FOOD, FEED AND GREEN ENERGY: PREMISE FOR THE SUSTAINABLE AGRICULTURE TOWARD TRANSNATIONAL NETWORK OF RURAL SOLIDARITY

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ABSTRACT

This study investigates the agro-food sector who is receiving a great deal of attention for topics of general interest as the food quality, security and safety, alternative uses of crops in food/feed/fuel, growing concern for GHG (Green House Gas) emission, LCA (Life Cycle Assessment), energy consumption. In the EU policies directed to implement sustainable local agro-food systems, the AFSC (agro-food supply chain) is emerging as the central issue in planning integrated farm-food activities performed in a space-time dimension.
Use of renewable energy in farming systems can mean several different things. For example, fossil fuels such as oil are non-renewable, so finding alternative ways of fertilising the land and controlling pests that do not depend on chemicals, will normally involve the use of renewable resources. Such methods reduce farmers' vulnerability to the rising price of oil.
Renewable energy also includes generation of power to do a number of farm tasks: pumping water for irrigation, for livestock or for domestic use; lighting farm buildings; powering processing operations and others. These forms of renewable energy include solar energy, wind and water power, oil from plants, wood from sustainable sources, other forms of biomass (plant material), and biogas (gas produced from fermentation of manure and crop residues).

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1 Introduction

The interest for the elaboration of the agro-food policies has been growing over the last decades, since the new directions of the EU policy (second pillar) focusing on the sustainable production system, rural development and multi-functionality, have pointed out on the importance of a systemic vision of strategies directed to the implementation of the AFSC.
The structural changes in agriculture, the diversification of agriculture, the integration with food/feed/fuel industry, the relevance of climatic changes, energy and LCA, the importance of information, have increased the interest for the management of complex Agro-food complex (Sexton, 2009).
The agro-food sector has evolved from the achievement of scale/scope economies, to the broader strategic positioning approach encompassing the risk management, logistic and marketing control extended all steps of the AFSC. These changes impose to manage the network extended to producers, consumers and actors involved in planning the agro-industrial activities sequentially connected in the chain organizations (Boehlje, 1999). Producers, processors, and seller of food products are growingly involved in any sort of network organizations to redistribute the returns and risks among participating partners (Christopher, 2005).
New organization models are needed to achieve a higher level of competitiveness (Murdoch et al, 2000) dictated by a host of technological, regulatory and financial reasons to give quick response to rapid changes in consumer preferences for food quality and diversified uses of feedstock in renewable energy and green chemistry industries.(Hobbs and Young, 2000; Bourlakis and Weightman, 2004). To adequately plan the AFSC it is necessary to reformulate the strategies to incorporate issues such as production, and logistics (harvesting and transport), marketing and channels, appropriate organizational models based on vertical coordination and hierarchies, (Menard and Valceschini, 2005), unbiased and symmetric distribution of information among partners, risk sharing along the chain (Epperson and Estes, 1999).

2 Toward a sustainable agriculture

Future trends in population growth, energy use, climate change, and globalization will challenge agriculturists to develop innovative production systems that are highly productive and environmentally sound. Furthermore, future agricultural production systems must possess an inherent capacity to adapt to change to be sustainable (Jon D. Hanson, John R. Hendrickson, 2009).
Agriculture has been very successful in meeting the needs of most of the world's population. Specifically, today's agriculture feeds a population of six billion people (Tilman et al. 2002) using only 0.2 ha of land per person (Trewavas 2002). Despite such impressive achievements, there are concerns about the sustainability of modern agriculture. Intensive agriculture impacts the resource base and potentially reduces both its capacity (Huang et al. 2002) and its sustainability (Brummer 1998; Tilman et al. 2002). In the Great Plains, many cropping systems are characterized by a lack of diversity (Brummer 1998) and declining soil organic carbon (Krall and Schuman 1996). Beef production in the United States has done an excellent job of developing animals that can convert feed grains into meat (i.e., feedlots) acceptable for human consumption, but it relies heavily on fossil fuels (Heitschmidt et al. 1996).

2.1. Sustainable Agricultural Systems

Agricultural systems need to be developed that are sustainable and adaptable to change, but yet maintain their productivity. Most producers do not develop and use management systems that are designed to be unsustainable. Rather, managers have difficulty discerning between sustainable systems and those that are not. A cursory search of the literature will demonstrate the vast array of what “sustainable” actually means. Such a search demonstrates there are different understandings of sustainability and different visions on how to achieve it. A multitude of definitions of sustainable agriculture exist, yet most include economic, environmental, and social/community dimension. Tinsley (2005) stated that sustainable agriculture “balances the need for Agricultural systems need to be developed that are sustainable and adaptable to change, but yet maintain their productivity. Most producers do not develop and use management systems that are designed to be unsustainable. Rather, managers have difficulty discerning between sustainable systems and those that are not. A cursory search of the literature will demonstrate the vast array of what “sustainable” actually means. Such a search demonstrates there are different understandings of sustainability and different visions on how to achieve it. A multitude of definitions of sustainable agriculture exist, yet most include economic, environmental, and social/community dimension. Tinsley (2005) stated that sustainable agriculture “balances the need for essential agricultural commodities such as food, fibre, etc. with the necessity of protecting the physical environment and public health, the foundation of agriculture.” A composite definition might define sustainable agriculture as an approach to growing food and fiber that is profitable, uses on-farm resources efficiently to minimize adverse effects on the environment and people, preserves the natural productivity and quality of land and water, and sustains vibrant rural communities (UCS 2005; Hendrickson et al. 2008). Regardless of the definition, the potential benefits of a sustainable agriculture should include long-term viability and resilience of farm economics, conservation and enhancement of the natural resource base, minimization of off-site environmental impacts, improvement of farm-level management skills, and enhancement of socioeconomic viability of rural communities.

2.2. Impact of Fossil-Fuel Energy Use on Animal-Based Production

The use of fossil fuels in agriculture has greatly impacted agriculture. Escalating price of fuel has increased everything, from transportation costs to fertilizer costs, and to feed costs. At the same time, high transportation costs have limited some attributes of industrialization because high fuel costs mean that large firms cannot simply ship feed or product to areas of low labor costs. In response, the United States is turning in a cyclonic manner to develop renewable energy systems. Future agricultural production will no longer be focused solely on food and feed markets, but will include other outlets like energy and industrial uses. For example, corn and soybean will not only be used as livestock feed, but will also be sold for generation of biofuels (ethanol and biodiesel). Use of a biofuel crop within an integrated system adds not only to farm diversity, but also contributes to the rural community.

Switchgrass has been evaluated for cellulosic energy development (Schmer et al. 2008). Two primary concerns of using switchgrass as a biofuel crop are its net energy efficiency and its economic feasibility. In this base-line project conducted on marginal cropland, switchgrass was found to produce 540% more renewable energy than nonrenewable energy consumed. Managed correctly, average greenhouse gas emissions from cellulosic ethanol derived from switchgrass were 94% lower than estimated emissions from gasoline. Thus, incorporation of biomass crops for cellulosic ethanol production into a portfolio of enterprises for ranchers could become a viable alternative component of a holistic management system. (Jon D. Hanson, John R. Hendrickson, 2009).

2.3. Impact of Water Shortages on Animal-Based Production

Humans use about 26% of terrestrial evapotranspiration and about 54% of available runoff (Postel et al. 1996). With increasing global population, water availability is decreasing throughout the world, and models suggest that a large portion of the world's population is currently experiencing water stress (Vörösmarty et al. 2000). In some countries, reduction of water tables is critical. For example, in Yemen, the water table is falling by roughly 2 m per year as water use far exceeds replenishment of aquifers. Iran is also facing a severe water deficit problem. Its water table is falling by 2.8 m per year. Similar situations exist in Egypt, Mexico, and the United States.

2.4. Potential Solution for Animal-Based Production

Full integration of livestock and cropping systems may help in slowing or reversing some of the detrimental environmental and sustainability issues associated with agriculture. Traditionally, farms with livestock used animal manure in crop production and feed grains in animal production (Honeyman 1996). Integration of livestock and cropping systems had benefits of enhancing nutrient cycling efficiency, adding value to grain crops, and providing a use for forages and crop residue (Brummer 1998). Crop producers with livestock traditionally raised a greater diversity of crops in rotation (Honeyman 1996), and livestock could convert low-quality crop residues or failed crops into higher value protein (Oltjen and Beckett 1996). Despite these advantages, many farms in the Great Plains have not achieved integrated land use (Krall and Schuman 1996).

Use of forages and other crops in rotation can reduce energy-intensive inputs required by agriculture (Brummer 1996; Entz et al. 2002; Schiere et al. 2002), enhance yield of subsequent crops (Entz et al. 1995, 2002), enhance and intensify nutrient cycling (Brummer 1998; Schiere et al. 2002), and improve soil quality (Krall and Schuman 1996). Use of legumes in rotation can add significant amounts of organic N to soil (Krall and Schuman 1996; Entz et al. 2002), which can be used by subsequent crops.

The future will present new challenges as well as opportunities for developing and integrating forages, crops, and livestock into production systems. With producers under increasing economic constraints, one of the major benefits of integrating forages, crops, and livestock systems would be spreading production risks over several very different enterprises, thereby taking advantage of a variety of agricultural markets (Krall and Schuman 1996; Brummer 1998). As an example, incorporation of forages into a cropping system reduced risk more than government programs (Entz et al. 2002). Under dryland conditions, integrating crop and livestock systems would appear to be both economically and ecologically sustainable (Krall and Schuman 1996).

3 Bioenergy today

Globally, some 40 to 50 exajoules (EJ) (1 EJ = 1018 joules) of biomass are used every year for energy today (Hall et al., 1993; Nakicenovic et al., 1998), out of some 400 EJ of total energy use per year. Many have difficulty conceiving of biomass as a modern energy source, given the role that it has played, and continues to play, in most developing countries today.

Biomass accounts for an estimated one-third of primary energy use in these countries. Over two billion people cook by direct combustion of biomass, primarily in rural areas. Such traditional use of biomass fuels is typically inefficient, relying largely on low-cost sources such as forests and other natural vegetation.

Biomass fuels as used in developing countries today have been called “the poor man’s oil” because direct use by combustion for domestic cooking and heating ranks it at the bottom of the ladder of preferred energy carriers.

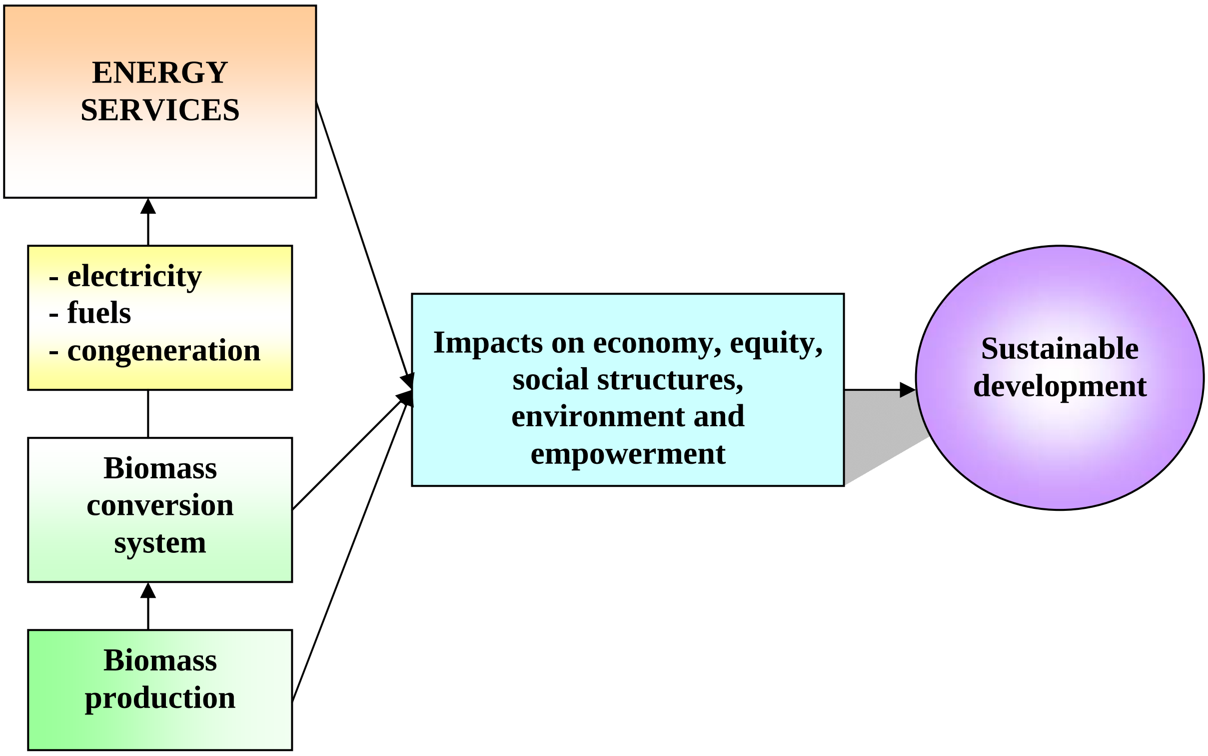

Figure 1 Conceptual representation of biomass energy systems and linkages to sustainable human development

Biomass might more appropriately be called “the poor woman’s oil”, since women (and children) in rural areas must devote a considerable amount of time collecting daily fuelwood needs and suffer the brunt of indoor air pollution caused by direct combustion of biomass for cooking and heating. An astounding 58% of *all* human exposure to particulate air pollution is estimated to occur indoors in rural areas of developing countries.

Biomass utilization in industrialized countries contrasts sharply with that in developing countries. On average, biomass accounts for 3 or 4% of total energy use in the former, although in countries with supportive policies (e.g., Sweden, Finland, and Austria), the biomass contribution reaches 15 to 20%. Most biomass in industrialized countries is converted into electricity and process heat in cogeneration systems (combined heat and power production) at industrial sites or at municipal district heating facilities.

This produces a greater variety of energy services from the biomass and results in much cleaner and more efficient use of available biomass resources than traditional uses of bio-energy in developing countries.

Biomass energy has the potential to be “modernized” worldwide, i.e., produced and used efficiently and cost-competitively, generally in the more convenient forms of gases, liquids, or electricity. Table 1 lists a few of the technologies which can convert solid biomass into clean, convenient energy carriers. Most of these technologies are commercially available today. If widely implemented in combination with sustainable supply of biomass feed-stocks, such technologies would enable biomass energy to play a much more significant role in the future than it does today.

• *Household applications:* Most households in developing countries that use biomass fuels today do so largely because it is available at low (or zero) financial cost or because they lack access to or cannot afford higher quality fuels. Improvements in wood and charcoal stoves over the past couple of decades have allowed households to cook with biomass more efficiently, more cleanly, and with greater convenience. Still, as incomes rise, households invariably choose to consume more of higher quality fuels such as kerosene, liquified petroleum gas, natural gas, and electricity (Dutt and Ravindranath, 1993; Saatkamp et al., 2000).

This shift is associated with the quality of the energy carrier utilized rather than with the primary energy source itself. Gaseous cooking fuels can be used far more efficiently and conveniently than solid fuels, while also emitting far fewer toxic pollutants. Thus, by efficiently converting a given amount of biomass into a cooking gas, more households can meet their cooking demands than by burning the biomass directly, and detrimental health impacts are greatly reduced.

Two gases that can be made from biomass at small scale for cooking are “producer gas”, via a simple high-temperature process and biogas, via low temperature anaerobic fermentation.

• *Small enterprise applications:* In small industrial applications, rural enterprises are often seeking to modernize their use of biomass resources to improve their competitiveness. The more efficient use of locally available biomass energy resources – by brick-makers, bakers, ceramic and wood workers, timber-dryers, agricultural processors, and others – also contributes to increasing the sustainability of these important rural enterprises in many cases. For example, efficient down-draft pottery kilns have been developed in Mexico that help artisans to reduce fuel-wood consumption, while simultaneously eliminating the use of lead and improving the competitiveness of rural pottery enterprises (Masera, 2000).

• *Industrial applications:* Sugarcane provides an example of the potential for biomass modernization at large industrial scales. Over eighty developing countries grow and process sugarcane, generating substantial quantities of by-product biomass fiber (bagasse) that is used today at most mills as a fuel for combined heat and power (CHP) generation. CHP systems typically generate just enough electricity (a few megawatts at an average-sized facility) and process steam to run the mill. Because such an abundance of bagasse is generated, however, the CHP systems are designed to be inefficient in order to consume all of the bagasse and thereby avoid disposal problems.

With more efficient CHP systems, sugar factories can generate substantial amounts of electricity in excess of their own needs.

Given such possibilities for improving the efficiency with which biomass energy is used, a number of international organizations have formulated energy scenarios that envision large contributions from modernized biomass energy in the 21st century. For example, in one scenario developed by the Intergovernmental Panel on Climate Change, biomass energy contributes 180 EJ/year to global energy supply by 2050 – satisfying about one-third of total global energy demand, and about one-half of total energy demand in developing countries (IPCC, 1996). Roughly two-thirds of the global biomass supply in 2050 is assumed to be produced on high-yield energy plantations (Eric D. Larson, 2000).

The rest comes from residues of agricultural and industrial activities.

3.1. Biomass resources

Residues concentrated at industrial sites, e.g., sugarcane bagasse, are currently the largest commercially used biomass source. Global production of residues, including by-products of food, fiber, and forest production, exceeds 110 EJ/year (Hall et al., 1993), perhaps 10% of which is used for energy. Some residues cannot be used for energy: in some cases collection and transport costs are prohibitive; in other cases, agronomic considerations dictate that residues be recycled to the land. In still other cases, there are competing non-energy uses for residues (as fodder, construction material, industrial feedstock, etc.).

Residues are an especially important potential biomass energy source in densely populated regions, where much of the land is used for food production. In fact, biomass residues might play important roles in such regions precisely because the regions produce so much food: crop production can generate large quantities of by-product residues. For example, in 1996, China generated crop residues in the field (mostly corn stover, rice straw, and wheat straw) plus agricultural processing residues (mostly rice husk, corncobs, and bagasse) totaling about 790 million tonnes, with a corresponding energy content of about 11 EJ (Gu and Duan, 1998). To put this in perspective, if half of this resource were used for generating electricity
at an efficiency of 25% (achievable at small scales today), the resulting electricity would be equivalent to half the total electricity generated from coal in China in 1996.

Growing crops specifically for energy also has significant potential. The IPCC's biomass-intensive future energy supply scenario includes 385 million hectares of biomass energy plantations worldwide in 2050, with three quarters of this in developing countries. Such levels of land use for bio-energy could intensify competition with other important land uses, especially food production (Eric D. Larson, 2000).

Many analysts have suggested that competition between land use for agriculture and for energy production can be minimized if degraded lands are targeted for energy (Johansson et al., 1993; Hall et al., 1993; Williams, 1994; Ravindranath and Hall, 1995; Sudha and Ravindranath, 1999). In developing countries in aggregate, hundreds of millions of hectares have been classified as degraded (Grainger, 1988; Oldeman et al., 1991). Many successful plantations have already been established on degraded lands in developing countries (Hall et al., 1993), indicating the feasibility of this option for the longer term.

Energy crops can be produced in two ways:

(1) by devoting an area exclusively to production of such crops (energy plantations) or

(2) by commingling the production of energy and non-energy crops (such as in agroforestry systems and intercropping systems). Since energy crops typically require several years of growth before the first harvest, co-production in some form has the benefit of providing energy-crop farmers with revenue between harvests of energy crops. The co-production approach can also help to meet environmental and socioeconomic criteria for land use. Farm forestry activities in Brazil have been especially successful at involving small farmers in the high-yield production of biomass feedstocks (Larson et al., 1994).

3.2. Socioeconomic and environmental issues with modern bioenergy

Because bio-energy systems are both land- and labor-intensive, they interact intimately with their local environmental and socioeconomic contexts. If designed well, bioenergy systems will contribute to sustainable livelihoods and help address environmental problems such as land degradation or agricultural waste disposal. However, if not properly executed, they can exacerbate social inequities and intensify pressures on local ecosystems. Poor rural populations are perhaps most at risk of adverse socioeconomic and environmental impacts. For this reason, proposed bioenergy activities must be scrutinized and judged along several dimensions: how do they contribute to

(1) satisfying basic needs,

(2) providing income opportunities,

(3) promoting gender equity,

(4) efficiently and equitably using land resources, and (5) promoting the health of the local environment.

Meeting the basic needs of the rural poor

Modernized bio-energy, like any well-designed rural energy source, can help satisfy basic needs and considerably improve local well-being, especially for households that have very low energy consumption (Reddy, 1999). For example, access to modern forms of energy can make it possible to pump water for drinking and irrigation, to light homes, schools and health clinics, to improve communication and access to information, to provide energy for local enterprises, and to ease pressure on fuel-wood resources.

Providing opportunities for income generation

Satisfying the basic needs of the poor will help to relieve the symptoms of poverty, but eliminating poverty requires increasing the access of the poor to a sustainable livelihood.

Bio-energy can contribute in at least three broad ways.

• *General improvement in health and productivity:* Modern energy services can improve the general health conditions of the poor, by providing potable water, cleaner cooking fuels, lighting and refrigeration for improved medical services, improved educational opportunities and access to information, and can free up time for productive activities by relieving effort devoted to gathering fuel-wood, hauling water, milling grain, and other laborious tasks.

• *Direct revenue or employment in the bio-energy services:* The commercial production and conversion of biomass is rurally based and labor-intensive, and can thereby provide important employment opportunities.

Since bio-energy feedstock production based on perennial crops requires less labor than most agricultural activities, extra employment opportunities will arise only to the extent that bio-energy feedstock production augments – rather than supplants – other agricultural activities.

In order for the rural poor to benefit from such opportunities, farmers need to be able to negotiate fair terms of trade, and workers need to have basic protections as wage laborers.

Promoting farmer cooperatives and the ability of workers to organize and collectively bargain can help to equip farmers and workers to identify, articulate, negotiate, and secure acceptable terms of trade and labor conditions.

• *Expansion of rural enterprises:* Many rural enterprises can become commercially viable and provide expanded income and employment opportunities only once there is access to reliable modern energy – such as mechanical power for milling grain, illumination for fine work, heat for processing agricultural output, refrigeration for preserving products, and transport for conveying goods to market. However, rural enterprise won't be spurred automatically merely with the arrival of modern energy. Rural entrepreneurs are often impeded by a lack of capital or access to credit, and/or they are isolated by a lack of upstream and downstream linkages for inputs and buyers. Bio-energy projects must seek to establish links with income opportunities, e.g., by creating the enabling conditions that make rural enterprises viable (FAO, 1998).

Bio-energy activities should recognize that the diffusion of energy services and an increase in mechanization can have complex consequences, as in the well-studied case of the introduction of small rice-milling machines (Eicher and Staatz, 1998).

Rural women readily gave up the laborious task of hand-pounding rice, reallocating the time to other activities – such as income-generating activities – that improved household welfare. However, in some cases, rice mills displaced the labor of hired women from poorer families, for whom rice-milling was one of precious few employment opportunities. Bio-energy planners must try to anticipate adverse secondary effects such as these, and take steps to avoid or ameliorate them.

3.3. Promoting environmental health

Biomass feedstock production can help restore the environment on which the poor depend for their livelihood – replenishing topsoil, re-vegetating barren land, protecting watersheds, harvesting rainwater, providing habitat for local species, stabilizing slopes or river banks, reclaiming waterlogged and salinated soils. It can also serve as an efficient use for agricultural residues, thereby avoiding the pest, waste, and pollution problems of residue disposal.

However, because bio-energy feedstock production can also have adverse environmental effects, guidelines are needed to help ensure that good practices are followed, accounting for environmental issues such as the following.

• Soil quality and fertility: Bio-energy feedstock production can dramatically affect the natural balance of soil nutrient cycles and the texture and organic content of soil. With rapid-growth bio-energy crops and complete harvesting of agricultural residues, there is a potential for depletion of nutrients and decline in soil fertility.

In many cases, the risk of nutrient depletion can be reduced by allowing the most nutrient-rich parts of the plant – e.g., small branches, twigs, and leaves – to decompose on-site. In some bio-energy conversion systems, it is possible to recover the inorganic nutrient content of the feedstock as ash or sludge and return it to the field.

• *Biodiversity:* Bio-energy feedstock production systems should not be confused with forests or other natural ecosystems. They are managed systems, like that of any agricultural crop, and they can affect biodiversity on several levels – from the micro-fauna within the soils, to the plants and animals in the field, to the large vertebrates whose habitat extends far beyond the planted area. To the extent that bio-energy production creates an environment that is more similar to a natural habitat than other agricultural options, it can enhance biodiversity.

Soil biodiversity will generally thrive if the above-ground cropping system itself is diverse, but will suffer under frequent tillage and excessive application of chemical inputs. Local biodiversity – of birds, insects, and other guest species – benefits from a cropping system with a high degree of inter-species and intra-species variation (including varied sizes, shapes, ages, and ecological functions). Debris such as standing and fallen dead wood and litter serve as microhabitats for insects, fungi, and epiphytes, which in turn support other animals.

Harvesting and other major agronomic activities should be timed and carried out in ways that interfere minimally with the species that share the managed area, especially during their nesting periods and other key lifecycle activities. A bio-diverse bio-energy cropping system can fill gaps in remaining fragments of natural habitat and serve as corridors between natural habitat for the benefit of migrating or wide-ranging wildlife. In turn, biodiversity in surrounding areas can also benefit bio-energy crops.

• *Carbon emissions:* Bio-energy cycles can affect carbon emissions by displacing the use of fossil fuels and by altering the quantity of carbon sequestered on land.

Energy produced from bio-energy emits much less net carbon than fossil fuel options – even when accounting for emissions from biomass production, transport, handling, and conversion. If biomass is produced in a manner that restores degraded lands, then additional greenhouse gas benefits arise from increasing the amount of carbon sequestered on the land. On the other hand, if natural forest is cleared for bio-energy feedstock production, it could take many decades of fossil fuel displacement to offset the carbon initially released from the land (Borjesson, 1996).

• *Water resources:* Biomass production can improve local water resources by reducing runoff (thereby recharging groundwater and sustaining spring-fed streams), contributing to rainwater harvesting, and addressing water-logging problems in poorly drained or flood-prone zones. On the other hand, fast-growing crops are water-hungry compared with slower-growing natural flora, and can tax water supplies. Problems of over-consumption can be exacerbated by harvesting residues, cultivating tree crops without undergrowth, and planting species that, by not generating adequate amounts or types of litter, can reduce the ability of rainfall to infiltrate soil and replenish ground water supplies.

• *Chemical loading of soil and water:* Inputs such as fertilisers and pesticides, especially broad-spectrum pesticides and herbicides, can claim a range of unintended victims. Such chemicals are likely to be used for growing perennial bio-energy feed-stocks, although to a lesser extent than for annual row crops. As farmers have gained awareness of the environmental and health impacts of agricultural chemicals, they have developed integrated pest management (IPM) practices, which rely less on chemical inputs and more on nature's species diversity, adaptability, and nutrient cycling capability.

For example, pesticide use can be reduced by using non-chemical traps, more labor-intensive methods for more efficiently applying inputs and controlling weeds, and introduction of natural predators.
Fertiliser use can be reduced by using nitrogen-fixing species and green manure, rotation of crops, intercropping, and changes in tillage practices (Thrupp, 1996).
Certain crop species can help to remove chemical contaminants, for example where there is excessive nitrogenor heavy metal pollution.
• *Preventing erosion and restoring degraded land:* Relative to healthy natural ecosystems, bio-energy feedstock systems, like most agricultural practices, may increase erosion and other forms of land degradation.
The most important single strategy for reducing adverse impacts is to recognise the fragility of marginal lands and to avoid cultivating them. Lands that are highly sloped, semi-arid, subject to forceful water flows, or already degraded are especially susceptible
to further damage. On the other hand, under certain conditions, bio-energy production can help restore such land. This requires careful management regimes that are specially tailored to local conditions. The most effective elements of such a regime are to maintain a continuous, dense cover of living plants and/or plant litter, to limit and manage water runoff, and to adopt practices such as minimum tillage agriculture that reduces disturbance to the soil. Through careful selection of the various species in a cropping system, a regime can be devised that helps accomplish site-specific objectives such as reducing salinity, reversing water-logging, discouraging browsing, adjusting alkalinity, and stabilising topsoil (Evans, 1982).
A set of locally-tailored good practice guidelines should take these above factors into account, as well as other site-specific environmental issues. Good practice environmental
guidelines will only help, however, if land is allocated to feedstock production in appropriate ways. Even if the bio-energy feedstock is produced in a seemingly responsible manner, the broader environmental consequences could be dire if local populations are pushed to more marginal or ecologically delicate lands.

4 Conclusions

One often overlooked aspect of sustainability is the ability of producers and land managers to adapt to change (Holling 2001; Hendrickson et al. 2008). Agricultural producers need to respond to rapid changes occurring in the agricultural environment by reducing risk, while retaining management flexibility. Holistic management and integrated agricultural systems are approaches by which whole-farm strategies and technologies are organized to help producers manage enterprises in a synergistic manner for greater profitability and natural resource stewardship. In the past, US agriculture was focused solely on its ability to produce sufficient food and fiber to meet national and global demands. Agriculture has been largely successful in meeting these production demands. While productivity will continue to be a major factor in food production systems, increased societal demands for environmentally sound management, use of agriculture for fuel production, the need for rural community viability, and a rapidly changing global marketplace are now shaping the evolution of more integrated and sustainable agricultural systems.
Environmentally sustainable agriculture emphasizes the need to mix complementary crops and animals in appropriate times and places, keeping the soil covered with growing crops and mulches, including crops and practices that maintain the productivity of the farm, and using detailed knowledge of ecological relationships to reduce the use of purchased inputs, such as pesticides and fertilizers, and to solve problems. Nutrient-use efficiency is a major concern when environmental sustainability is a goal. A range of solutions for improving nutrient-use efficiency exist and they range from simple to complex. Government policies, including

subsidies, farmer/rancher innovation, research and technology, and public acceptance of farming practices all combine to create these solutions.
The question now is, “What does the future have in store for agriculture?” The driving factors for the near future in agriculture have been put in place.
This leads to competition between agricultural producers and other programs for federal funds. Increased competition for limited federal funds in combination with international trade issues are likely to result in changes to farm programs.
The majority of the current population is one or more generations removed from farming. This means the public has less direct connection to issues involved in agricultural production; however, they still have a strong demand for perceived benefits from environmental stewardship. Consumers may not be well informed, but they are discerning. This will bring to the forefront such issues as product identity preservation, designer crops (i.e., biotechnological crops developed to meet specific criteria defined by the consumer), improved quality (especially in relation to health issues), organic production (reduced use of chemical pesticides and fertilizers), and further industrialization of food. These demands for environmental stewardship and food quality characteristics are likely to shape future agricultural policy and to be reflected in the marketplace.
Concurrently, producers are looking for additional economic opportunities and are becoming more market astute. This may cause a movement away from standard agricultural products to include such items as biomass for renewable energy production, long perennial phases in cropping systems, use of crop residue for animal feed, and recycling animal manure to meet N demands. This could result in an increase in multiple farm enterprises within a single farm operation, development of other forms of income-generating operations (i.e., hunting, fishing, site-seeing, etc.), and flexibility to generate an alternative array of products. Thus, changes in agriculture and public demand will benefit grazing and integrated crop-livestock operations, in addition to other aspects of sustainable agriculture, by providing an environmentally sustainable agriculture that provides multiple income streams to the producer, while providing socially acceptable land management.
Some of the unmet demand for energy services in rural areas of developing countries comes from potential customers who are unserved by a market in energy services even though they have sufficient resources to pay for energy services. With adequate institutional support, a market in bio-energy services can grow that will enable the private sector to meet this demand. However, some of the unmet demand comes from rural residents who do not have sufficient resources to pay for energy services even if there were an active market. Extending energy services to this population will require public sector support and involvement, either directly or through incentives to the private sector. If rural energy services are entrusted to private sector actors responding to market forces *alone*, then financial, capital, and entrepreneurial resources might be commandeered by relatively elite customers, diverting these scarce resources from community-based initiatives.
Policies can help correct this bias. For example, rural energy concessions could be granted to private enterprises only under the condition that they serve even the poorest households (Reddy, 1999). The current trend toward free market economics and non-interventionist government undoubtedly makes it more challenging to enact strong policies.
But an unequivocal social commitment to universal access to energy services is unquestionably warranted, as providing energy services to the rural poor is fundamental to promoting sustainable development.

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Abstract

The agro-food sector is receiving a great deal of attention for topics of general interest as the food quality, security and safety, alternative uses of crops in food/feed/fuel, growing concern for Green House Gas emission, Life Cycle Assessment, energy consumption.
The European Union has an active rural development policy because this helps us to achieve valuable goals for our countryside and for the people who live and work there.
The central goal of the European Commission`s food safety policy is to ensure a high level of protection of human health and consumers` interests in relation to food, taking into account diversity, including traditional products, while ensuring the effective functioning of the internal market. The increase in the world population and the change in eating habits will mean that the demand for agricultural products will increase by 50% between now and 2030 and by 70% by 2050.
Europe must accept its share of responsibility at international level by maintaining its capacity to produce quality products in sufficient quantities while at the same time respecting very high health standards and encouraging sustainable production practices in order to not harm the environment.
Agriculture is the economic motor in the majority of rural areas and the basis of the European food chain. In total, the agro-food sector employs 17.5 million people (13.5% of them in industrial jobs). It is essential to ensure that jobs in agriculture remain sufficiently attractive, in particular to provide for a minimum level of generation renewal. Agricultural incomes represent only 40% of the average European income.
Many of our rural areas face significant challenges. Some of our farming and forestry businesses still need to build their competitiveness.
Energy is a global business. Growing population and rising standards of living could push global energy demand up by 40% by 2030. One of the most important sources of renewable energy is the biomass. Heat and light produced by burning the biomass energy is not the only way of using Biomass energy. It can be converted into many more convertible forms of energy such as: methane gas, ethanol and diesel. Diesel, which is one of the major transportation fuels, is also obtained from remnants of food which are generally thrown away consisting of animal fats and vegetable oils.
The role of vegetable oils is increasing and it’s became very important today. Because of the multifunctional character, the farms produce meat, milk, grains, biomass and often combine these activities with the rural tourism or manufacture of traditional products. An effective tool for solving problems facing the rural economy is the transnational network of rural solidarity.
Agriculture is the supplier for food, feed and renewable energy from biomass industries, facts who’s leading to the need to support research in the field and to create fair policies able to ensure competitiveness of the European agriculture on the international market, thereby ensuring the premise for a sustainable agriculture development.