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The opportunities of a path towards bioeconomy in Southeast Asia

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ABSTRACT

A Bioeconomy can be defined as an economy where biotechnology plays a decisive role in the growth path of a country or region. This paper analyses the specific characteristics associated with a Bioeconomy, exploring the potential it might have in the Southeast Asia region, taking into account its particular endogenous resources and its social and economic characteristics. The paper discusses both potentials of biotechnology in different sectors of the economy as well as provides perspectives for the future. Analysing different natural, economic and social features of the countries in the Southeast Asia region, this paper discusses how these characteristics are suitable for a growth path based on Bioeconomy and how this strategy might be a solution for the continuation of the growth path that the region started years ago, in a way that guarantees sustainability and address the different challenges that this particular region faces currently, and will face in the future.

Keyword: Bioeconomy, Sustainable growth strategy

JEL Classification: Q01, Q28, Q57

1. Introduction

The world as a whole, with Southeast Asia in particular, faces a wide spectrum of challenges – economic, social, demographic and environmental – that could impact its development paths. The strategies that the Southeast Asian countries could choose to manage and address these challenges will determine the success of their economic and social development. This paper presents the current and prospective opportunities that biotechnology offers and to what extent the Southeast Asia region's natural, social, and economic characteristics are suitable for a growth path towards a Bioeconomy.

The present paper is divided into 5 sections. In section 2, the definition of a Bioeconomy will be discussed, exploring how recent literature and different institutions characterizes it, defining the concept of the Bioeconomy that will be used throughout the paper. Section 3 presents the outlook for Bioeconomies, exploring how it is affecting different sectors of the economy – agriculture, industry and health – and what are the development prospects, and how its adoption can lead to more sustainable development paths. Section 4 discusses the specific opportunities that biotechnology innovations bring to the Southeast Asia region and the prospective impacts that an investment towards a Bioeconomy growth path could imply for the region. This section also presents the case of Malaysia's first national plan towards the building of a Bioeconomy. Finally, section 5 provides a brief conclusion.

2. Bioeconomy Definition

Before understanding the potential opportunities behind an investment in Bioeconomy in Southeast Asia, it is essential to understand the meaning of Bioeconomy as used in this paper. In this section, a review of different definitions

of this particular division of Economic Science will be provided.

McCormick and Kautto (2013) define a Bioeconomy as "an economy where the basic building blocks for materials, chemicals and energy are derived from renewable biological resources, such as plant and animal resources". In a recent paper, Golden and Handfield (2014) presented Bioeconomy as the "global industrial transition of sustainably utilizing renewable aquatic and terrestrial resources in energy, intermediate and final products for economic, environmental, social and national security benefits".

Apart from academia, different institutions and governments have presented alternative definitions of the concept of Bioeconomy. The first institution to introduce the term was the European Commission in a White Paper released in 1993 (McCormick & Kautto, 2013). The European Commission, in its most recent definition of Bioeconomy, defines it as a science that encompasses "the sustainable production of renewable resource from land, fisheries and aquaculture environments and their conversion into food, feed, fiber bio- based products and bio-energy as well as the related public goods". The OECD (2009) presents Bioeconomy as a "set of economic activities relating to the invention, development and use of biological products and processes".

The Government of the United Kingdom introduced the Bioeconomy as the economic activity derived from utilising biological resources or bioprocesses to produce products such as food, energy and chemicals. On the other hand, the White House presents the Bioeconomy as an economy based on the use of research and innovation in the biological sciences to create economic activity and public benefit (Sillanpaa and Ncibi, 2017).

Despite these differences to some extent, we can summarize the previous definitions and present Bioeconomy as the field of economic science that studies the transition towards an economy based on sustainable and renewable resources from land, fisheries and aquaculture, where innovations in the biotechnology field play a key role.

3. Bioeconomy Outlook

Economic growth promotes the rise of incomes for human beings, which is translated into more consumption of various products. However, the path that have led the world economy until the current economic situation is potentially not sustainable. Indeed, nowadays the world faces several challenges as a result of overexploitation and unsustainable use of resources (OECD, 2009). To further aggravate the situation, the future trends in income and population growth pose an even more critical challenge, especially in terms of natural resources. The European Commission predicts that the world population will reach a total of 9 billion people by 2050, a growth of almost 25% compared with the current population (Carus & Dammer, 2013). Besides that, income per capita will rise, by 2030, to USD 8,600, which is a growth of more than 45% comparing with the value of USD 5,900 registered in 2005 (OECD, 2009). One consequence of such a trend is the alarming increase in food demand that is projected to grow by 70% until 2050, mainly due to the consumption of meat (Carus & Dammer, 2013).

The Bioeconomy is presented as a promising way to not just help to promote the efficient and sustainable usage of natural resources, but also as a key player in reverting some situations caused by the improper use of natural resources in the past. As the European Commission states, “life sciences and biotechnology are probably the most promising of the frontier technologies”. Indeed, the potential of Bioeconomy

is so great that some authors point out that it can promote a shift from oil-based economy to a bio-based economy, as 90% of oil-based products can be replaced by bio-based one, in the present state of the art (McCormick & Kautto, 2013). Also, as an OECD report (2014) states, "economic growth and environmental protection are not only compatible but can also be mutually reinforcing".

The investment of regions and countries in the Bioeconomy, apart from promoting a more sustainable growth path that is capable of meeting the current and future challenges, also creates side effects of promoting the economic activity in rural lands (McCormick & Kautto, 2013). In fact, the emerging Bioeconomy has the potential to develop a rural economy with higher levels of self-sufficiency, as several of these regions are major sources of underutilized agricultural material, such as crop residues or animal manure, which could be converted in bio-energy, producing both economic and environmental benefits (Golden & Handfield, 2014).

In fact, all these possibilities that Bioeconomy possesses to drive economic growth in a more sustainable and efficient way have been present for a long time. Throughout human history, agriculture has served other purposes apart from food, such as energy, clothing, shelter and other everyday human needs (Golden & Handfield, 2014). Nowadays, the Bioeconomy employs more than 22 million people across Europe, which represent 9% of its labour force, and contributes 2 trillion Euros to the European economy (McCormick & Kautto, 2013).

For example, in Finland alone, the bio-based economy contributed 60 billion Euros – 16% of the country's GDP – and 300,000 jobs – 26.3% of total workforce – in 2011. Finland's government expects that by 2025 the country's Bioeconomy will generate 100 billion Euros and create

100,000 new jobs. Finland is not an isolated case. Apart from the common strategy designed by the European Commission for the transition towards Bioeconomy, several European countries have already designed their own strategies, compatible with the endogenous characteristics of their economies, natural resources and strategic goals. For example, the strategy of Finland is oriented towards forest resources, Germany in its self-sufficiency in energy and raw materials, the Dutch in the chemical and energy sectors, and the Swedish in zero greenhouse gases emissions, and so on (Government of Finland, 2014).

Bioeconomy covers a wide spectrum of economic activities in the primary, industrial and health sectors. An OECD report (OECD, 2009) presents the following economic activities as part of the field of Bioeconomy. In the primary sector: Plants (with focus on Genetically Modified Organisms), Forestry, Plant and Animal Diagnosis, Animal Breeding; in the health sector: Health Therapeutics and Diagnosis, Pharmacogenetics, Functional Foods and in the industrial sector: Production of Chemicals and Biomaterials, Industrial Enzymes, Resources Extraction and Biofuels. In the following part of the present paper, we discuss the current situation in some of the fields described above and the estimates of the prospects for the future.

In the primary sector, taking the case of Genetically Modified Organisms (GMO), the market has been growing steadily, from a total of 67.7 million acres of plantation in 2003, to 181.5 million acres in 2014, which represents an average growth of 15% per year. In 2014, the four main crops produced using GMO technology – soybean, cotton, maize and canola – represented, respectively, 82%, 68%, 30% and 25% of the total production of that specific crop. The prospects towards 2030 are the continuation of the growth in this field, especially in developing economies, where it will

play a key role in lowering the pressure on demand for food that is resulting from population and income growth in these economies. The trend is also towards an increase in investment in biotechnology for functional foods, promoting an increase in quality in the nutrition levels of the population. The prospects point out that a primary sector based on biotechnology could contribute to half of total primary sector output by 2030. In terms of value, it is expected that the primary sector would contribute to a total of 381 billion USD to gross added value by 2030 (OECD, 2009).

In the industrial sector, the plastics industry – associated with the field of Production of Chemicals and Biomaterials – is one of the most prominent field of Bioeconomy nowadays. The European Bioplastics Association estimates that 85% of polymer plastic consumption - one of the most common thermoplastics used in industry – can be replaced by bioplastics in Western Europe. In fact, the bioplastics industry has been growing at an impressive rate of 20-30% a year in the present decade, and it is expected to grow by 500% between 2013 and 2016. In United States, a shift of the plastic industry towards bioplastics, of around 20% production, could result in the creation of 104,000 jobs (Golden & Handfield, 2014).

Still in the field of Production of Chemicals and Biomaterials, it is expected that by 2025 one quarter of the total chemicals used in industry will be produced with bio-based solutions. In total, the OECD estimate for the industry sector based in bio-based products will represent a total of 422 USD billion by 2030 (OECD, 2009).

Concerning the health sector, it is expected that all research developed or applied to new diagnosis and pharmaceuticals will use biotechnology in the near future. The contribution of the Bioeconomy in the gross value added in the health sector in OECD countries is estimated to be

around 259 billion USD by 2030. Although it will represent just 25% of the Bioeconomy market in OECD countries by 2030, nowadays it is the field that gets the majority of the investment in biotechnology R&D (OECD, 2009).

Aggregating all the sectors, Arundel and Sawaya (2009) estimate that by 2030 the emerging Bioeconomy will represent a total of 1.062 trillion USD of gross value added in the OECD countries, which represents about 2.7% of the total gross added value of these countries, employing a total of more than 170,000 people. It is important to understand that for the computation of the estimates presented, the authors opted to follow a cautious scenario analysis – where new innovations in biotechnology were not considered – and neglected the biofuels industry, especially because of the possibility of electricity being the main source of energy for transportation sector in the near future. It is also important to state that the estimates are pure economical, not translating the potential improvement of well-being that a move towards Bioeconomy would represent.

4. Bioeconomy for Southeast Asia

As the previous sections showed, Bioeconomy already plays an important role in the world economy, especially in the developed nations, and the trend is that its importance will increase in the next decades. However, taking into account the particular structure of the economies in developing regions, and specifically in the case of Southeast Asia, Bioeconomy constitutes an opportunity that can promote sustainable growth for the region, answering the most urging environmental challenges that it faces, while at the same time promoting sustainable well-being of its population.

In fact, Bioeconomy could be the answer to promote well-managed natural resources, in order to preserve and

reinforce their capacities to provide essential services to human well-being that cannot be replaced by other forms of capital. This idea is related with the concept of strong sustainability that states that some services of natural capital are essential to human welfare and cannot be replaced by other forms of capital (OECD, 2014). The longer the majority of Southeast Asian countries continues with their unsustainable growth model, the higher the risk associated with compromising strong sustainability. A move towards Bioeconomy growth models could promote not only strong sustainability, but also revert some environmental issues like pollution and drought that are a result from the previous growth model.

The Southeast Asia growth model has been based, in large part, on natural resource exploitation. This has much to do with the intrinsic characteristic of this part of the world, where the natural capital accounts for 20% of total wealth – compared with just 2% in the OECD countries. Despite its huge potential in terms of natural capital, many countries of the region have adopted an unsustainable growth model of 'grow-now-and-clean-up- later', which deals separately with economic and environmental issues. This model has been responsible for some natural threats that the region faces presently, and if it continues to be followed could result in significant constraints for future growth and also affect the well-being of the region's population. For example, between 1999 and 2012 Brunei's natural capital was depleted at a rate of almost 40% GNI per year, and in Vietnam, Malaysia and Indonesia at 10% GNI per year (OECD, 2014). The wild fires happening in Indonesia in 2015, caused by the El Niño phenomenon will put the country as the fifth biggest world polluter ("Indonesia's forest fires", 2015). Indeed, Southeast Asia is a region with a high propensity to natural disasters associated with climate change. Between the time period of

1980 and 2009, up to 85% of the deaths and 38% of the economic losses from natural disasters occur in Southeast Asia. For instance, the big flood that took place in 2011 resulted in an economic loss of 45.7 billion USD in Thailand alone, which represents a value of around 13% of its GDP that year (OECD, 2014).

As a consequence, one of the main challenges the region faces in the present time is to address natural capital depletion, pollution, biodiversity loss and climate change, as otherwise the gains in living standards and well-being registered in the previous decades could be reversed. In fact, the region registered an impressive growth path, which allowed more than 86 million people to escape poverty since the 1990's. Although it is predicted that, between 2013 and 2017, the region will register an average GDP growth of 5.5% per year (OECD, 2014). In order to sustain this growth, and the increase well-being associated to it, it is imperative that the countries of the region follow a path that is compatible with the challenges that the region faces. Bioeconomy presents itself as a potential alternative path that could foster even more economic development than the region has registered, while at the same time promoting more sustainable usage of natural resources and creating the conditions for an increase in equality, as Bioeconomy favours the rural regions, which are usually poorer than the urban ones.

One important field where Bioeconomy can play an important role in the region is the primary sector. First, bio-based production in the food sector register higher yields per acre than the traditional one (OECD, 2009), which constitutes an important solution for a growing population – that is estimated to reach the number of 800 million in individuals in 2050, comparing to 522 million registered in 2000. On the other hand, it could address the water pollution

problem that the region faces, especially due to the fertilizer usage in agriculture – as biotechnology provides bio-based solutions for fertilizers. For instance, 48% of the rivers of Thailand are considered to be polluted to some extent (OECD, 2014). As discussed previously, GMO food share in total crops is growing steadily. However, most of its production is concentrated in a few countries, highlighting the case of US, Brazil and Argentina. An investment in GMO crop cultivation in Southeast Asia could promote food security in the region, while promoting better usage of land at the same time – as far as GMOs crops have higher yields, because of its improved characteristics and also of the capacity for double cropping feature that the majority of the GMO seeds present (Barrows et al., 2014).

Other important and strategic sectors in the region are the fisheries and aquaculture industries. They contribute to over 10% of GDP in Cambodia and between 2% to 5% of GDP in the rest of the regional countries. This has much to do with the privileged geographical location of the region, which has the world largest share of marine biodiversity. Again, in this case, the overexploitation of natural resources is resulting in severe natural consequences. For example, intensive shrimp farming has led to the destruction of 50% to 60% of the mangroves of the region since 1975 (OECD, 2014).

In terms of aquaculture, this industry expanded by 230% in the region between 2000 and 2009. Nowadays, aquaculture in Southeast Asia represents a share of 22% of the world's industry, and accounts for 43% of total fishery production in the region (OECD, 2014). The OECD report (2014) states that "aquaculture can (…) contribute to protect fish stocks and increases the region's food security". In this case, Bioeconomy could also play an important role for a more sustainable path. First, biotechnology has, nowadays, enough

resources to produce GM plants to feed the aquaculture fishes, improving the rate of land usage. Second, by using biotechnology the producers can control better the quality of the fishes and promote genetic changes that improves their nutritional value. This may result in improved environment and health quality across the region.

Besides food production, the primary sector in Southeast Asia region is also important in terms of forests. In fact, forests represent an important source of revenue for many of the regions countries. In Laos, it contributes to 6% of GDP and in Cambodia to around 4.5% of the GDP, being the average of the region of around 1%. Forests cover 45% of total land in the region, a value well above the world average of 30%. However, despite the high dependence of the region on their forests, the way they have been exploited in recent years poses major challenges. Between 1990 and 2010 the forests of the region contracted by an area equivalent to Vietnam, especially due to Rubber and Palm Oil plantations (OECD, 2014). Bioeconomy presents a great potential to draw on the forest resources. An investment towards a Bioeconomy growth model would promote the exploitation of the region's endogenous resources in a way that improves sustainability and generates higher added value. First, it can promote a better management of forest resources, using biotechnology in order to draw better yields in forestry production. On the other hand, biotechnology, especially in the case of GM crops, can promote higher yields of production per acre, which will result in a lower pressure for conversion of forest lands into agriculture fields. Furthermore, with the recent advances of biotechnology in creating GM trees, adapted to tropical and subtropical climates, species like aspen, eucalyptus and birch could be harvested in the Southeast Asia region, creating a great

opportunity to develop industries like pulp and paper and other fibres (OECD, 2009).

Rapid economic development in the region is being matched by fast-rising energy requirements, which are being met through an increasing reliance on coal. However, the region presents one of the highest shares of renewable energy production around the world – a share higher than the OECD countries. This high value is, in part, attributable to the lack of access of some region's countries to modern energy resources, where biomass is still important for domestic use, especially in rural areas. In Myanmar and Cambodia, renewable sources of energy account for over 70% of total primary energy supply (TPES) – mainly due to reliance on traditional biomass. In Philippines and Indonesia TPES account for around 35-40%, while in Vietnam and Thailand TPES is around 15-20%. Concerning this starting point, the region faces a situation where a bet on biotechnology for energy production could not only fulfil the region needs, but also takes advantage of the endogenous and vast resources that the region has at its disposal. In fact, the region has a high potential in terms of renewable sources of energy, especially hydropower, solar, geothermal and biomass. The estimates for energy demand in the region point out that by 2035 it will have increased by more than 80%, which will require an investment in energy infrastructure of more than 1.7 trillion USD (OECD, 2014). A path towards Bioeconomy will imply that this investment would be directed mainly towards renewable sources of energy, such as biomass and biofuels, taking full advantage of the regions endogenous resources. However, one of the main challenges that Bioeconomy faces in the region is the high dependence of some of the economies of the region on oil and gas sectors. Countries like Brunei, Indonesia, Malaysia and Thailand still have oil and gas as some of their main exports as well as

important sources of income. Considering that these kinds of resources are limited and non-renewable, a bet from the Southeast Asian countries towards a model based on Bioeconomy could improve their chances of continuous and sustainable growth path, at the same time tackling some of the region's main problems, especially the ones related to environment. In the particular case of biofuels production, some countries of the region have made decisive moves towards a bio-based economic growth model. The biofuel industry promotes the improvement of energy security, rural income and reduction of greenhouse gas emissions, although it is sometimes criticized because it can constitute a threat to food security if mismanaged. But as Carus and Dammer (2013) explain, "the question is not food crops being used for food, industrial or energy purposes, but the sustainability of the land used to produce them". In their paper the authors present several studies showing that some areas will remain free for other purposes than food production, even after worldwide food demand has been satisfied.

Good planning of land usage and the recent advances in biotechnology, either in food production or in biofuels production, that have achieved increasing levels of productivity, open up an opportunity for a sustainable investment in biofuels. Thailand is one of the regional countries that is taking this opportunity very seriously. The country is one the main producers of biofuels in the region, starting with a negligible value in 2000 to a yearly production of 3,500 thousand tonnes of oil equivalent in 2011 – an outstanding value, especially if compared to China's 1,000 thousand tonnes of oil equivalent in the same year. A study by Kumar et al. (2013) shows that second generation biofuels – produced with agricultural residuals – could displace between 25-69% of Thai gasoline consumption and 6-15% of diesel consumption of 2011. The Thai plan for biofuels has

targeted to provide 44% of the oil consumption needs for transportation from biofuels, by 2021. In the rest of Southeast Asia, although the investment in biofuels is lower than the case of Thailand, the average rate of growth of biofuel consumption between 2005 and 2010 was of 33% per year (Kumar et al., 2013). This strategic move can prove very rewarding, if we compare to the success that a similar strategy had in another emerging economy- Brazil. In Brazil, the bio-ethanol programme resulted in a total of 1 million people employment and, from 1975 to 2002 in a reduction of oil imports of 50 billion (OECD, 2011). As can be seen, the empirical evidence supports that a move towards bioeconomy, besides promoting a more sustainable future, can promote job creation and economic growth and, in the particular case of biofuels, energy independence.

In terms of infrastructure, the countries of Southeast Asia, by taking the decision to move towards a path to Bioeconomy, would be promoting a more sustainable and green infrastructure, capitalizing on the infrastructure gap to fill it with better and more sustainable infrastructure, capable of fulfilling their economic and social needs, while at the same time addressing the environmental issues that the region faces, promoting a "green growing" path (OECD, 2014). This path is already being followed by some countries. For instance, Thailand is investing in bio-refineries owing to its policy towards biofuels. In 2012, the country already counted with 21 bio-refineries, which produced 3.7 million litres per day of ethanol and 5.4 million litres per day of biodiesel. This bio-refineries, as traditional refineries, also have the infrastructure and technology needed to produce other products, especially chemicals and bio-plastics- two markets that present high growth rates and with great potential for further growth in the future. Bio-refineries can provide several benefits, promoting the replacement of an oil-

based economy to a bio-based one, and thus based on renewable and sustainable resources. This creates opportunities for energy and industrial resources independence, and also promotes rural development and income generation opportunities for rural population, as agricultural products and by-products constitute the main resources that feed bio-refineries (Kumar et al., 2013).

Southeast region of Asia (including India) contributes to a share of plastic goods production around 16.4%, a value close to the production share of NAFTA countries, of 19.4%, or Europe, of 20.0%, in 2013 (PlasticsEurope, 2014). The increasing demand of plastics in the future could require an amount about 25% of the total current oil production. So, a move towards bioplastics, as discussed above, is being made not only for environmental reasons, but also for economical ones. In fact, that projections show that by 2025, the bio-based polymers, a type of plastics, will represent 10% to 20% of the market share (OECD, 2011).

In the chemical sector, Southeast Asia has been increasing its position as world supplier, from a total sales value of 9.2 billion Euros in 2003 to 12.9 billion Euros in 2013. Although its sales value is still behind the ones presented by European Union and United States – a total of 16.7 billion Euros in 2013 – the trend in the former is to decline, instead of increasing sales in the sector (CEFIC, 2014). In 2005, the production of chemicals based on biotechnology accounted for 1.2 billion USD, which represented a share of around 2% of the chemicals market (OECD, 2009). Two years later, the share of bio-chemicals in total chemical industry was already 3.5% (OECD, 2011). This rapid growth in bio-chemicals results from the fact that biotechnology is capable of producing the majority of the industrial synthetic oil-based chemicals and also because of the diminishing costs of producing chemicals in a bio-based

way – as this was a key factor for a slow growth of this industry in the previous years. Although it is expected that Southeast Asia world market share for chemicals will remain at the same 8% between 2010 and 2020, this implies an annual average growth rate of 6.2% (KPMG, 2014).

A particular example in bio-based chemicals that is of major importance for the region is bio-isoprene, a chemical used to produce synthetic rubber that is used to supplement natural rubber in tyres which constitutes 27% of the final product. To produce one litre of the petrochemical derived isoprene, it needs about seven litres of crude oil. Bio-isoprene not only promotes a more sustainable way of production by reducing drastically the greenhouse gases emissions, but it also promotes oil independence for countries that are not oil producers (OECD, 2011). As Southeast Asia houses four of the top five world producers of rubber – where Thailand is the major rubber producer, with a total share of 29.6% in 2013 – this bio-based solution promotes a more sustainable growth path for this industry in the region (FAO, 2013). For the reasons described above, a move towards bio-based chemicals would create the base for a sustainable growth for the region in the future.

Although major usages of bio-chemicals are oriented to industry, their increasing share has been applied to the health industry, especially pharmaceuticals. In fact, in a OECD report in 2011, it was projected that by 2012 the total share of "active pharma ingredients" in the bio-based chemicals sales will account for more than 33%. This might constitute an important opportunity for the Southeast Asian countries in the health sector, especially those that are highly dependent on pharmaceuticals imports, to design a pharmaceutical industry that is sustainable, while taking advantage of the endogenous resources of the region at the same time.

Due to the potential that a move towards a bio-based economy in the Southeast Asia, some countries in the region are starting to orientate part of their investment into Bioeconomy. However, national plans or strategies are still rare in the region, with a few exceptions, such as the case of Malaysia. In 2012 the Malaysian Prime Minister, Datuk Rasak, launched the "Bioeconomy Transformation Program", in line with the governments' goal of turning Malaysia into a high-income country by 2020. With this program, the Malaysian government expects that, by 2020, the Bioeconomy in the country would grow up to reach 36 billion USD, comparing to the 2010 value of 25 billion USD, which corresponds to around 13.4% of Malaysian GDP in that year. In fact, the report release by the Government of Malaysia shows evidence that the bio-based economy in the country is growing at a rate of 15% a year, projecting a Bioeconomy that would worth more than 42 billion USD by 2030 (FAO, 2018).

The Malaysian program is oriented to palm oil industry and primary agricultural sectors, taking advantage of their endogenous resources and competitive advantages. The goals of the program will be to enhance the productivity, yield and quality of the output of these sectors, with biotechnology as the main driver. The plan also includes a strategy towards a bio-based health industry, focused in bio-cosmeceuticals, wellness and pharma nutrition, cellular medicine and stem cells and bio-based chemicals (BioTechCorp, 2015).

Inserted in the Bioeconomy Transformation Programme (BTP) is the initiative "Bioeconomy Community Development Programme", which aims to promote projects oriented towards individual farmers in order to foster the growth of the Bioeconomy in the country. This program is still in the pilot stage, with a total of seven pilot projects. So far, it has involved 47 farmers, affecting, directly, a total of

230 people. The first results point out a total of more than 225,000 USD impact in the communities where the projects have been launched.

Another component of the Malaysian BTP is a fiscal incentive scheme, called Bionexus, that is designed to promote the investment in bio-based activities in Malaysia by national and international companies. In 2013, the Bionexus program generated a total income of 236.8 million USD, a 88.5% growth comparing with the 2011 value. In 2013, the BTP promoted the investment of more than 200,000 USD and the employment of 83,400 people, both values above the targets established by BTP in its conception. Therefore, although the values are still not very significant in terms of the Malaysian economy, the rapid growth and the overcoming of the projected targets show that with the right policy orientation, Bioeconomy can gradually become a more important sector in the value generation in Malaysia, in particular, and in all Southeast Asian countries, in general (BioTechCorp, 2015).

5. Conclusion

The present paper discusses some current and prospective opportunities that a move towards a growth path based on biotechnology and bio-based economy can cause. It brings up the particular case of the Southeast Asia region, highlighting some of its current problems and constraints to economic growth and development, but also discusses some of its resource-based advantages that, if explored in the right way, can allow this sub- region of Asia to achieve high standards of development.

Focusing on different sectors – agriculture, industry and health – there is a large potential that a Bioeconomy growth strategy could create for the future of Southeast Asian countries in terms of economic growth, job creation and

social and environmental sustainability, taking into account the particular characteristics of this region.

The extension of the present paper did not allow further discussion in policy design for Bioeconomy, and the different fields of the Bioeconomy were presented in a summarized way, in order to give a wide perspective of the potentials of a bio-based economy to the reader.

Some example strategies that are being followed by different countries are reviewed in order to point out that Bioeconomy is already a priority issue for many nations. The particular case of Malaysia, which is the first country in the region to adopt a political framework to promote Bioeconomy, has been presented as an evidence that coordinated political action can produce interesting results. This suggests that if other countries in the region follow a similar path, a Bioeconomy growth path can be a reality in Southeast Asia in the near future. Furthermore, besides particular strategies and guidelines for a bio-based economy, Southeast Asian countries should promote coordinated action – for example, within the framework of ASEAN so that the move towards Bioeconomy could be more beneficial as a whole.

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