*International Conference on Conservation and Sustainable Use of Wild Plant Diversity –CSUWPD-2010*
*Orthodox Academy of Crete, 4-8 May, 2010*


# SESSION TOPIC: ECO-THEOLOGY AND PLANT ETHICS BIOFUELS: WILD PLANTS AMONG THE WHEAT

**Ms. Linda E. Vogt Turner**

Graduate Liberal Studies Program,
Simon Fraser University (SFU)
Vancouver, British Columbia, Canada V6B 5K3
Email: levogt@sfu.ca

**Abstract**. *It sometimes seems as if we see energy options in stark terms of good and evil. For decades, environmentally aware people have portrayed nuclear power and fossil fuels as bad options that need to be replaced by the good option of renewable energy. But now, as humanity finally develops renewable sources of energy, we witness the re-emergence of this good and evil dichotomy as each renewable option is pursued with greater vigor. Thus, one increasingly hears that the development of energy from biomass, called biofuels, is an inherently bad thing to do. This will lead to higher food prices and a greater risk of starvation among the planet's very poor. It will lead to a loss of natural ecosystems and plant diversity with the development of monoculture biofuel plantations. But is this perception fair? Or is this a product of a desire to see the world in simple terms of good and evil? The purpose of this paper is to explore the potential benefits and risks of biofuels as an energy option for humanity, with a careful nuanced look at the complexity of energy options and their impacts. Part of this involves the development of a richer understanding of energy options and their desirable and undesirable attributes to develop them and minimize the risks associated with them. To serve this end, this paper focuses on second generation biofuels and uses* ***the Parable of Weeds among the Wheat*** *as an analogy to move beyond a dualistic world view analysis.*

**Keywords:** Biofuels, Eco-Theology, Plant Ethics, Renewable Energy, Sustainability.

## INTRODUCTION

It sometimes seems as if we see energy options in stark terms of good and evil. For decades, environmentally aware people have portrayed nuclear power and fossil fuels as bad options that need to be replaced by the good option of renewable energy. But now, as humanity finally develops renewable sources of energy, we witness the re-emergence of this good and evil dichotomy as each renewable option is pursued with greater vigor. Thus, we increasingly hear that the development of energy from biomass, called biofuels, is an inherently bad practice, causing higher food prices and a greater risk of starvation among the planet's very poor. It will lead to a loss of natural ecosystems and plant diversity with the development of monoculture biofuel plantations. [1] But is this perception fair? Or is this again a product of a desire to see the world in stark terms of good and evil? The purpose of this paper is to explore the potential benefits and risks of biofuels as energy options for humanity with a careful nuanced look at the complexity of energy options and their impacts. To serve this end, this paper focuses on second generation biofuels and uses the *Parable of Weeds among the Wheat* [2] as an analogy to illustrate the need for humanity to listen for subtleties and challenge the assumptions and desires that see the world in stark terms of good and evil. This paper begins with an examination of the first generation biofuels in light of the myopic good or evil debate and continues with an expanded presentation of the *Parable of Weeds among the Wheat*. [2] Following is a discussion of our present energy system, our need for alternative energy in an integrated system, and the hope for biofuels. Finally this paper examines second generation biofuels, research advances and the parable of the weeds more closely to demonstrate how Christianity and science are not mutually exclusive and can help people break free from a tyranny of their assumptions about and desires for simple black and white solutions. In the process people will gain a richer understanding, and mobilize and motivate humanity to throw themselves and everything they have into the creation of a global sustainable energy system—that includes biofuels among an array of diverse options.

## 1 THE GOOD BAD DEBATE

People can have strong views about biofuels, seeing them as either an eco-friendly saviour or a big scammer contributing to global warming. [3] Proponents of biofuels tout them as non-polluting, sustainable, reliable, and locally attainable fuels [4] that can save our manufacturing lifestyle and lead to a new industrial era. [5] Opponents claim that renewable fuels and the eco-hype promoting them are a scam [6] and a scourge, diminishing grain supplies, and inflating food prices. [3] They see biofuels as a plague, a scourge designed to wipe humanity out by adding to the human carbon footprint and contributing to global warming through the

destruction of forests, such as the Amazon that store large amounts of carbon, as poor peasants rush to sow these new crops that store far less amounts of carbon and plant false hopes for a sustainable future. [6]

Up until 2008, little heed was paid to biofuel critics. But by the spring of 2008, biofuels were no longer touted as humanity's saviour. By summer, as wheat, corn, and rice prices soared and the news of food riots in poor nations fuelled and drove public debates, biofuels became the big scam and the false saviour that was making monoculture plantation farmers and investors rich while hindering efforts to reduce climate change and its impacts on the Earth's most vulnerable, the poor. [3]

Countering the claim that biofuels are carbon negative and bad for the environment, Peter Kendell, the president of Great Britain's National Farmers Union, claimed that the extra wheat yield of a fertilized crop yields six times more energy than that used to produce it. Further to this Kendall confidently reported that farmers could produce enough biofuel to meet the government's greenhouse gas reduction emission targets for 2010 and added that a certification scheme ensuring Britain did not import carbon negative biofuels would reduce the risk to rainforests. [7]

While many critics have quickly pointed the finger of blame at biofuels for increased food prices, people have started to look at nature and human economy as an integrated system [1] and question the prevailing assumption that the introduction of biofuel crops into our agricultural system has caused grain shortages and soaring food prices. [3]

## 2 THE WEEDS AMONG THE WHEAT

The parable of the weeds among the wheat provides a classic example of the human desire for a sustainable agricultural system and the hope for an ever abundant wheat harvest and how a wild plant assumed to have been planted by the Devil—the enemy of the Master—causes the Master's farming slaves to question their Master.

> The kingdom of heaven may be compared to someone who sowed good seed in his field; but while everybody was asleep, an enemy came and sowed weeds among the wheat, and then went away. So when the plants came up and bore grain, then the weeds appeared as well. And the slaves of the householder came and said to him, 'Master, did you not sow good seed in your field? Where, then, did these weeds come from?' He answered, 'An enemy has done this.' The slaves said to him, 'Then do you want us to go and gather them?' But he replied, 'No for in gathering the weeds you would uproot the wheat along with them. Let both of them grow together until the harvest; and at harvest time I will tell the reapers, Collect the weeds first and bind them in bundles to be burned, but gather the wheat into my barn.' [8]

In explaining this parable to the disciples, Jesus identified the weeds as the children of the evil one, and the enemy who planted them as the Devil. Why would Jesus identify weeds, wild plants in such a way?

Christians often claim that Jesus used the *Parable of Weeds among the Wheat* to illustrate how people need to repent of their heretical and desirous ways so that when they die they can be judged obedient and worthy to enter the Father's Kingdom. For many that may be the simple truth. However, Jesus challenges all the disciples gathered together pressing in closely to listen, to listen carefully. [9]

> Explain to us the parable of the weeds of the field." [Jesus] answered, "The one who sows the good seed is the Son of Man; the field is the world, and the good seed are the children of the kingdom; the weeds are the children of the evil one, and the enemy who sowed them is the devil; the harvest is the end of the age, and the reapers are angels. Just as the weeds are collected and burned up with fire, so will it be at the end of the age. The Son of Man will send his angels, and they will collect out of his kingdom all causes of sin [stumbling blocks] and all evildoers, and they will throw them into the furnace of fire, where there will be weeping and gnashing of teeth. Then the righteous will shine like the sun in the kingdom of their Father. Let anyone with ears listen! [9]

Did your ears pick up on the words fire and furnace? Did you hear how the angels collect the causes of sin, the stumbling blocks, as well as the evildoers? Because if you did, then you will have heard how the angels throw what they have collected into a fiery furnace and those who have ears to hear with will shine like the sun.

The other key words in this allegoric explanation are the "harvest," the "end of the age," and the Devil. The Devil is the enemy of the Master who keeps slaves. The end of the age is the harvest, the time when the plants mature. In this case the end of the age is when the disciples, those who hear the message, mature. When the disciples mature—the Son of Man will sit down with them and direct the harvesters to collect and use all the resources collected. Everybody will benefit and mature people not fooled or led astray—by the Devil—the Father of Eros who ignites human desire—will gather in the harvest and everyone will shine like the sun. The

harvesters will not just bring wheat into the barns of the world. They will gather weeds. Then there will be weeping and gnashing of teeth over the fire –soaring fuel prices, food shortages, and foreign competition—and then the harvesters will get on with the task at hand. They will produce a fiery furnace, a more efficient energy system, to make the commodities of life. In the process something extraordinary will happen. The people will become righteous and they will shine like the sun. In the process of throwing themselves and everybody and everything they have into the creation of an efficient sustainable energy system, humanity will undergo a transformation and emerge as righteous. Transformed they will distribute rays like the sun—electricity and its benefits to all. When humanity comes of age, humanity will do the will of the Creator—shine like the sun—and humanity will no longer be a slave in the Master's house.

The Parable of the Weeds illustrates that the Master and the Devil, like Christians and Scientists are not mutually exclusive. They can work together to help people break free from the tyranny of assumptions about and desires for simple either-or solutions and choices. Assuming the Devil is the bad crop choice and the Master is the good crop choice or vice versa keeps the master slave and the good bad cycle going and imposes an either-or moral choice on their supporters showing loyalty or a preference for either one. People not fooled by assumption or led astray by the desire for simple quick fix solutions can break free from this cycle. They can shine like the sun. Christians and Scientists can mobilize political action groups to weep and gnash their teeth with fiery resolve over food and energy issues. Glowing like angels, these groups working together can motivate humanity to commit to work for and towards the creation of a global energy system—a fiery furnace of hope—so all can be free to shine like the sun.

Religious and secular teachers, scientists, and indigenous prophets, philosophers and poets who love the earth need our respect. We need to listen to them and we need to listen with our ears tuned to listen for their prejudice and ours. Teachers often use debates to simplify the issues and expect their students to be capable of arguing both sides. The objective is to prepare students to defend and criticize new invasive ideas that threaten well cultivated old ones. Poets, teachers, and storytellers often use fiction, and figurative truths like the parable above to embellish the truth. Technically, they tell lies or exaggerations to push people into hearing and accepting a more complex version of the truth. In doing so, they push us into a refining fire of discovery beyond a good bad analysis of nature and the human economy, they show us an integrated system, and challenge all our assumptions [1] so that we will have the political resolve to challenge the laws, policies, and practices of our governments, and ethical institutions when they are failing and no longer sustainable. [10]

## 3 OUR PRESENT ENERGY SYSTEM

Our present global energy system is not sustainable and it is linked to our economic, agricultural, and political systems. [1, 3, 10] We cannot shine like the sun while our need for sustainable fuel sources and our international accords cause the world's most vulnerable inhabitants to remain in poverty. [10] The late, former President of the Philippines, Corazon Aquino, in her inaugural address said: "Faith is not simply patience which suffers passively until the storm is past. Rather, it is a spirit which bears things—with resignation, yes, but above all with blazing, serene hope." Blazing hope is active and compelling. It causes people to weep, to gnash their teeth and to motivate others to sustain the dream and the burning desire for a just sustainable system, to face the truth, and find a way to actively replace and renounce the tyranny of selfish assumptions and immature desires closely interwoven with our unsustainable, failing systems.

In the World Policy Journal Spring 2008 Edition, Susan Hunt speaks to a recent report published by the International Energy Agency, admitting that biofuels have contributed to recent price increases in food crops, qualifying other factors, such as droughts and the increased demand for "meat and milk products in Asia [as playing] a significantly larger role." [11] Hunt, building on her theme that biofuels are neither a saviour nor a scam, points out that soaring fossil fuel prices, not the high prices of biofuels, have caused higher diesel prices and fertilizer costs for farmers, pushing up food prices. She also reminds her audience, that farmers use 40% of the grain crops they grow to feed their livestock. To this she adds, that the recent demand for meat and dairy in Asia combined with the diminishing of world food stocks caused by droughts in corn and wheat producing countries have also contributed to food price increases, far more than the demand for grain used in the production of biofuels. [11] For Hunt, "The most egregious scam on the American people is not biofuels. Rather, it is the myopic debate that distracts from the larger issues at hand." She urges her audience to see and hear the bigger picture and recognize that our present day agricultural, energy, transport, and economic systems are failing. Recognizing this failing is not the end of all things. Hunt concludes. "Human innovation, forward thinking legislation, and collective action will be our saviors, not the fuel flavor of the day." [12]

## 4 WE NEED ALTERNATIVE ENERGIES

Biofuels are only one energy alternative. For a global sustainable energy system, we need a diverse system. [1] [13] Other energy alternatives such as solar, wind, hydro electricity, nuclear, and energy efficiency should be

included and considered according to regional environmental assessments of risks and benefits that include the impacts to natural economy and human economy that is part of nature. [1, 13] No energy is perfect. Each alternate energy source impacts the environment and makes demands on the economy and the land. The materials and rare minerals used for solar panels are costly to mine and produce, and the panels themselves need open space free from shade. [1, 14] Windmills can be unsightly and interrupt bird migration; nuclear energy requires uranium and creates hazardous wastes; and even energy efficiency has a downside. People need energy before they can use it efficiently, [14] and the replacement of old inefficient energy consuming products and systems, causes more garbage.

Concern about land use and rising food prices has affected the way people feel about biofuels and the heightened awareness of climate change and its impacts plays a significant role in the policies and the research and development of the emerging biofuels industry. Statistics gathered in 2008, held agriculture responsible for 14% of global greenhouse gas emissions and deforestation to clear land for agriculture for another 17% [12] showing that biofuels do not directly cause greenhouse gas emissions. [12] Currently, according to Transport Canada, 30% of Canada's total energy use is in the transportation sector and transport fuels account for 25% of all greenhouse gas emissions. [15] In North America another 35% of all greenhouse gas emissions come from the buildings and the industry that supports them. [16] Totaling these percentages of green house gas emissions, challenges the popular assumption that the manufacturing industry is the biggest polluter. Adding up 14% + 17% + 25% + 35% totals 91 %. This means that 91% of greenhouse gas emissions come from agriculture, deforestation, transportation, and the building industry—and biofuels are insignificant in the equation.

As long as the good versus bad debate over biofuels floods our ears, people fail to hear the prejudices and subtle nuances that link biofuels to other issues such as land use, food prices, transportation costs, dietary preferences, weather, and access to energy sources. [11] As Hunt and others [12, 1, 13, 14] point out, biofuels present risks and opportunities and we need to consider them as an alternative fuel. Globally, approximately 1.6 billion human beings lack access to electricity and approximately 2.4 billion still rely on inefficient traditional ways of burning biomass sources. [17] Humanity needs access to and control of clean energy options [1] in order to illuminate their lives and shine like the sun. [9]

## 5 THE BURNING HOPE: REDUCING AND REVERSING CLIMATE CHANGE

The hope for biofuels, especially second generation biofuels, is that they will diversify humanity's energy options and reduce the need for fossil fuels and the traditional burning of biomass. With the awareness of climate change and the desire for healthy sustainable alternatives to fossil fuels, people and nations are turning to the burning of biofuels as a sustainable option. [1] Since the discovery of the first burning bush, biomass has been the traditional energy source, thinking wood and plant stock was renewable and plentiful. As populations have increased, burning wood for fuel has caused deforestation and desertification. In addition, the burning of straw or other combustible biomass material in open fires has seriously affected human health and air quality. Now that developing nations have invented more efficient furnaces and technologies using fossil fuels, the overall quality of health and life expectancy for humans has improved considerably. [18] Today, biomass can be burned in efficient furnaces and converted to liquid fuel that can in turn be used to generate electricity. For example, one innovative company in Renfrew Ontario Canada, Envergent Technologies, converts biomass into pyrolysis oil in an almost carbon neutral process. [19] This oil can then be used to power generators or to supplement transport gasoline as a drop-in replacement fuel without any engine alteration. Envergent plans to have the capacity to produce 100 million gallons a year by 2011 and be completely ready to market their biomass gasoline by 2012. [19-20]

As promising as this biomass gasoline is, it has drawn criticism because although pryrolysis production is almost carbon neutral, it is not neutral. The external production produces some carbon and capacities of companies near to production readiness cannot produce enough to replace gasoline consumption entirely. [21] Further to this concern, pyrolysis oil and other biofuels can only offset $CO_2$ emissions from fossil fuels and with the predicted doubling of energy needs by 2050, [10] energy consumers need to find a way to lower $CO_2$ emissions in the atmosphere to reverse climate change. [21]

On the other hand, researchers think they might have found away to lower $CO_2$ in the atmosphere through the production of pyrolysis bioenergy. Although at the moment it is cheaper to produce pyrolysis at high temperatures, a major by-product of low-temperature pyrolysis production is biochar. Applied to the soil, biochar seems to improve the nutrient content and the physical and biological make-up of the soil. Preliminary research suggests that the application of biochar to the soil reduces the soil's nitrous oxide ($N_2O$) by 50% and completely suppresses methane ($CH_4$) emissions. If further research supports these preliminary findings, pyrolysis bioenergy combined with biochar application to the soil presents an energy strategy that benefits the environment *and* reduces greenhouse gas emissions. [21]

The practical wisdom of the world's environmental policy makers suggests that the only way to stop global warming is to convince governments and their citizens that they must slash their reliance on a finite supply of

$CO_2$ emitting fossil fuels. [10] Developed nations want to break their dependency on fossil fuels for a number of reasons. Oil rich nations and conflicts abroad control the flow of oil, and local refineries want the ability to meet domestic demands in the event of a natural disaster or terrorist attack. [17] At the same time concerned policy makers point out, rich nations have an obligation to the poor. [10, 17] Right now fossil fuels are efficient and cheap. In order to make drastic cuts in $CO_2$ emissions by limiting reliance on fossil fuels, developing nations such as China and India would need to slash their domestic economic growth and condemn hundreds of millions of people to poverty. [10] In order to achieve the goal of keeping global temperature rises below two degrees Celsius and to keep nations from relying on fossil fuels, environmental policy makers and governments would have to impose global carbon cuts and taxes that would cost the world $40 trillion a year in taxes and lost revenue, a price even the wealthiest of nations cannot afford. [10]

To reduce and reverse climate change, nations need to develop affordable alternatives to coal and oil and some experts are now suggesting that governments set aside a 0.2% global tax on gross domestic product—approximately $100 billion a year – for green-energy research and development. This they argue would be cheaper than trying to cut carbon emissions and predict that this tax would reduce global warming far more quickly as bioenergy development becomes more profitable and sustainable. [10] Although, presently biofuels and other green alternative energy sources are incapable of assuming a large portion of the fossil fuel load, research is making advances producing a second generation of biofuels and with more research, comes more hope. [22]

## 6 SECOND GENERATION BIOFUELS

With the research and development of second generation biofuels such as biobutanol, synthetic diesel, and other biofuel products derived from switchgrass, garbage, and algae, comes the hope and expectation to increase alternative fuel production, lower greenhouse gas emissions, and make improvements to the environment. [22]

Switchgrass is a native prairie grass that can produce cellulosic ethanol. Farmers can get 500% more renewable energy from its conversion in comparison to the energy the farmers expend in growing and producing it. [23] According to the David Suzuki Foundation, results of life-cycle analysis using all the production and management information from 10 different farms in the Midwestern United States, published recently in the National Academy of Science journal proceedings, demonstrates that greenhouse gas emissions from cellulosic ethanol used on the farms were 94% lower than if the farmers had used energy that had come from a petroleum fuel. Another benefit and another reason researchers are excited about this demonstration is that switchgrass grows on marginal land. This means that farmers can maintain switchgrass crops using fewer chemicals, rotating them with wheat fields—making it less likely that growing large crops of switchgrass would compete with land already set aside for food production. [23]

Garbage incineration can produce biogas to generate electrical power. In February 2008 a company called the Plasco Energy Group opened a 27 million dollar demonstration plant in Ottawa. "For every tonne of trash brought into the plant" it can produce biogases to generate "about 1,400 kilowatt hours of power—enough electricity to supply an average [Canadian] home with power for almost two months." [24] Plasco Energy CEO Rod Bryden said Plasco can build a plant in Vancouver or anywhere in 18 months capable of processing 500 tonnes of garbage a day, approximately one sixth of Metro Vancouver's current garbage loads. Taking a risk, CEO Bryden proposed that Vancouver provide Plasco with the land and Plasco in return would finance the building of the plant. Plasco then promised to deliver clean energy for two years by processing the waste environmentally, without violating set pollution standards. Should Plasco fail, Plasco promised to remove their site at no cost to Metro Vancouver and restore the land to its previous state. Should Plasco deliver on their promises, Metro Vancouver would have to commit to a 20 year contract paying Plasco a pre-negotiated price per-tonne fee for garbage disposal. As of September 2009, Metro Vancouver was too uncertain of the cost implications involved with Plasco's deal and was considering a cheaper landfill strategy. [25]

Raw algae produce oil and when refined this oil can replace biodiesel and jet fuel. An algae farm can be located in a variety of places and does not compete with food production because it can use sea water and gobble up pollutants from sewage and power generating plants. [26] Raw algae use photosynthesis to transform $CO_2$ and sunlight into energy and as they perform this natural function they produce oil. [26] However, a 2007 press release stated that algae fuel was not cost efficient enough and that to achieve better cost efficiency, the cost of production needed to drop dramatically from USD $20 a gallon to USD $2 a gallon. [26] Challenging that assumption, a recent study conducted at the University of Malaya in Malaysia published in 2008, insists that algae oil is already more economical than diesel. [27]This same study demonstrates that microalgae use sunlight to produce oils much more efficiently than crop plants and productivity of many microalgae greatly exceeds the oil productivity of the best producing oil crops. [27]

Algae biofuel research estimates that to replace 5% of the world's diesel consumption with algae oil grown in ponds will require 2.5 million acres of land. [28] Biofuel proponents are not daunted by this fact and are challenging this estimate. *Solix Biofuels* estimates that it can replace US diesel fuel consumptions, at present

levels, by growing and harvesting algae on 1 half of 1% of the US's productive agricultural land. [29] Other proponents point out how algae can grow using saline water on desert land unsuitable for vegetation and how algae can grow on municipal and industrial waste water on existing land set aside for waste management. [30, 31] They claim Algae can also be grown vertically in reusable, recyclable plastic bags maximizing the amount of land and sunlight required while minimizing the risk of invasion or escape. [31]

## 7 FURTHER BIOFUEL ADVANCES

The biofuel industry is making research advances within the biocrop industry to overcome the land use criticism and to minimize environmental risks associated with the growing of wild plants such as camelina, and jatropha for biodiesel jet fuel.

Camelina is primarily known in North America as false flax and classified as a weed species. [32] Commercial airlines are testing jet fuels derived from wild plants such as camelina. [33] Currently, camelina is not grown for food although it could be because it is rich in omega 3, and it would make a much healthier sandwich spread than corn oil. [32] In addition, farmers can plant camelina in wheat fields in years when the fields would normally be fallow, enhancing the soil. [32-33] Farmers are being recruited by the company Targeted Growth to grow camelina. By the end of 2010, Target Growth plans to have production up past 50 million gallons of jet fuel per year. The whole aviation industry hopes to produce 100s of millions of gallons of camelina fuel a year by 2014. This sounds impressive, and is a significant amount. However, the global aviation industry burns nearly 270 million gallons of jet fuel a day. So other biofuel sources have to be recruited.

Jatropha is a tall poisonous shrub that grows on marginal land not suitable for food crops and the aviation industry has been experimenting with it to increase its biodiesel production and to insure that the demand and the price of camelina does not compete with wheat prices or land needs. [32]

Overcoming the land use criticism cost effectively and minimizing environmental risks are significant challenges confronting the biofuel industry. 93% of the world's airlines hope to supplement at least 10% of all aviation fuel with sustainable plant sources by 2017. [33] This has some biologists worried because the growing of wild plants and algae as biofuel feedstocks more efficiently has put the pressure on scientists to genetically modify feedstocks and to use synthetic biology and bacteria such as e coli to speed up the chemical breakdown process. Critics fear that these "genetically engineered organisms could cause havoc as bioweapons or become invasive species" that threaten the diversity of native habitats. [34, 28] Wild plants such as camelina, jatropha, switchgrass, mythcanthus and Eurasian giant reed are being selected, bred, and genetically engineered to enhance the very traits that typify invasive weeds and "the most promising biofuel crops are non-native to the regions proposing cultivation, compounding the potential risk of future invasions." [35]

According to some plant scientists the risks that these weedy biofuel crops pose to the environment are too great. [36] One Australian study recommends against the introduction of jatropha and other plants that have reputations as weeds. It claims that the risks of introducing and cultivating weeds are just too great as colonial history bears witness to the non-native plants introduced by colonial settlers that are now threatening the diversity of native ecosystems. [34]

Other plant scientists disagree. They claim that the benefits are too great to prevent widespread introduction of non-native species as biofuel crops. Thus they recommend that non-native species be introduced in an environmentally sustainable manner that minimizes the risks associated with invasive plants through risk assessments based upon area specific pre-introduction and screening trials, taking into account that cultivation for production could put other habitats at risk through the unintended transportation of seeds and cuttings. [35]

Going beyond a good bad analysis of the risks and benefits of the use of wild plants, it is important to remember that big monoculture farming interests often conflict with small-scale farming interests that are often quite diverse. For example: In Asia and Africa, homeowners, especially women and small-scale farmers plant poisonous jatropha bushes as fences to keep goats and cattle away from their fruit, vegetable and flower plots and it is women primarily who collect the seeds to sell or to make candle wax and organic manure cakes for their gardens by expressing the oil by hand with a ram press. 90kg of seeds yield between 15 and 18 litres of fuel that homeowners can use with little or no cost. [37]

## 8 CHALLENGING OUR ASSUMPTIONS

Coming back to the analogy drawn from the Parable of the Weeds among the Wheat that illustrates how the good/bad debate can lead people astray and cause them to make false assumptions. A closer look at the 'weed' in the parable is instructive. It seems that the weeds sewn may have been darnel. Darnel closely resembles wheat and the well-known Christian commentary of William Barclay points out that the ancient Jews called these weeds (more traditionally known as tares) "bastard wheat," and that there is a popular Hebrew story associated with this plant. [38 ] The 1975 Barclay commentary summarizes the story as follows:

> The Hebrew for tares is *zunim*, whence come the Greek *zizanion*; *zunim* is said to be connected to the word *zanah*, which means to *commit fornication*; and the popular story is that the tares took their origin [root] in the time of wickedness which preceded the flood, for at that time the whole creation, [humans], animals and plants, all went astray, and committed fornication and brought forth contrary to nature. In the early stages the wheat and the tares so closely resembled each other that the popular idea was that the tares were a kind of wheat which had gone wrong.

The commentary [38] then expands upon the Hebrew story as follows:

> The wheat and the tares could not be safely separated when both were growing, but in the end they had to be separated, because the grain of the bearded darnel is slightly poisonous. It causes dizziness and sickness and is narcotic in its effects, and even a small amount has a bitter and unpleasant taste... "Women have to be hired to pick the darnel grain out of the seed which is to be milled."
>
> The picture of a [person] deliberately sowing darnel in someone else's field is by no means only imagination. That was actually sometimes done. To this day in India one of the direst threats which a [person] can make to [their] enemy is "I will sow bad seed in your field."

As Barcaly points out, with the introduction of darnel into the wheat field came a popular story of how a wild plant came to be seen as an intoxicating and bitter threat to the food supply. [38] The story of how the *Bastard Wheat* came to be planted is fiction. The origin story of the *Bastard Wheat* is not a scholarly assertion based on carefully researched scientific fact. Nor is the Bible story of *Noah's flood* alluded to in the origin story of the *Bastard Wheat*. Yet, the *Bastard Wheat* story as part of an oral tradition works with the written tradition to provide a richer understanding of the historical socio-economic world of the Hebrew people. [38]

Like the *Bastard Wheat* story, the *Parable of Weeds among the Wheat* illustrates the tension between the written and the oral traditions as well as the dualism of a legally recognized plant crop and an illegal wild plant crop assumed to be an enemy plant, a weed. And yet even though darnel like jatropha was poisonous and a false or bastard plant like camelina, women marginalized in patriarchal societies without a legitimate husband, benefitted from its planting. Harvesters hired and brought women into the labour force as a result of its planting so that all could share the benefits of the harvest such as access to fuel sources, refineries, and illumination. Harvesters collected and considered the legal and illegal as an integrated whole, like the biblical exegetes collected and considered scholarly and unscholarly sources. The parable of Weeds illustrates how the Master and the Devil and the authorized tradition and the oral traditions work together to mobilize and motivate people working as a community to challenge the tyranny of assumption and desire so all may share creation's energy—may shine like the sun.

If we challenge the assumptions of authorities who respond to weeds as the enemy, we can be surprised. Science has challenged the age old biblical assumption that darnel is poisonous and has discovered that it is a fungus that infects darnel and makes darnel poisonous, not the darnel itself. Scientists have also learned that the infected darnel plants keep themselves and other plants growing near them from being consumed by herbivores, crop eating pests, protecting the harvest. [39] Research studies have also discovered that darnel (lolium temulentum) can be used as a model plant to help plant scientists genetically modify grass crops to compost them faster and thereby help with the economics of the biofuel industry. [40] Another surprise arising from popular practice reveals that anglers have long realized that darnel seeds, commonly referred to as tares, can be cooked and used as bait for catching fish, supplementing the diet of agricultural families with fish. [41] These surprises show how the use of a wild plant can contribute to sustainable diversity and why wild plants should not be defined as good or bad.

Other assumptions that should be challenged arise with policy making. Policy makers need to consider the goals and needs of the small-scale agribusinesses and those of the monoculture plantations as an integrated whole and resist the temptation to assume that the needs of all growers are the same. Likewise, some nations and their communities want control over their food sources and their energy. [3] Others may not and others may not have the capability. Similarly, people in rural communities have different preferences than urban communities. For instance, rural communities like the traditional idea of collecting biomass and burning it as fuel and so technology has found a way to build small portable on-sight ethanol producing systems that allow small-scale agribusinesses to collect and bundle left over chaff, straw, grass and wood from their operations and grind it on-sight to produce burnable pellets in small stoves that capture the gases emitted to produce ethanol. These small on-sight systems are becoming cost efficient and are capable of producing enough ethanol for the owners own use with the potential to sell or trade left over pellets to neighbours. [42] Of course one side problem could be an

increase in homemade liquor and laws governing the production of grain alcohol will need to be rethought in order to facilitate and promote these small-scale agribusinesses. [42]

The need to rethink and challenge outdated energy policies is imperative especially in view of differing and changing energy needs globally and the emerging global biorefinery industry. [5] The United States hopes to produce 1.3 billion tons of biofuels, bioenergy and biomaterials annually by 2030 and replace over 30% of their transportation fuels with domestic biofuels produced through an integrated, nationwide industry without cutting back on its present export obligations. [5, 43] As other nations adopt similar hopeful goals, societal policies and sustainable land use practices will need to change and old assumptions about wild plants and their management will need to be rethought, globally and locally.

While rethinking and considering humanity's energy needs, policy makers must not ignore human economy. Humans want comfort. They want comfortable living and recreational spaces and comfortable temperatures inside and outside. They want round the clock electric lights, stoves, refrigerators, fireplaces, television sets, swimming pools, Jacuzzis and patio heaters. People need access to fast convenient transportation to take care of their economic and domestic needs and have a strong desire to acquire and trade useful tools, resources and luxury items to keep or give away as gifts. The acquisition and disposal of these items gives them economic security and pleasure. It also requires energy. Finally, we need to understand what motivates people if we hope to mobilize them and get them working and re-thinking old assumptions and ways to produce and maintain a sustainable energy system [1] that will empower humanity to shine like the sun. [9]

An important assumption to consider as developed nations wean themselves off fossil fuel and support community projects working to achieve a sustainable energy system. Not all countries or regions will be economically capable of weaning themselves off fossil fuel or accepting new innovative ideas. [10] Nor do developed nations need to think of first generation biofuels or fossil fuels and our dependency on them as the enemy. [1] Some first generation biofuels can help sustain rural economies and the technology exists to help them. The technology also exists to separate carbon from fossil fuels. [44] Carbon storage and sequestering have also drawn heavy criticism and researchers are thinking of ways to address this. [44] However, in the future our cars, our homes, and places of work will be much more energy efficient and depend upon electricity more so than petroleum based products. [18] Other alternatives such as wind, solar energy and hydrogen fuels will also be included in the global sustainable energy system. [18] Every day, human innovation challenging old assumptions, thinks of new ways to do things.

## 9 CONCLUSION

Working together and challenging the tyranny and divisiveness of foolish assumptions and immature desires, Science and Christianity can mobilize and motivate the whole diverse human population into a global community for the purpose of creating and maintaining an integrated sustainable energy system—that includes biofuels among an array of diverse energy options, including fossil fuels. The biofuel industry is making research advances within the bioenergy and biorefinery industries to provide secure locally attainable fuel alternatives, while striving to overcome the land use and food price criticism and to minimize environmental risks associated with the growing of biocrops.

Christianity's *Parable of the Weeds among the Wheat*, understood in the context of the good and evil dichotomy that has re-emerged with advances in the biorefinery industry, is ethically instructive and morally compelling. In this context, the *Parable of Weeds among the Wheat* reveals and resolves the tension between science and faith, between the scholarly and the unscholarly. Moreover, this parable enriches our understanding of cultural preferences and demonstrates how every person, every plant, and every cause and effect are interconnected and need to be considered in relation to realizing the goal, the everlasting hope for energy and the joy of clean air, fresh water and sustainable soils refreshing one and all daily.

To mobilize and motivate humanity with the vision and goal to shine like the sun, leaders in the Science and Christian communities need to communicate this vision to members. They must also push their members into a refining fire of discovery beyond a good bad analysis of nature and human economy, to help them realize the integrity and worth of an integrated system, and hone their members' discernment skills to better equip them to listen and challenge cultural assumptions, laws, policies, and practices of governments, and ethical institutions.

## 10 REFERENCES

[1] M.K. Jaccard, Sustainable Fossil Fuels, the Unusual Suspect in the Quest for Clean and Enduring Energy, New York, N.Y.: Cambridge University Press, 2005, pp. 1-28.

[2] "The Gospel According to Matthew," The Holy Bible containing the Old and New Testaments, Revised Standard Version ed., Nashville, Tenn.: Thomas Nelson Publishers, 1990, 13: 24-30, 13: 36-43.

[3] S. Hunt, "Biofuels, neither saviour, nor scam," World Policy Journal, vol. 25, no. 1, pp. 9-17, 2008.

[4] A. Demirbas, "Biofuels sources, biofuel policy, biofuel economy and global biofuel projections," Energy Conversion and Management, vol. 49, no. 8, pp. 2106-16, 2008.
[5] A. J. Ragauskas, C. K. Williams, B.H. Davison, et al., "The path forward for biofuels and biomaterials," Science, vol. 311, no. 5760, pp. 484, 2006.
[6] M. Grunwald, "The clean energy scam, (Cover story)," Time Magazine, vol. 171, no. 14, pp. 40-5, 2008.
[7] R. Harris, "Kendall attacks biofuel critics," Farmers Weekly, vol. 146, no. 24, pp. 7-7, 15 Jun., 2007.
[8] "The Gospel According to Matthew," The Holy Bible containing the Old and New Testaments, Revised Standard Version ed., Nashville, Tenn.: Thomas Nelson Publishers, 1990, 13: 24-30.
[9] "The Gospel According to Matthew," The Holy Bible containing the Old and New Testaments, Revised Standard Version ed., Nashville, Tenn.: Thomas Nelson Publishers, 1990, 13: 36-43.
[10] B. Lomborg, "Time for a rethink on global warming," The Wall Street Journal, (Eastern Edition), [Online serial], New York, N. Y.: pp. A.13, (Jan 2010), [2010, Mar 8], Available at http://proquest.umi.com.proxy.lib.sfu.ca/pqdweb?did=1949994981&Fmt=7&clientId=3667&RQT=309&VName=PQD
[11] S. Hunt, "Biofuels, neither saviour, nor scam," World Policy Journal, vol. 25, no. 1, p. 11, 2008.
[12] S. Hunt, "Biofuels, neither saviour, nor scam," World Policy Journal, vol. 25, no. 1, pp. 16-17, 2008.
[13] L.P. Koh and J. Ghazoul, "Biofuels, biodiversity, and people: Understanding the conflicts and finding opportunities," Biological Conservation, vol. 141, no. 10, pp. 2450-60, 2008.
[14] M. Parfit, "Future power (cover story)," National Geographic, vol. 208, no. 2, pp. 2-31, 2005.
[15] Canmet Energy, "Transportation," [Online document], (Feb 2009), [2010, Mar 18], Available at http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/transportation.html
[16] D. Biello, "Green buildings may be the cheapest way to slow global warming," [Online document], (Mar 2008), [2010 Mar 18], Available at http://www.scientificamerican.com/article.cfm?id=green-buildings-may-be-cheapest-way-to-slow-global-warming
[17] S. Hunt, "Biofuels, neither saviour, nor scam," World Policy Journal, vol. 25, no. 1, p. 9, 2008.
[18] M.K. Jaccard, Sustainable Fossil Fuels, the Unusual Suspect in the Quest for Clean and Enduring Energy, New York, N.Y.: Cambridge University Press, 2005, p.22-25.
[19] J. R. Regalbuto, "Cellulosic biofuels," Science [Online], vol. 325, no. 5942, pp. 822-824, (Aug 2009), [2010 Mar 8] Available at http://www.sciencemag.org.proxy.lib.sfu.ca/cgi/content/summary/325/5942/822
[20] Envergent Technologies, "RTP and the future: Green technologies," [Online document], [ 2010 Mar 8], Available at http://www.envergenttech.com/technology.php#green
[21] J.L. Gaunt and J. Lehmann, "Energy balance and emissions associated with biochar sequestration and pyrolysis bioenergy production," Environmental Science & Technology, vol. 42, no. 11, p. 4152, 2008.
[22] S. Hunt, "Biofuels, neither saviour, nor scam," World Policy Journal, vol. 25, no. 1, pp. 10-11, 2008.
[23] Science Matters, "Fill 'er up with switchgrass" [Online document], [2010 Mar 8], Available at http://beta.davidsuzuki.org/blogs/science-matters/fill-er-up-with-switchgrass/
[24] M. Cernetig, "Garbage + plasma = clean energy" [Online serial], (Feb 2008), [2010 Mar 8], Available at http://www.canada.com/vancouversun/story.html?id=152b5f0d-662e-4960-90e6-a1e12cd4bfbe
[25] L.Jackson, "Why burning garbage is the best option," Vancouver Sun [Online serial], (Sep 2009), [2010 Mar 8], Available at http://www.vancouversun.com/life/burning+garbage+best+option/2045694/story.html
[26] Associated Press, "Algae emerges as a potential fuel source," New York Times [Online], (Dec 2007), [2010 Mar 8], Available at http://www.nytimes.com/2007/12/02/us/02algae.html?_r=2&scp=1&sq=algae
[27] A Hossain, A. Salleh, A.N. Boyce, and et al, "Biodiesel fuel production from algae as renewable energy," American Journal of Biochemistry and Biothechnology, vol. 4, no.3, pp. 250-254, 2008.
[28] W. Wolfson, "Synthetic biology transforms green goo to black gold," Chemistry & biology, vol. 16, no.3, pp. 237-238, 2009.
[29] A. Herro, "Better than corn: algae set to beat out other biofuel feedstocks," World Watch, [Online serial] vol. 21, no. 1, p. 4-4, (2008), [2010 Mar 8], Available at http://search.ebscohost.com.proxy.lib.sfu.ca/login.aspx?direct=true&db=aph&AN=27966124&site=ehost-live
[30] D. Geer, "Cultivating algae in wastewater for biofuel," Biocycle, vol. 50, no. 2, pp. 36-39, 2009.
[31] M. Torrey, "In the tank: although not yet available on a commercial basis, fuels made from algae are attracting research and investment dollars," [Online document], [2010 Mar 8], Available at http://blog.valcent.net/i/pdf/LubricationEngineering.pdf
[32] K. A. McVay, "Camelina production in Montana," [Online document], (Mar 2008), [2010 Mar 8], Available at http://msuextension.org/publications/AgandNaturalResources/MT200701Ag.pdf
[33] D. Biello, "Green fuels for jets," Scientific American Earth 3.0, vol. 19, no. 1, pp.68-68, 2009.
[34] T. Low, C. Booth, "The weedy truth about biofuels," [Online document, (2008), [2010 Mar 8], Available at http://www.lifeofthelandhawaii.org/Bio_Documents/2007.0346/LOL_EXH_7_Weedy_Truth.pdf

[35] J.N. Barney, J.M. Ditomaso, "Nonnative species and bioenergy. Are we cultivating the next invader?" [Online document], (2008), [2010 Mar 8], Available at http://www.bioone.org.proxy.lib.sfu.ca/doi/abs/10.1641/B580111?journalCode=bisi

[36] D. Simberloff, "Invasion biologists and the biofuel boom: Casandras or colleagues," Weed Science vol. 56, no. 6, pp. 867-872, 2008.

[37] T.A. Tigere, T.C. Gatsi, I. I. Mudita, and et al., "Potential of *Jatropha Curcas* in improving smallholder farmers' livelihoods in Zimbabwe: An exploratory study of Makosa Ward, Mutoko District," [Online document], (2006), [2010 Mar 8], Available at http://scholar.google.ca.proxy.lib.sfu.ca/scholar?hl=en&q=jatropha+and+small+scale+farming+in+zimbabwe&btnG=Search&as_sdt=2000&as_ylo=&as_vis=0

[38] W. Barclay, the Daily Study Bible Series: The Gospel of Matthew, vol.2, rev. ed., Philadelphia: The Westminster Press, 1975, pp. 71-75.

[39] K. Clay, "Fungal endophytes of grasses: A defensive mutualism between plants and fungi," Ecology, vol.69, no. 1, pp. 10-16, 1988.

[40] J.C. Baldwin, J.E. Dombrowski, R.C. Martin, and G.M. Banowetz, "Differentially expressed genes associated with post-harvest processing in Lolium temulentum L," Plant Science, vol.173, no. 2, pp. 73-83, 2007.

[41] "Baits and lures. Using tares," [Online document], (2009), [2010 Mar 8], Available at http://www.sjmfishing.co.uk/tares.html

[42] D. Lemke, "Small-scale biofuels production," Biocycle, vol. 50, no. 9, pp. 41-44, 2009.

[43] U.S. Department of Energy, U.S. Department of Agriculture, "Biomass as feedstock for a bioenergy and bioproducts industry: the technical feasibility of a billion-ton annual supply" [Online document], (Apr 2005), [2010 Mar 8], Available at http://www.sciencemag.org.proxy.lib.sfu.ca/cgi/content/full/311/5760/484

[44] E.A. Parson, D.W. Keith, "Climate change: Fossil fuels without $CO_2$ emissions," Science, [Online serial] vol. 282, no. 5391, pp. 1053-1054, Nov 1998, [2010 Mar 8] Available at http://www.sciencemag.org.proxy.lib.sfu.ca/cgi/content/summary/282/5391/1053