for biomass production.* ***Source:*** *Wit et al., 2010*

Hungary is considered as a biomass rich country in general with biomass potential enough to meet the 2020 renewable energy requirements with the existing technologies. A background study was written to the Hungarian Renewable Action Plan (REAP) summarizing different existing potential estimations (table 1.). The summary showed that Hungary has 420-500 PJ/year theoretical potential, out of which 203-328 PJ/year is convertible in long-term (2050). The technical potential of all biomass sources is 215 PJ/year, the economic potential is 220 PJ/year and the sustainable potential would be 208 PJ/year on the long run (2030). In medium term (2020) 122PJ/year sustainably exploitable potential can be estimated. Nevertheless, the concrete methodology and framework conditions may be not known and differ, thus leading to very diverse potentials. (As comparison the gross inland consumption of primary energy of Hungary is around 1000-1100 PJ/a).

Table 1. Agricultural residues potential for Hungary, results of a few analyses

Source	Amount
Monforti et al. (2013) GIS based methodology considering environmental (soil) limits and competing uses	Available amount of straws of eight crops (wheat, barley, rye, oat, maize, rice, rapeseed and sunflower): 6.3 million tonnes (on 2000-2009 basis) (~60 PJ)
Fischer et al. (2010)	Amount of agricultural residues: – observed 2000-2002: 9.4 million tonnes (88 PJ) – 2020: 7.1 million tonnes – 2030: 5.9 million tonnes (56 PJ)
Hungarian Academy of Sciences	74-108 PJ/a
Garay et al. (2012)	8.5 million tonnes/a (80PJ)

Detailed classification of the different biomass resources can be also collected in Hungary. The latest estimations – which seems to be the most accurate – for available amount of solid biomass from different sources, and the calculated energy potential are aggregated and introduced in the followings the of the Garay et al. (2012)

- Forestry: cca. 13 million m3 of wood is produced every year, from that 10.5 million m3 (cca. 7.5 million tonnes) can be lumbered in a sustainable way. In the last decade was logged cca. 5.3 million tonnes of which about 50% was utilised for energy generation. It means, about one third of this energy source is currently unutilized. Every year about 525,000 tonnes of wood by-products (waste wood, wood chips) are generated in the wood processing plants from which about 50% – mostly sawdust and bark – could be used for energy production.
- Agricultural by-products:
  - 2.4-2.8 million tonnes from the annually production of 4-4.5 million tonnes of straw originates from the production of all kind of grain cereals could be used for energy production in a sustainable way;
  - 8-10 million tonnes of maize stover is produced annually, from which about 2.5-3.0 million tonnes could be utilised as biomass for energy production;
  - a significant amount of sunflower stems and oilseed rape straw is produced annually, as is about 150-200 thousand tonnes of vineyard biomass and a further 400-500 thousand tonnes of orchard biomass.

(Although the heating value of these horticultural by-products is very similar to wood, at the moment most of the resulting biomass is either burnt on site or is chopped and ploughed into the soil.)

- Currently underutilized capabilities: regarding the potential, Fischer et al. (2005) envisage that roughly 1.4 million hectares (15.2% of the country's area) delivering 327.6 PJ are suitable for poplar, willow and miscanthus, excluding forest land, ''other'' land, and land highly suitable for cereals. Based on the calculation of the former Ministry of Agriculture and Rural Development, the traditional structure of production can be feasibly maintained on 3.3-3.4 million ha arable land, therefore at least 1 million ha land could be utilized for alternative forms of exploitation. This area would be also good for energy crops.
- The authors of the REAP also envisage a dominant role for energy crops. They estimate that there are about 1 million hectares of land that are not suitable for agricultural production, and from this area some 200,000 hectares could be used for the production of energy crops. The REAP anticipates the production of 5.6 million tonnes of energy crops annually.
- There are 400 hectares of perennial and 2,122 hectares of herbaceous energy crops in Hungary (REAP, 2010). On this production area, assuming an average yield of 20 tonnes/ha, about 50,000 tonnes of biomass is produced annually
- Although there is increasing interest in growing energy crops, the production area has not changed significantly in recent years. The main reason for this is that the price for chips is almost the same as the price of firewood, but the production of wood chips from energy crops is more expensive than logging. Therefore the production of energy crops can only be envisioned if the distance to the recipient plant is no more than 50-80 km (Gyuricza, 2010).
- Municipal solid waste: the amount of it and its yet not selected organic fraction constitutes an enormous potential, of which utilization mostly depends on waste management policy framework, as well as on possible introduction of distinct collection of organic wastes as foreseen by EU policies.

Conclusion

As it can be summarized bioeconomy can contribute to the development of a higher developed region as well as on underdeveloped region anywhere, where biomass can be grown. As a green energy source it and its further products must not be transported too far from the producing area, therefore it can make the basis for a locally supply chain which creates high value added products. This supply chain means investments into the local economy infrastructure on the human side as well as on the built infrastructures. If the utilisation of the feedstock stays (and it must be) sustainable it cannot be attached by environmental exploitation but can produce high value products in underdeveloped areas as well which can be attractive for other users of these products as well. A complete chain needs also investments in research, which takes elementary part in a path to a high developed economy.

The EU has targeted these positive changes and supports the path to reach them. If Hungary tries to use this aid for a sustainable way of the future, the prominent – currently underutilized – capabilities can promote this goal of the community.

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