



Jatropha curcas

A solution or false hope?

Fossil fuels are a non-renewable source of energy that contribute to climate change. Biofuels are considered, in part, a solution to such issues as sustainable development, energy security and rising greenhouse gas emissions. The oil from *Jatropha curcas* seeds can be converted into biodiesel, but is it the solution to our energy problem?

Suitable for Key Stage:



Contents

- 02 Key information
- 04 Background
- 05 How to play
- 11 Homework activities
- 12 Character cards
- 16 Option cards
- 18 Glossary
- 19 Feedback
- 19 Further reading and links

View online



Scan the QR Code.

Science topics

Renewable energy, biofuels

Resources

Age



13-19 years old

Duration



40-60 minutes

- Background information sheet
- Character cards
- Option cards

Cover Image © University of York

Keywords

Jatropha curcas, biofuel, renewable energy, greenhouse gas, biodiesel, climate change, toxic, biodegradable, carbon footprint, energy poverty, environmental, social, edible, water, yield.



Learning outcomes

Students will be able to:

- Explore the different issues around *Jatropha curcas*
- Discuss the views of the different people involved

Prior learning

What you will need

- Background information sheet (including copies for the class if you are handing them out)
- Character cards
- Options cards
- Flipchart paper for groups
- Pens

Students should be familiar with fossil fuels, climate change and the requirement plants have for water and nutrients in order to grow properly. In order to get the most from discussions and to contribute their opinions it will help if students are familiar with the concepts of fossil fuel depletion and the role of greenhouse gases in climate change.

Research link

Professor Ian Graham – Biorenewables and Biofuels, Centre for Novel Agricultural Products, Department of Biology, University of York

www.york.ac.uk/biology/centrefornovelagriculturalproducts/research/bioenergy/biorenewables/

Biofuels, biodiesel and *Jatropha*

Biofuels are considered, in part, a solution to sustainable development, energy security and rising greenhouse gas emissions. In the past decade **biodiesel**, obtained from vegetable oils and animal fat, has attracted a considerable amount of attention as a **renewable** and **biodegradable** fuel alternative to fossil fuels.

Jatropha curcas in particular contains a high amount of oil in its seeds which can be easily converted into biodiesel. It has been recognised as a way for countries to grow their own renewable energy source with many promising benefits. It is also able to grow on poor soils in areas of low rainfall hence it being promoted as an ideal crop for small farmers. However, in order to commercialise *Jatropha* on a large scale it will require increasing amounts of land as well as water. This can not only cause competition for domestic water use but also means that land that is used to grow food crops could be turned into *Jatropha* growing areas. This raises social, environmental and economic concerns such as rising food prices and concerns about our ability to grow enough food and fuel. Converting the oil from *Jatropha* involves biochemical substances that need to be carefully handled and could pose risks if ingested. Furthermore, its benefits have been called into question and it is now evident that more research may need to be carried out into *Jatropha*.



Jatropha curcas plant

© University of York

The situation

The burning of fossil fuels and subsequent release of carbon dioxide is thought to be responsible for climate change. The European Union (EU) has set a target of meeting 20% of total EU energy consumption from renewable energy sources by 2020, with a minimum target of 10% for biofuels, along with measures for promoting renewable energy sources. With increasing global temperatures and the rising cost of fossil fuels we need to find an alternative soon! Is *Jatropha* the answer?



Jatropha curcas seeds

© University of York

The future

Fossil fuels are a **non-renewable** source of energy and therefore they will eventually run out. However, it is not just their depletion that is a problem. The use of fossil fuels brings up issues around climate change and our increasing **carbon footprint**. These are some of the reasons to find more eco-friendly alternative sources of energy.

Starter

Duration



5 minutes

1. Introduce the topic to students using the background notes, this can be done either by presenting the information to your class or giving them handouts to read.
2. Introduce the students to what *Jatropha* is using images or resin cast seeds available in our biofuel kit if you have received one
www.bbsrc.ac.uk/engagement/schools/keystage5/practical-biofuel-activities/

Discussion

Duration



25 minutes

5 minutes

3. Split the class into at least four teams.
4. Explain the themes. The game is divided into four colour-coded themes:
 1. Carbon footprint (green)
 2. Environmental (blue)
 3. Social (orange)
 4. Health (pink)
 Also explain that after their group discussions, they will be reporting back to the class and voting on a possible solution.
5. Give each group the corresponding **character cards** for one of the themes.

10 minutes

6. One person from the group reads out a **character card** to the rest of their group.
 - Is this character for or against *Jatropha*?
 - Can the group think of any arguments to counter what the character is saying?
7. Repeat step 6 with a different member of the group reading out the other **character card** e.g. car manufacturer card is swapped with climate change campaigner and so on.
 - What do students think of each position?

10 minutes

8. Give each group the colour-coded **options card** for their theme.
 - Can they think of a way for the two sides to find a solution?
 - The group should rank the options available from most preferable to least preferable. If required they can vote on the best option

Plenary

Duration



10 minutes

9. Each group reports back to the class on their discussions and the options they voted for as the best solutions. Students should report:
- Who their characters were
 - What their characters thought of Jatropha
 - How they ranked their options

Theme 1: Lowering carbon footprint

Car manufacturer

I work at a car manufacturing factory in the North East of England. The processed *Jatropha* oil can be used directly in diesel engines after minor modifications or after mixing it with conventional diesel. This is great news for us as we can contribute to lowering carbon emissions and become less reliant on fossil fuels so helping the fight against global warming.

Climate change campaigner

The benefits of biofuels from *Jatropha* are still uncertain as it has not been used on a wide commercial scale and some experts believe it will take many years for the benefits to show. Instead the government should direct its efforts into reducing emissions from road transport through policy measures that have been proven to deliver effective greenhouse gas reductions e.g. walking and cycling could save 7.3 million tonnes of CO₂ a year. Also, if politicians made car manufacturers increase the efficiency of cars, then 95 million tonnes of CO₂ could be saved across the European Union.

Options

Students should rank the options and take a vote on which solution they think is best – add in any options that the students have come up with.

1. Money from the government should be invested in researching whether *Jatropha* can be beneficial.
2. Car manufacturers can continue using *Jatropha* but should be fined if 50% of their cars do not have increased efficiency by 2030.
3. Money should be invested in promoting more eco-friendly ways of travel and transport and not in *Jatropha*.
4. Car manufacturers cannot use *Jatropha* unless they pay money towards its research.

Theme 2: Environmental

Farmer - Mexico

I live in an area of very dry land and we often have drought. We are unable to grow food crops and have very little income as a result. *Jatropha* would give me the chance to have an income as it grows well even in dry conditions that are not suitable for food crops. Since these areas are unused it would make sense for me to grow *Jatropha* crops.

Environmentalist

Jatropha will indeed survive on waste land without fertiliser and water, however it does not grow well under such conditions and seed production is sharply reduced. To maximise its yield it requires water. Water collection for *Jatropha* could end up competing with domestic uses such as cooking and sanitation. Also if *Jatropha* becomes a success more and more land will be needed and it may contribute to deforestation.

Options

Students should rank the options and take a vote on which solution they think is best – add in any options that the students have come up with.

1. The farmer should be paid by the government to grow a trial crop of *Jatropha*.
2. Environmentalists should help farmers grow drought-tolerant food crops.
3. Environmentalists should lobby the government to provide better access to water for irrigation and domestic use.
4. *Jatropha* should not be grown until research has been done on the best areas to grow it and the best practices to follow.

Theme 3: Social

Farmer – Swaziland - small land farmer

I used to grow cotton and food crops but a biofuel company told us we could make lots of money from growing *Jatropha*. I decided to change. But *Jatropha* yields vary, so my income isn't stable. Now food prices are too high as fewer farmers are growing food. I want to pull out but contracts issued to farmers by big companies cannot be terminated for several years. We don't even benefit from the oil made; it is sold on to big companies and exported. I fear that an influx of large investors could lead to competition with food crops, and too much land will be converted or even sold.

Local investor

Planting *Jatropha* is a great idea to help rural communities. In my community it has not only helped incomes but also helped to address "energy poverty". The oil has been used for diesel-powered electricity generation giving benefits for health – being able to refrigerate vaccines – and education – better light for extending studying hours as well as better access to information through computers, televisions and radios. The crop can also be used to make soap and fertiliser! I think it will greatly improve the living conditions in other villages.

Options

Students should rank the options and take a vote on which solution they think is best – add in any options that the students have come up with.

1. Local investors should focus on food crops only.
2. Large companies should establish fair-trade agreements with farmers who grow *Jatropha*.
3. Large companies should be banned from buying *Jatropha* and land directly from farmers.
4. Farmers should only be given a licence to grow *Jatropha* if they grow an equal amount of food crops or if they intercrop – grow food and *Jatropha* on the same land.

Theme 4: Health

Scientist

Jatropha comes in toxic and non-toxic varieties. However, non-toxic ones do not produce as much oil as the toxic ones, making them less profitable. Many plants are naturally toxic so those dealing with *Jatropha* need to have clear safety and handling instructions. Scientists are researching cross-breeding non-toxic varieties with those that have a high oil yield to create a new variety that is not toxic but has a lot of oil. All this research will help it to be a more advantageous crop as farmers will be able to use the plant leftovers as animal feed, making it more cost-efficient and environmentally friendly.

Toxicologist

The seeds are acutely toxic to humans and animals if ingested. The toxicity attributed to these seeds has been shown when children have accidentally consumed the seeds. It has been classified as an invasive species and a harmful weed in many countries. These crops are often grown in low economically developed countries where the people have little understanding of how to deal with the toxicity issues. Why should these communities have to be put at risk for everyone else to benefit?

Options

Students should rank the options and take a vote on which solution they think is best – add in any options that the students have come up with.

1. Only edible varieties should be planted.
2. There should be government regulations on the handling and disposal of *Jatropha*.
3. Scientists should do more to develop non-toxic *Jatropha*.
4. *Jatropha* should not be planted until a new variety is developed.

Homework activities

- Create a fair-trade agreement that will satisfy farmers' and companies' needs in *Jatropha* trading - think about the social, environmental and economic issues that affect each side.
- Write a letter from local farmers to the Mexican government persuading them to provide better access to water for irrigation and domestic use.
- Create a poster on renewable energy including biofuels.



Car Manufacturer

I work at a car manufacturing factory in the North East of England. The processed *Jatropha* oil can be used directly in diesel engines after minor modifications or after mixing it with conventional diesel. This is great news for us as we can contribute to lowering carbon emissions and become less reliant on fossil fuels so helping the fight against global warming.



Climate Campaigner

The benefits of biofuels from *Jatropha* are still uncertain as it has not been used on a wide commercial scale and some experts believe it will take many years for the benefits to show. Instead the government should direct its efforts into reducing emissions from road transport through policy measures that have been proven to deliver effective greenhouse gas reductions e.g. walking and cycling could save 7.3 million tonnes of CO₂ a year. Also, if politicians made car manufacturers increase the efficiency of cars, then 95 million tonnes of CO₂ could be saved across the European Union.



Environmentalist

I live in an area of very dry land and we often have drought. We are unable to grow food crops and have very little income as a result. *Jatropha* would give me the chance to have an income as it grows well even in dry conditions that are not suitable for food crops. Since these areas are unused it would make sense for me to grow *Jatropha* crops.



Farmer - Mexico

Jatropha will indeed survive on waste land without fertiliser and water, however it does not grow well under such conditions and seed production is sharply reduced. To maximise its yield it requires water. Water collection for *Jatropha* could end up competing with domestic uses such as cooking and sanitation. Also if *Jatropha* becomes a success more and more land will be needed and it may contribute to deforestation.

Character Card



Character Card



Character Card



Character Card





Character Cards

Student



Scientist

Jatropha comes in toxic and non-toxic varieties.

However, non-toxic ones do not produce as much oil as the toxic ones, making them less profitable. Many plants are naturally toxic so those dealing with *Jatropha* need to have clear safety and handling instructions. Scientists are researching cross-breeding non-toxic varieties with those that have a high oil yield to create a new variety that is not toxic but has a lot of oil. All this research will help it to be a more advantageous crop as farmers will be able to use the plant leftovers as animal feed, making it more cost-efficient and environmentally friendly.



Toxicologist

The seeds are acutely toxic to humans and animals if ingested. The toxicity attributed to these seeds has been shown when children have accidentally consumed the seeds. It has been classified as an invasive species and a harmful weed in many countries. These crops are often grown in low economically developed countries where the people have little understanding of how to deal with the toxicity issues. Why should these communities have to be put at risk for everyone else to benefit?



Farmer - Swaziland

I used to grow cotton and food crops but a biofuel company told us we could make lots of money from growing *Jatropha*. I decided to change. But *Jatropha* yields vary, so my income isn't stable. Now food prices are too high as fewer farmers are growing food. I want to pull out but contracts issued to farmers by big companies cannot be terminated for several years. We don't even benefit from the oil made; it is sold on to big companies and exported. I fear that an influx of large investors could lead to competition with food crops, and too much land will be converted or even sold.



Local Investor

Planting *Jatropha* is a great idea to help rural communities. In my community it has not only helped incomes but also helped to address "energy poverty". The oil has been used for diesel-powered electricity generation giving benefits for health – being able to refrigerate vaccines –and education – better light for extending studying hours as well as better access to information through computers, televisions and radios. The crop can also be used to make soap and fertiliser! I think it will greatly improve the living conditions in other villages.

Character Card



Character Card



Character Card



Character Card





Carbon Footprint

1. Money from the government should be invested in researching whether *Jatropha* can be beneficial.
2. Car manufacturers can continue using *Jatropha* but should be fined if 50% of their cars do not have increased efficiency by 2030.
3. Money should be invested in promoting more eco-friendly ways of travel and transport and not in *Jatropha*.
4. Car manufacturers cannot use *Jatropha* unless they pay money towards its research.



Environmental

1. The farmer should be paid by the government to grow a trial crop of *Jatropha*.
2. Environmentalists should help farmers grow drought-tolerant food crops.
3. Environmentalists should lobby the government to provide better access to water for irrigation and domestic use.
4. *Jatropha* should not be grown until research has been done on the best areas to grow it and the best practices to follow.



Social

1. Local investors should focus on food crops only.
2. Large companies should establish fair-trade agreements with farmers who grow *Jatropha*.
3. Large companies should be banned from buying *Jatropha* and land directly from farmers.
4. Farmers should only be given a licence to grow *Jatropha* if they grow an equal amount of food crops or if they intercrop - grow food and *Jatropha* on the same land.



Health

1. Only edible varieties should be planted.
2. There should be government regulations on the handling and disposal of *Jatropha*.
3. Scientists should do more to develop non-toxic *Jatropha*.
4. *Jatropha* should not be planted until a new variety is developed.

Option Card



Option Card



Option Card



Option Card



Biodegradable

Substances that are able to decompose in a natural environment.

Biodiesel

An organic compound derived by processing and transesterification of plant oil or animal fats that can be used as a transport fuel in replacement of diesel derived from fossil fuel.

Biofuel

A renewable fuel produced from biological material such as recently dead plants, animals or their waste.

Carbon footprint

The amount of carbon dioxide emitted due to the consumption of fossil fuels.

Energy poverty

A term for a lack of access to electricity, heat, or other forms of power.

Jatropha

A plant which contains oil in its seeds which can be converted into biodiesel.

Non-renewable

A resource that cannot be renewed at the same rate as it is being used and will eventually run out.

Renewable energy

A resource that can be renewed more quickly or at the same rate as it is being used or is unlikely to run out due to inexhaustible supplies.

Providing feedback

In order to ensure the materials we produce are of the highest quality and are effective for use with young people, we are keen to receive feedback.

We would like to receive two types of feedback: 1. Teacher feedback on the quality of the materials and their use in class; 2. Student feedback on their views and opinions of biofuels and the learning they have gained through the activity.

Further reading and links

Potential of *Jatropha curcas* as a source of renewable oil and animal feed

Author: Nafisa Bakkar, Tristan MacLean

Acknowledgments: Duncan Eggar, Ian Graham, Carol Ellison

Copyright: BBSRC 2014

Design: Creative Sponge, www.creativesponge.co.uk

The materials in this resource may be reproduced for teaching purposes in universities, research institutes, schools and colleges provided that the copyright of the BBSRC and sources of the original material are acknowledged. No copies may be sold for gain.

Feedback: Please provide us with feedback so we can improve this resource.

Email: external.relations@bbsrc.ac.uk