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[ The Economics of the Mango Trade ]
Examining the economic impact of globally traded mangoes
# Table of Contents

**History of the Mango Trade:**  
History of the Mango Trade  

**Production of Mangoes and Advantage of Trade**  
Growing, Producing, and Selling  

**Winners and Losers of Trade**  
Trade Barriers, Tariffs, and Restrictions  

**Trading Currencies**  
Relationship between Real and Euro  

**Summation**  
Summation  

**Work Cited**  
Sources and References  

2-23
History of the Mango Trade

Cultivated for over six-thousand years and considered the "apple of the tropics," the mango (of the genus Mangifera) continues to profoundly flavor human history ("Mango Fruit Facts"). First cultivated in the Indian sub-continent, Buddhist monks, Persian armies, and Portuguese colonists—in that order—spread the means for a now globally traded commodity, and, while today's mangoes—through artificial selection—hardly resemble their harder, stringier forbears, many cultivation methods and perquisites remain unchanged ("Mango History").

Revered by Buddhist, Hindi, and Sanskrit cultures, the fruit represents hospitality, fertility, and good fortune and is even featured in the Sanskrit heaven ("Mango in Spirit). Past-civilizations harnessed the mango for a variety of needs, using it to treat everything from fungus to diarrhea ("Mango History"). Today, civilization also uses the mango to treat political ailments. Mangoes are the national fruit of Pakistan and India, and so the fruit has been employed to soften tensions between the countries. The United States has also employed mangoes to foster peace. As recent as 2011, Hillary Clinton exploited the fruit in so-called "Mango Diplomacy" (Hilliar).
Production of Mangoes and the Advantage of Trade

According to The South African National Department of Agriculture, mangoes grow in a variety of temperatures though are most "successfully cultivated under conditions which vary from very hot, very humid to cool and dry, to very hot and arid." More specifically, the ideal mango-growing temperature resides between 27-36 degrees Celsius. For disease free crops, average humidity should also not exceed 55%.

Planters should seek wind-free areas for mango groves as high winds increase the risk of fungal growth through micro-abrasion. Additionally, due to increased oxygen levels, trees planted at lower elevations produce more fruit. Best planted on a "slight slope" in soil that is crumbly in nature, mango trees thrive in high-drainage areas. Therefore, planting trees in depressions or clay soil should be avoided. Also, soil should be slightly acidic (6-7.2), between 15-25% clay, and having an "unimpeded" depth of one meter.

Before planting, proper soil preparation should take place including soil inspection, adding lime and phosphate for fertilization, and "deep ripping" (plowing to aerate the root zone). When choosing nursery trees, planter should search for bright, glossy leaves; long, slender internodes; and uniform leaf appearance.
Once planted, mangoes can bear mild drought, but not without it negatively affecting fruit production. Usually planted after the region’s corresponding “winter” months (May-June for Northern Hemisphere, August-September in Southern), trees require 20-44 cubic meters of water daily (annually 11,000 m$^3$), fluctuating with seasonal temperament. Once planted, trees should also receive quarterly fertilization, with the most fertilization occurring directly after harvest.

While many different mango species and strains exist, most bear fruit 100-150 days after flowering, prompting harvest in late summer (“Mango Fruit Facts”). Thrips, mealybugs, and mites pose the greatest pest risk to mangoes. However, fungus, gophers, and specifically mildew also hold pronounced risks (“Mango Fruit Facts”). In the event of disease or smaller pest invasion, planters may use sodium bicarbonate, kelp, copper, malathion, or fungicidal sprays to control negative impacts (“Mango Fruit Facts”). In combating bigger pests, planters may consider fencing or growing indoors (“Mango Fruit Facts”).

While most fruit relies on mechanized harvesting, due to the mango’s susceptibility to bruising, harvesting mangoes exclusively requires manual labor (Sarig). Therefore, the mango industry heavily relies on a low wage, highly replaceable workforce, along with planters which harness that
labor. Any form of bruising results in waste, so workers usually harvest mangoes wearing padded gloves and buckets ("Worker’s"). The mangoes are then sorted into trays based on size, loaded onto pallets, and sent to a packer where the “Grade A” fruit will either be cooled or ripened and the” Grade B or C” canned (“Worker’s”).

Interestingly, the packer can also sort the incoming fruit through “machine vision” or “Fuzzy Image Analysis” (Razac). Instead of relying on expert sorters, a camera records visual imagery of mangos; interprets visual cues such as color, dimension, weight, and roundness of stem; and then feeds the raw data into an algorithm which labels the mango with the corresponding grade letter (Razac). Eighty percent accurate, the automation greatly increases the efficiency of sorting mangoes in the packing process (Razac).

Most tropical and some subtropical countries have weather conducive for growing mangoes as they meet the aforementioned requirements ("Mango Fruit Facts"). Therefore, countries with suitable climates like India, Pakistan, Mexico, and China produce most of the world’s mangos. Moreover, they have a comparative advantage in producing such goods as they have high populations of unskilled workers. Therefore, commodity labor comes cheap and the trade-off
for using unskilled workers is less, heightening comparative advantage by lowering the overall economic cost.
Winners and Losers of Trade

Mangoes are produced in over ninety countries, but, as of 2006, only 3% of that crop was traded globally with the U.S. importing a third of those fruits (Evans). Therefore, through controlling a majority position, U.S. statistics serve as a fair representation of the holistic mango trade. As seen from figure 14 and 15, mango prices have risen steadily while U.S. demand has doubled since 1996 (Evans). The increase in demand has resulted from “year-round availability, consumer preferences, and more disposable income” (Evans). Additionally, world oil prices have climbed, passing increased shipping costs to the consumer.

Resulting from inexpensive labor, suitable growing conditions, and local taste, India, China, Thailand, and Pakistan—in that order—hold the comparative advantage to produce the world’s mangoes (“Mango” United). That said, most globally traded mangos originate from either Mexico, Brazil, or Peru due to primarily Western importers (“Mango” United). Therefore, while producing a significant less amount of fruit compared to the East, the Western
Hemisphere controls a disproportionate amount of the fruit trade ("Mango" United). As a result, while India produces nearly twenty times more mangoes than Mexico, Mexico leads the world in mango exports due to close importers ("Mexican Mangoes").

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<td>8,274</td>
<td>9,014</td>
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<td>3,545</td>
<td>3,268</td>
<td>2,996</td>
<td>2,815</td>
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<tr>
<td>Other</td>
<td>3,981</td>
<td>5,061</td>
<td>6,782</td>
<td>8,053</td>
<td>7,984</td>
<td>6,318</td>
<td>5,922</td>
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<tr>
<td>Total</td>
<td>239,051</td>
<td>267,017</td>
<td>298,088</td>
<td>303,562</td>
<td>305,958</td>
<td>295,653</td>
<td>332,095</td>
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Figure 11: Mango Exporters to the US

According to recently published Global Post article, that has changed ("Mexican Mangoes").

Due to increasing rainfall, erratic weather behavior, and poor agricultural practice,

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<td>84,858</td>
<td>83,025</td>
<td>96,870</td>
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<td>11,129</td>
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<td>15,006</td>
<td>12,743</td>
<td>12,998</td>
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<td>Pakistan</td>
<td>7,094</td>
<td>12,307</td>
<td>10,120</td>
<td>13,225</td>
<td>12,941</td>
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<td>10,595</td>
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<td>Mexico</td>
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<td>565</td>
<td>1,764</td>
<td>2,680</td>
<td>1,674</td>
<td>1,596</td>
<td>4,938</td>
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</table>

Figure 12: Mango Exporters to Europe

Mango-laborers wages in Chiapas—a region of Mexico which produces the most Ataulfa mangoes in a country from which the US sources 60% of its mango imports—have fallen to 40 pesos (from 150 pesos) per box due to decreased fruit yield ("Mexican Mangoes").

Moreover, many planters are reconsidering growing mangoes at all, eyeing palm or sugar cane
instead, crops that require more resources but provide more predictable harvest ("Mexican Mangoes").

Such a switch would further increase global mango price due to a decrease in supply, but it could also potentially lower the price of other Mexican food imports due to a glut of labor, either that or raise unemployment and increase emigration to the US ("Mexican Mangoes").

In 2011, Peruvian growers suffered similar irregular weather, resulting in a 15% loss of exported mango crop ("Peru"). Also, in 2013, striking mango pickers caused Peru to experience a 30% loss in mango exports ("Peru").

US mango demand is at an all-time high, and, with Western suppliers facing weather and labor problems, mango prices will likely continue to rise (Evans).

Increases of price will logically make Indian and Pakistani mangoes, substitutes, more competitive—perhaps bolstering trade relationships—but could also result in Central and South American unemployment.
Figure 14: Weekly Mango Prices in the US, Source: USDA
Figure 15: Median Yearly Highs and Lows of Mango Prices, Source: USDA
Trade Barriers and Policy

The mango holds an interesting and dynamic position in global politics and US trade. Due to concerns over pesticides and fruit flies, from 1989 to 2007, the United States banned all Indian mangoes for US import (Deodhar). However, in 2007, US-Indo negotiations over the countries' civilian nuclear programs precipitated a deal allowing the importation of Indian mangoes for the exportation of Harley Davidson motorbikes into India (Kavilanz). Though, while President Bush told India's Prime Minister that the United States is "looking forward to eating Indian mangoes," the fruit faces an uneasy market (Deodhar). US restrictions have rendered Indian mangos uncompetitive (Deodhar). Due to fears over invasive fruit-flies, the US requires all Indian mangos to undergo stringent inspection along with expensive mandatory irradiation, the process of using gamma rays to disinfect fruit ("Irradiation"). Such extra precautions have made importing Indian mangoes overtly expensive (Sen). On the other hand, numerous Western producers have clearance from irradiation and instead use much cheaper hot water and soap for disinfection and protection from fruit flies—including Mexico (Prendergast). According to the Animal and Plant Health Inspection Service (APHIS), a division of the USDA, in addition to irradiation, Indian mangoes also require pre-shipping inspection by APHIS, insect-proof packaging, and exporter permits.
Pakistan's mangoes face similar restrictions ("Pakistan Needs"). That said, in 2011, part of a 21 million dollar program to spur Pakistani agriculture, Hillary Clinton promised to boost Pakistani mango production by financing cold storage areas, grading and sorting machinery, and hot-water treatment facilities (Hillary). The Express Tribune summates the resulting effects:

KARACHI: Pakistani exporters are abandoning much-publicised mango exports to the United States after just a year because American requirements made profit margins too narrow, members of the industry said Monday.

In 2011, Pakistani growers exported five tons of the country's signature fruit to the United States and had hoped for a higher yield this year.

But if exports grind to a halt, it could prove embarrassing for efforts dubbed "mango diplomacy" when US Secretary of State Hillary Clinton offered to help Pakistan export the fruit in a bid to ease anti-Americanism.

The US embassy was unavailable for comment, but announced in January that US support had helped select mango growers increase regional exports by more than 60 percent and revenue by more than $4 million over the past year.

Pakistani officials confirmed the assistance, but said sending mangoes to the United States was not cost effective.
“Pakistan cannot export mangoes to the United States this season because of certain restrictions, which the growers feel makes the business unprofitable,” Kashif Niazi, an official at the commerce ministry, told AFP.

An official at the Trade Development Authority of Pakistan, which regulates exports, said producers had been annoyed by compulsory US irradiation in Chicago that ate into their profits. Although Pakistan has its own irradiation plant, it has not been approved by the United States. Transporting the mangoes to the United States has been another expense and complication, the Pakistanis added.

Asif Iqbal, a mango grower in Sargodha district of Punjab province, told AFP that unless the irradiation issue was resolved and more US markets found “it will never be profitable for us to do business with America”.

A Pakistani official speaking to AFP on condition of anonymity confirmed that US aid had helped modernise mango production and improve exports, particularly to the Gulf (Hillary).
Unlike India, which has gained the USDA’s approval for use of its domestic irradiation facilities, Pakistani mangoes require irradiation in the US, mainly in Sioux City, Iowa—increasing costs (“Guidance”). The USDA’s approval of India’s domestic irradiation facilities but not Pakistan’s has not only given Indian mangoes an advantage in the US market but has also exacerbated the neighbors’ uncomfortable relationship (“Pakistan Needs”). Should the USDA reconsider and approve Pakistan’s Lashore and Karachi domestic irradiation facilities, four pounds of Pakistani mangoes would drop by eight dollars in cost (“Guidance”). Further increasing Eastern mango costs, as of September 1st, 2013, “the Agricultural Marketing Service of the U.S. Department of Agriculture increased the assessment rate on first handlers and importers of mangos from 0.5¢ per pound to 0.75¢ per pound. The increase is permitted under the Mango Promotion, Research, and Information Order, which is authorized by the Commodity Promotion, Research, and Information Act of 1996” (“Increased”).

Therefore, both India and Pakistan exporters face a significant cost hurdle which Australia, Bahrain, Canada, Chile, Israel, Jordan, Peru, Oman, and Mexico avoid (“Harmonized”). Under the harmonized tariff of the US, the aforementioned countries face exemption from all mango tariffs and have the advantage of duty-free mango importation into the US (“Harmonized”).
Should trade tariffs ease, India holds significant potential to increase world supply and, in turn, lessen global mango price. Besides leading the world in mango production, the state can also produce over 1,000 varieties at commercially viable levels (Kavilanz). However, prevalent concerns about foreign pests, subpar mango hygiene, and safety standards keep irradiation measures and procedure in place ("India Needs"). In India, mangoes are routinely transported in trucks without air-conditioned, standards unsuitable for global trade ("India Needs"). Some mango exporters contend a total infrastructure overhaul would be required for feasible export to the US ("India Needs"). And, without doubt, consumer would pay for that advancement through higher mango prices. Regardless, competition runs high between Pakistan and India for trading what each presumes as their national fruit. Therefore, US policy must walk a fine line between each nation’s trade policies.

While the US requires irradiation for imported Eastern mangoes, Japanese and Australian import laws allow less-expensive vapor heat treatment (VHT) as an option for sterilizing mangoes from fruit flies and disease ("India Needs"). Hoping to export more mangoes, Pakistan has plans to build a VHT center in compliance with Japanese trade standards in Multan and Karachi ("Pakistan Needs"). Because VHT is a much cheaper alternative to irradiation, both India and Pakistan hope to capitalize ("Pakistan Needs").
Around the world, mango duties abound. While the US does not add a value added tax (VAT) to mango imports, many other importing countries do ("Import Duty"). China charges a 17% VAT in addition to a 6% import tax, Australia charges a 5% import tax with a 10% VAT, and the Netherlands, the gateway to Europe's mango trade, charges a 1% import tax alongside a 20% VAT ("Import Duty"). VAT's pass additional costs to consumer and supplier, lowering demand while decreasing supply.

While Europe occupies only a secondary role in the mango trade, technology may change that. Until 2010, due to dated sterilization techniques, Europe received its entire mango supply from air-freight (Hussain). However, a Pakistani company successfully pioneered sea shipment to Europe in 2010, halving logistical costs (Hussain). Due to time at sea, mangoes transported by ship need immediate sale, but fine-tuning could cause a European mango import boom as transportation costs significantly drop. (Hussain).

**Fig. 20: Import Taxes and VAT (from left to right) per Nation, Source DutyCalculator.com**

<table>
<thead>
<tr>
<th>Netherlands</th>
<th>6110.11.9000</th>
<th>12%</th>
<th>21%</th>
</tr>
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<tbody>
<tr>
<td>China</td>
<td>6110.11.0039</td>
<td>14%</td>
<td>17%</td>
</tr>
<tr>
<td>Australia</td>
<td>6110.11.0041</td>
<td>10%</td>
<td>10%</td>
</tr>
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*Customs Service Fee(AU$55.20)*
Trading Currencies

The EU, the world’s third largest importer of mangoes, is entirely dependent on foreign imports for its mango supply ("CBI"). Because most Europe-bound mangoes enter through The Netherlands, the country’s shipping records accurately reflect the EU’s holistic consumption and trends. While the EU maintains one of the lowest mango-consumption rates in the world, demand increased annually by 7% from 2003 to 2007 while net import volumes are predicted to grow by 2.3% until 2014 ("CBI"). Brazil currently holds 65% of Europe’s mango market for an estimated value of 132 million dollars ("Kupitis"). Because Europe unequivocally illustrates a rising mango market, analyzing the relationship between its currency and its largest importer’s—Brazil—holds extreme merit.

The euro has made significant strides of appreciation against the dollar and other world currencies since 2012 (Kanter). Currently, one euro equals approximately 2.5 reals, increasing the appeal of Brazilian mangoes (Kanter). While the currency nearly crashed due to concerns regarding a Greek bank default, the euro has risen stridently as the world regains confidence that Europe can handle its debt crises (Kanter). As the euro has appreciated, the real has gone “from best to worst,” according to a 2012 Forbes news article. And, since that article’s publication, the real has only depreciated.
further, partly due to Brazilian President Dilma Rouseff’s monetary policies (Rapoza). Additionally, investors have raised questions over Brazil’s ability to return to growth at such a break-neck pace (Rapoza). If the aforementioned trends continue, the effects on the mango trade are clear. As the real depreciates and the euro appreciates, it increases reward for European importers. As a result, a weakening real and appreciating euro may increase mango demand by heightening the purchasing power of a major importer.

As the euro strengthens against the real, the EU wins in respect to the mango trade. Resulting from the fact that the EU has virtually no domestic mango planters and, thus, must always import mangoes, a strong euro holds only an upside for European mango lovers; an appreciating euro goes further in buying and importing mangoes. However, the Brazilian mango grower loses. While more demand exists for his or her commodity, the weakening real hinders the purchasing power of the Brazilian individual. In a sense, the real goes faster than before; it cannot buy as much, so workers must acquire more—work more—than previously necessary. On the other hand, increased demand may improve job security for Brazilian growers and laborers while bringing offshore dollars to the government.
Summation

Mangoes are cultivated in tropical to sub-tropical countries which have a sizeable unskilled workforce ("Mango"). Such factors deliver a comparative advantage by lessoning economic cost and trade-off through cheap, unskilled production.

Mango prices have increased in recent years due to weather patterns, demands, and tastes (Evans). The US imports most of the world’s globally traded mangoes from Mexico due to location ("Peru"). India, while producing most of the world’s mangoes, faces heavy US trade restrictions as does Pakistan ("India Needs"). Other countries afford more leniencies towards non-irradiated fruit but charge a VAT tax ("Import"). The US must also walk a fine line when enacting “Mango Diplomacy” between India and Pakistan to avoid exacerbating suspicions of favoritism ("Pakistan Needs").

Finally, as the euro appreciates against the depreciating real, Brazilian mangoes have become cheaper for Europe ("Rapozas"). As a result, importers increase their purchasing power while exporters lose theirs. However, this could also heighten Brazilian job security by strengthening trade bonds. In the future, expect mangoes to become more expensive, India and Pakistan to export more, and more Western demand. While mangoes have been part of the human story for thousands of years, they are now entering a more dynamic time than ever before.
Works Cited


PDF File.


