Cultivation of Jatropha in the Philippines
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1. What is jatropha?

Jatropha, commonly known as physic nut or purging nut, is a non-edible oil-yielding perennial shrub that has green leaves with a length and width of 6 centimeters (cm) to 15 cm, and can reach a height of up to 5 meters (m). It originated in tropical America and West Asia.

Jatropha can grow in various areas in the Philippines. It is known locally as tuba-tuba. Others call it tagumbao, tawa-tawa, kalunay, kasla and tangan-tangan.

Botanist Carl Von Linne first classified the plant in 1753 and named it Jatropha curcas.

Jatropha comes from the Greek words: jatros (doctor) and trophe (nutrition). It belongs to the family Euphorbiaceae.
2. **Are there different types of jatropha?**

   The genus jatropha has 176 species distributed throughout the world. Twelve species, alone, can be found in India.

3. **What type of weather is ideal for jatropha?**

   Jatropha grows in tropical and subtropical regions.

   It is drought-resistant.

4. **What type of soil is ideal for jatropha?**

   Jatropha can be planted on any kind of soil. It can grow even in marginal areas.

   However, low yields have been recorded in low rainfall areas while it can be grown with higher yields in high rainfall/irrigated areas.

5. **What are the uses of jatropha?**

   Jatropha is used in traditional medicine. It is likewise used as pesticide, soap and fuel oil for lighting and cooking.

   Because of its strong root system, jatropha can grow almost everywhere. It can hold water and survive the driest season. It is, thus, useful in reforestation, soil rehabilitation and soil erosion projects.
In the Philippines, jatropha is mainly used as a live fence for protection of agricultural fields from damage by livestock. As a non-edible plant, it is an effective barrier between livestock and crop fields; thus, the local name *tubang bakod*.

**Uses of Jatropha**

*Jatropha curcas*
- Erosion control
- Hedge plant
- Fire wood
- Plant protectant

**Fruits**

**Leaves**
- Development of Eri Silkworm
- Medicinal uses
- Anti-inflammatory substance

**Latex**
- Wound-healing protease (curcain)
- Medicinal uses

**Seeds**
- Insecticide
- Food/fodder (non-toxic varieties)

**Fruit Hulls**
- Combustibles
- Green manure
- Biogas production

**Seed Oil**
- Soap production
- Fuel
- Insecticide
- Medicinal uses

**Seed Cake**
- Fertilizer
- Biogas production
- Fodder (non-toxic varieties)

**Seed Shells**
- Combustibles

Source: G.M. Galvez, et. al. (1998). *Exploitation of the Tropical Oil Seed Plant Jatropha Curcas L.*
6. What is the productive life of jatropha?

Jatropha has a productive life that can span from 35 years up to 50 years.

It starts flowering a year after planting.

Economic yield is obtained from the fourth year onwards in the Indian experience.

7. What are the advantages of jatropha over other biodiesel feedstocks?

- Economics

The advantages of jatropha are mainly its economic seed yield and oil recovery.

Cultivation of jatropha is not capital-intensive.

- It can be planted on any kind of soil and grows well under tropical and subtropical climate.
Palm, the “chosen one” in Indonesia and Malaysia, takes eight years before the first harvest while the coconut takes four years. Harvest in jatropha is 14 months.

- It can easily be propagated by seed/cutting, has lesser gestation period and can generate high yield per hectare.
- Lastly, jatropha has a lower price since there is no other application, except for biodiesel feedstock. Other feedstocks are largely food commodities.

• Variety of uses

As mentioned earlier, jatropha can be used as traditional medicine, pesticide, soap and fuel oil for lighting and cooking. It can also be used as a plant for live fence, anti-soil erosion, fertilizer and biofuel. It, thus, increases rural and agricultural income and creates livelihood to the poor and marginalized sectors.
• **Effects on the environment**

The use of jatropha biodiesel reduces air pollution.

It has zero sulfur emission.

Tests by the United States Environment Protection Agency (USEPA) have shown that the use of biodiesel almost completely eliminates lifecycle carbon dioxide ($\text{CO}_2$) emissions. It is less neutral in its net addition to global warming because whatever $\text{CO}_2$ released in combustion is already sequestered when growing

• There are arguments that biofuels cannot be produced enough to replace petroleum-based diesel fuels since producing biofuels in great quantities could drive up food prices.

• A study by Professors C. Ford Runge and Benjamin Senauer of the University of Minnesota in the United States argues that the boom in ethanol threatens to divert massive amounts of corn and other food crops into biofuels.

• The Renewable Fuels Association of the United States further points out that the demand from the growing ethanol industry, which reached record production levels worldwide and traditional markets such as livestock feed and export customers, has helped drive corn to more than $4 a bushel in 2007.

• This “food-versus-fuel conflict,” however, failed to account for other non-food and biomass-based sources of fuel such as jatropha.

• **Food-vs.-Fuel Conflict**
The Kyoto Protocol is an agreement made under the United Nations Framework Convention on Climate Change (UNFCCC, which was adopted at the Earth Summit in Rio de Janeiro in 1992).

Based on the agreement, industrialized countries commit themselves to reducing their collective emissions of six key greenhouse gases by at least 5%. These six greenhouse gases are carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). Each country’s emissions target must be achieved by the period 2008-2012.

Carbon credit sales as a way of limiting climate-changing gases like carbon dioxide is being implemented following the signing of the Kyoto Protocol and under a program administered by the Bonn-based United Nations Clean Development Mechanism.

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8. Is the Philippines ideal for the cultivation of jatropha?

Yes.

In 2006, the Food and Agricultural Organization (FAO) studied the potential of jatropha as biodiesel feedstock in the Philippines. Its findings showed that the country has sufficient arable areas and favorable climatic conditions with adequate rainfall. These account for large feedstock production every year.

9. Apart from climatic conditions and soil quality, what can affect the yield of jatropha?

Farming techniques.

These include fertilizer applications, weeding, and pest and disease management, among others.

10. What lands are suited or have the potential for jatropha plantation?

- **Captive Plantation**

  Commercial biodiesel production warrants continuous supply of feedstock. This requires block plantation of jatropha in large areas.

  The country has a potential of about 4 million hectares of land for captive plantation of jatropha.

- **Hedge Plantation in Farm Land**

  There are about 10 million hectares of agricultural land under farming of various crops. Farmers may be motivated to grow jatropha as a hedge crop to serve as field protection from cattle. As a boundary plantation, jatropha can also provide additional income for the farmers.
• **Temporary Crop**

The reported area under temporary crop is 5.3 million hectares occupying 54% of the farmlands planted with different annual crops. It is estimated that 10% of the area under temporary agricultural annual crops, equivalent to 0.5 million hectares, can be used for jatropha.

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**Intercropping**

- **Intercropping is the practice of cultivating an additional crop in the spaces available between the main crop.**

- **It is a practice often associated with sustainable agriculture and organic farming.**

- **Examples of intercropping strategies are planting a deep-rooted crop with a shallow-rooted crop, or planting a tall crop with a shorter crop that requires partial shade.**

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• **Idle Land**

Idle lands, estimated at 0.1 million hectares, can be converted into jatropha plantations.

• **Permanent Crops**

Of the 4.2 million hectares under this category, the available land for hedge plantation is estimated at 0.2 million hectares. Hedge plantation or intercropping with well-maintained permanent crops will give good yield to farmers.
• **Meadows, Pastures and Other Lands**

It is estimated that about 0.2 million hectares of land under this category can be earmarked and converted into productive land for jatropha plantation.

With proper planning, availability of planting materials, technical know-how and funding, development of nurseries and plantations of jatropha is possible in a phased manner during the next five years.

11. **Do we have sufficient areas for jatropha cultivation vis-à-vis the total area required for jatropha plantation to meet the various biodiesel blends?**

Yes.

Based on 2006 FAO estimates, we have sufficient areas for jatropha cultivation vis-a-vis the total area required for jatropha plantation to meet the various biodiesel blends (1%, 2%, 5%, 10% and 20%).

A summary of area requirement for jatropha cultivation at various biodiesel blends at 5,000 kilograms (kg) yield per hectare for one harvest is presented below.
President Gloria Macapagal Arroyo visits a jatropha nursery cum plantation in Fort Magsaysay, Nueva Ecija.
12. What office is primarily tasked by the government to carry on the business of jatropha?

The Philippine National Oil Company-Alternative Fuels Corporation (PNOC-AFC).

It has been officially registered with the Securities and Exchange Commission on July 13, 2006, and officially mandated by President Gloria Macapagal Arroyo, during the Development Authority-National Anti-Poverty Commission August 8, 2006 Cabinet Meeting to “have the primary responsibility over the biofuels project and to coordinate with the concerned agencies.”

The Office of the Government Corporate Counsel, in its Opinion No. 285, dated December 29, 2006, affirms the PNOC-AFC’s primordial role as a direct investor with a purpose to invest its capital and carry on the business of alternative fuels.

Given jatropha’s advantages over other feedstocks, as discussed earlier, the PNOC-AFC has considered it as the Corporation’s feedstock for biodiesel production.

13. Is there a market for jatropha?

Yes.

With the enactment of the Biofuels Act of 2006, the current local demand for biodiesel, estimated at 980,000 liters per annum, is expected to increase on the average of about 78 million liters in 2007, with a minimum of 1% blend; and 167 million liters by 2009 at 2% blend.
14. How will PNOC-AFC address this estimated demand?

The PNOC-AFC came up with an integrated project on the establishment of jatropha mega-nurseries, plantations and biodiesel refineries.

This project aims to secure continuous feedstock supply of jatropha to the biodiesel refineries at the same time control the price of feedstock to ensure competitiveness of locally-produced biodiesel.

It is, therefore, important that the feedstock for the production of biodiesel will be continuously available and the source should be within a reasonable distance to the refineries.

Thus, by 2012, the PNOC-AFC shall have established the following:

- 1,500-hectare jatropha mega-nurseries cum pilot plantations
- 700,000-hectare biofuel crop plantations
- 1-million metric tons (MT) biodiesel refineries
16. How does one start to propagate jatropha?

Jatropha is normally propagated through main propagation (seeds/vegetative cuttings) and micro-propagation/tissue culture.
• **Seeds**

Healthy seeds are selected for raising seedlings.

Before sowing, seeds are soaked in water for 12 hours and seeds are subsequently sown in 10cm x 20cm sized polyethylene bags filled with soil, sand and organic fertilizer in the ratio of 1:1:1, respectively.

The raising of jatropha seedlings in polyethylene bags can accelerate the initial growth of plantation by at least four months. Four-month-old seedlings can be planted in fields.
• **Vegetative Cuttings**

Jatropha can also be propagated through cuttings.

Proper care is required in selecting the cuttings, which should be at least one-year-old and about 60cm long.

For seedling propagation, cuttings can also be sown in polyethylene bags for raising seedlings.
• **Tissue Culture**

Mass multiplication of high-yielding varieties is possible only through tissue culture.

Once high-yielding varieties are identified, millions of propagules can be multiplied only through tissue culture. Such plants possess certain advantages such as uniformity in yield and oil content and homogeneity in all respects. The research work on the development of suitable protocol for mass multiplication of elite jatropha has been initiated in India about two years ago. The standardization of protocol is in progress.

Two initiatives on the development of tissue culture of jatropha have been identified locally. The Mendez Organic Farms in Mendez, Cavite, studied jatropha tissue culture for more than a year now and its established protocol is awaiting approval from the Intellectual Property Office. The Freshwind Biotech Corporation is also engaged in tissue culture development but is still in the development stage.
Jatropha tissue culture
17. Are nurseries necessary?

Yes.

Maintaining a nursery is important in developing a jatropha plantation. This increases the rate of survival of the planting material.

The nursery should be accessible to the planting site, preferably on a non-sloping area close to a water source.

Nurseries established near the site of the plantation will facilitate the distribution of seedlings to the farmers/beneficiaries.
18. What is the ideal size of land for planting jatropha?

The planting density of 2,500 plants per hectare at 2m x 2m spacing has been found to be optimal under rain-fed conditions.

Recent experiences in India showed that spacing of 2m x 3m accommodating 1,667 plants per hectare is more suitable as it provides sufficient area to undertake inter-cropping and also allows easy harvesting and collection of seeds.

It was also observed that a 3m x 3m spacing can be followed if there is a sufficient irrigation facility and a well-distributed rainfall.

The spacing of 2m x 3m and 3m x 3m will facilitate intercropping during the initial three years of plantation operations.

If jatropha is to be planted as a hedge crop, the spacing of 1m x 1m may be adopted.

19. How much is the cost of plantation?

Based on the Indian experience of a 2m x 3m spacing with about 1,667 seeds per hectare, the estimated cost of nursery raising and plantation is likely to be P50,000 per hectare.

20. How many seeds are required in planting jatropha?

The seed requirement has been calculated based on a 1,667 seedlings per hectare for a 2m x 3m spacing and 2,500 seedlings per hectare for a 2m x 2m spacing.
Jatropha plantations
21. How much is the cost of seeds per kilo?

The price of jatropha seeds per kilo varies among localities in the country.

22. How does one go about in planting seedlings?

Two-month-old seedlings should be planted in pits (45cm x 45cm x 45cm) at specified spacings.

Each pit is filled with organic fertilizer and soil mixture at 3:1 ratio (3 parts soil and 1 part organic fertilizer).

The basal application of fertilizer at the rate of 20 gram (g) urea, 120g single super phosphate and 16g murate of potash is mixed with soil and filled into the pits.

Then the fertilizer is covered with topsoil in a hill-up manner to avoid erosion and the watering of the plants is done up to two weeks after transplanting.

For cuttings, the same procedure can be adopted provided that the stalk is transferred within five days after cutting.
Normally, five roots are formed from a jatropha seed, one central (tap root) and four peripheral. Cuttings, when planted, do not form a tap root.

23. How much is the cost per seedling and per cutting?

With very limited sources of jatropha sold locally, per seedling costs P10 to P15; per cutting P5 to P10.
24. There are different varieties of jatropha. Is there such specific variety that could well reproduce enough seeds for the country?

Jatropha is grown everywhere in the country and planting materials/seeds may be sourced nationwide.

Varieties from other countries likewise need to be assessed to determine, among others, their impact to local biodiversity.

Thus, the PNOC-AFC has conducted several assessments on the suitable/best variety of jatropha through studies and researches.

**PNOC-AFC’s R & D EFFORTS**

- The PNOC-AFC has reviewed several studies and reports claiming the high-yielding varieties exist in Madagascar, Ghana, Mexico and Mali.

- The PNOC-AFC’s approach is to initially use local varieties which also produce the same seed yield of 2kg to 3kg per plant (Romblon, Masbate, General Santos, Isabela and General Tinio) and 1,300 seeds per kg (Fort Magsaysay).

- Assessment on local and imported varieties is ongoing to determine their impact to local biodiversity, among others.
PNOC-AFC’s R & D EFFORTS

- **Provenance Testing** is being done to determine the best local variety in terms of seed yield per hectare and oil yield per unit measure. It also helps in determining the suitable spacing and plantation design.

- **Germplasm** is a term used to describe the genetic resources, or more precisely the DNA of an organism or collections of that material.

- **Germplasm Management** includes the conservation of the genetic diversity of jatropha through collecting, characterization, conservation and documentation of local germplasms.

- **Pest and Disease Management** refers to an ‘integrated’ approach, tackling the management of pests and diseases through cultural, biological and chemical means.

Before venturing into plantation, for instance, the PNOC-AFC has embarked on a nursery project which also serves as its research and development center with activities, such as different farming systems, germplasm management, provenance testing, and pest and disease management, among others.

25. **Who are PNOC-AFC’s partners in jatropha plantation?**

Recognizing the importance of research and development, the PNOC-AFC maintains strong partnership with the following institutions:
Pruning is a method of cutting off leaves or branches within limits in order to remove dead leaves or branches.

This is likewise used to control or direct growth, increase quality or yield of flowers or fruit and to ensure growth position of main branches to enhance structural strength.

26. How does one maintain a jatropha plantation?

In order to harness the full potential yield of jatropha, plantations should be maintained by providing the required nutrients and need-based irrigation.

After reaching full growth, pruning should be done not only to achieve desired yield but also to give shape, proper aeration and light required by the plant.

The total production of jatropha per hectare on the first year is 1,250 kilograms (kg); 2,750 kg on the second year; and 10,000 kg on the succeeding years.

- University of the Philippines at Los Baños
- Department of Science and Technology – Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
- Jatropha Research and Development Center, Ministry of Agriculture, Indonesia
- Bandung Institute of Technology, Indonesia
- Bogor Agricultural University, Indonesia
PNOC-AFC, represented by President Peter Anthony A. Abaya partners with Samsung, represented by Vice President Yoon Kwang Choi

with the Department of Science and Technology, represented by Undersecretary Graciano P. Yumul

with the University of the Philippines at Los Baños, represented by Chancellor Rey Velasco
27. How many seeds are produced per hectare?

The seed yield of jatropha will vary under different agro-climatic conditions and planting density. Seed yield varies from 5 MT to 7 MT per hectare under different agro-climatic conditions.

The farmers are likely to get the additional income from intercrops following the spacing of 2m x 3m and 3m x 3m under irrigated/well-distributed rainfall.

Under Indian climatic conditions, fruiting takes place once a year. It is likely to be twice a year under Philippine conditions thus resulting to higher yields.

Jatropha is expected to harvest an average of 5 MT per hectare of seeds under favorable conditions. The suitable intercrop may be undertaken during the initial years of plantation as this does not affect the yield of the jatropha.

The average annual income of farmers per hectare per year from jatropha is estimated at around P50,000.00.
28. How much oil can be extracted from a jatropha seed?

The oil content in jatropha varies from 30% up to 40% in seed and 40% up to 58% in kernel with good quality seed plantation.

With irrigation, fertile soil, favorable climatic conditions and the right choice of seeds, jatropha can achieve 6-8 oil tons per annum.

The jatropha seed contains 18% protein, 8% moisture, 35% fat, 17% carbohydrates, 16% fiber and 6% ash.

![Jatropha oil extracts](image)

29. What are the issues in the cultivation of jatropha?

- **Plant Stocks**

  Superior plant stocks mean excellent fruiting habits, prolific branching habits, and resistance to pest and diseases.

- **Plantation Management**

  Efficient plantation management requires standardized agro-techniques in harvesting, storage and the like, plus land type (plain rolling land), land size identification, good drainage, sufficient water supply and strategic location, i.e., close to the market or accessible to ports or roads.
The PNOC Alternative Fuels Corporation (PNOC-AFC), formerly known as the PNOC Petrochemical Development Corporation (PPDC), was officially incorporated in July 2006. Its mandate is to explore, develop and accelerate the utilization and commercialization of alternative fuels in the country. It has the primary responsibility over the biofuels project and to coordinate with the concerned agencies as directed by President Gloria Macapagal Arroyo during the joint National Economic Development Authority-National Anti-Poverty Commission Cabinet Meeting on August 8, 2006.

The PNOC-AFC also pursues the development, operation and management of the PNOC-AFC Industrial Park, an industrial estate with an area of more than 530 hectares located in the province of Bataan.