This chapter focuses on three examples of societal success that occurred in New Guinea, Tikopia, and Japan. State the two vastly different types of political structures employed on these three islands, briefly (sentence or two) state what each structure means, then identify which structure was used on each island.

The two types of political structures are the bottom-up approach, in which local communities work together to solve problems and manage their resources, and the top-down approach, in which centralized governing entities manage resources in a manner that benefits a large community. The bottom-up approach tends to work best in small communities, where inhabitants are familiar their environment and share a common identity with their neighbors, while the top-down approach best suits larger societies with more diverse interests, needs, and terrains. New Guinea and Tikopia adopted a bottom-up approach, in contrast to Tokugawa Japan's top-down management structure.

Nice reply!
AT 3, Q 1:

This chapter focuses on three examples of societal success that occurred in New Guinea, Tikopia, and Japan. State the two vastly different types of political structures employed on these three islands, briefly (sentence or two) state what each structure means, then identify which structure was used on each island.

There are both bottom up and top down political structures. **Bottom up** structures arise from **everyone knowingly participating in the maintenance of the area in which they live**, by creating some sort of democratic organizational structure that allows everyone to benefit. In contrast, a **top down** approach is some **small group of leaders that command from the top to the bottom** such that everyone follows their instructions, even if those in the bottom do not know each other, **alleviating the tragedy of the commons** that might occur if everyone were selfish. New Guinea and Tikopia are bottom up while Japan is top down.

Nice reply!
AT 3, Q 2:

Define silviculture and briefly summarize how the people of New Guinea used innovative approaches for both silviculture and agriculture. Can keep your answer to 2 to 3 sentences :) 

Silviculture is the process of growing trees instead of conventional crops. The people of New Guinea would plant Casuarina oligodon, a type of tree beneficial for the soil's fertility. The tree would be planted in nutrient depleted sites in order to decrease the amount of time the area would need in order to recover. The people used sophisticated methods to advance their agriculture, such as adding weeds, grass, and old vines to the soil to serve as compost.

---

The Highlanders also invented vertical drains, crop rotation principles, and terraces independent of other cultures (even without the aid of the "far superior" Europeans).

Like the well-deserved dig at the end.
AT 3, Q 3:

What two specific problems did the people of Tikopia have to overcome, in order to keep their 1.8 sq mile habitat continuously populated for 3000 years? Think about that for a moment ... 1,8 sq miles for 3000 years!

They had to make sure that the population was well regulated to prevent over population. They also had to overcome their limited food supply. There was a large decrease in birds and seafood, as well as a complete elimination of fruit bats. This caused them to have to find new ways to provide for themselves by relying on fish, shellfish, and turtles as well as raising orchards. They also had to consider emergency food for when there was a drought. They fermented breadfruit and stored it to be used in years of drought or ate from less desirable fruits and nuts from trees.

Emergency food supply likely decisive in the long-term survival of this society.
AT 3, Q 4:

Around 1700, the Shogun of Japan adopted a multi-staged, elaborate approach for woodland management. The responses are described as "negative responses" and "positive responses" enacted in a multi-staged approach. Briefly, in 2 to 3 sentences, summarize how the ruling class was able to manage the woodlands of Japan.

In your answer, state which of the two political structures described in your reply to Q1 was used. Finally, in another sentence or two, state whether you think the other political structure would have worked.

The elite of Japan utilized the top-down structure to combat deforestation by minimizing the rate at which trees were cut down through heavy regulation enforcement on cutting down timber, ensuring that tree is only cut down if deemed absolutely necessary by the shogun or daimyo. To produce more trees, research was conducted on how to effectively grow timber and began practicing plantation forestry, which treats trees as though they were a crop. I don't believe a bottom-up structure would have worked in the case of Japan as the threat of deforestation did not affect the vast majority of people as long as they had another log to cut down the next day. Japan was just too large of a society for individuals to get a sense of the larger threat at hand.

You've described the tragedy of the commons.
Remarkably, in the essay about Tikopia, Jared Diamond has resisted the temptation to draw an analog to modern, global society.

In your own words, in a paragraph (i.e., lead with a strong topic sentence), describe how Tikopia might serve as an analog to modern society. In your reply, see if you can work in the phrase "carrying capacity", which probably has already come up a few times in class.

There are already simply too many human beings on planet earth. Studies have shown that we are consuming three entire planets worth of resources currently with our population of about 7 billion people. Otherwise stated, we have far exceeded our carrying capacity. Short of finding another planet to exploit or decreasing our population through some sort of brutal and archaic method, our only option is to harvest our resources sustainably. The people of Tikopia were not only clever in their food production but also brutally pragmatic. At times, they ate foods they would not normally eat because of necessity. They went as far as murdering some of their population just to maintain a safe carrying capacity on their island. We are fortunate enough not to be in such a position. However, we must have that same sense of pragmatism in our decadent consumption of fossil fuels, timber, and certain unsustainable foods (such as beef or certain types of fish).

Earth’s carrying capacity is a crucial, often overlooked part of the lexicon of climate change. And the carrying capacity is invariably coupled to dietary choices.

https://link.springer.com/article/10.1007%2Fs10584-008-9534-6
One Island, Two Peoples, Two Histories:
The Dominican Republic and Haiti

Brad Daitch

18 September 2017
This chapter compares and contrasts the evolution of the societies of the Dominican Republic and Haiti, both of which are on the island of Hispaniola.

Address the first AT question:

The variation in forest cover between the Dominican Republic and Haiti is paralleled by differences in what?

and expound upon this, as you see fit. Also, should you like, can relate this to the prior reading and the theme of the book (i.e., deforestation)
This chapter compares and contrasts the evolution of the societies of the Dominican Republic and Haiti, both of which are on the island of Hispaniola.

Address the first AT question:

The variation in forest cover between the Dominican Republic and Haiti is paralleled by differences in what?

Cultural and political differences between the two societies. Dominican Republic has laws in place to regulate logging whereas Haiti lacks the governing bodies to implement and enforce environmental protection standards.

and expound upon this, as you see fit. Also, should you like, can relate this to the prior reading and the theme of the book (i.e., deforestation)
This chapter compares and contrasts the evolution of the societies of the Dominican Republic and Haiti, both of which are on the island of Hispaniola.

Compare and contrast the difference in land area and population of the Dominican Republic and Haiti.
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Compare and contrast the difference in land area and population of the Dominican Republic and Haiti.

The surface area of Haiti is only 1/3 of the island of Hispaniola (the DR encompassing the other 2/3) yet the population densities are around the same at 10.7-10.8 million people.
Review how the presence of gold and the suitability of being a good locale for the growth of sugar cane affected the people of Hispaniola, following the arrival of Christopher Columbus in 1492.
Review how the presence of gold and the suitability of being a good locale for the growth of sugar cane affected the people of Hispaniola, following the arrival of Christopher Columbus in 1492.

It allowed for Spain to establish a slave state on the island... At least after all the natives who inhabited the island died out due to slaughter, disease, or exodus facilitated by the the Spanish conquerors. Paved the way for Haiti to be one of the more wealthy states in the New World.
The Haitian side of the island had less environmental advantages than the Dominican side of the island, but developed a rich agricultural economy before the Dominican side
The Haitian side of the island had less environmental advantages than the Dominican side of the island, but developed a rich agricultural economy before the Dominican side.

"Haiti's burst of agricultural wealth came at the expense of its environmental capital of forests and soils." Without any external forces regulating the amount of logging done, and without any other means of producing renewable/nonrenewable energy sources to fuel cooking (charcoal is one of their main sources of energy) it was inevitable that they would experience extreme deforestation eventually.

Let's discuss how this happened and if it foreshadowed later events.
Why were the outcomes so different for the Dominican Republic and Haiti?
Diamond writes “Of the case studies described in this book, the contrast between Haiti and the Dominican Republic discussed in this chapter, and the contrast between the fates of the Norse and the Inuit in Greenland discussed in Chapter 8, provide the clearest illustrations that a society’s fate lies in its own hands and depends substantially on its own choices.”
Diamond writes “Of the case studies described in this book, the contrast between Haiti and the Dominican Republic discussed in this chapter, and the contrast between the fates of the Norse and the Inuit in Greenland discussed in Chapter 8, provide the clearest illustrations that a society’s fate lies in its own hands and depends substantially on its own choices.”

With the case of Haiti, it is within their best interests to fix the lack of structure within their government as this is the key difference between them and their counterparts in the Dominican Republic. They need someone to enforce legislation.
Plate 23. A partly wooded agricultural landscape of the Dominican Republic, occupying the eastern part of the island of Hispaniola, and many times richer than Haiti.
Plate 24. The almost completely deforested landscape of the New World’s poorest country, Haiti, which occupies the western part of the island of Hispaniola.
HONR 229L: Learning Enrichment

The Center for Climate and Energy Solutions cordially invites you to save the date for

State of the Art: Innovations in CO2 Capture and Use
Thursday, September 14, 2017
8:30 a.m. – 12:30 p.m.
Hart Senate Office Building, Room 902

https://www.youtube.com/watch?v=UPM1rDdbijg
The Center for Climate and Energy Solutions

Senator John Barrasso (R-WY)
Senator Shelley Moore Capito (R-WV)
Senator Heidi Heitkamp (D-ND)
Senator Sheldon Whitehouse (D-RI)

Panel I
Corporate Investment in CO2 Utilization

Panel II
Next-Generation Technologies in Carbon Capture Use and Storage
Carbon Capture Utilization and Storage Act

Heitkamp, Capito, Whitehouse, Barrasso, Graham, Kaine

CCUS: Carbon Capture Utilization and Storage

Section 45Q was enacted as part of the Energy Improvement and Extension Act of 2008 and amended by the American Recovery and Reinvestment Act of 2009. 45Q provides a credit for CO₂ sequestration and is available to taxpayers that capture qualified CO₂ at a qualified facility and dispose of the CO₂ in secure geological storage. The credit is equal to: (1) $20 per metric ton for qualified CO₂ that is captured and disposed of in secure geological storage or (2) $10 per metric ton for qualified CO₂ that is captured and used as a tertiary injectant in a qualified enhanced oil recovery (EOR) project.

To currently qualify a facility must capture and sequester a minimum of 500,000 tons of qualified CO₂ during the taxable year. The program is capped and expires when 75 million tons have been claimed. Under the current credit framework Carbon Capture Utilization and Storage (CCUS) projects have not been deployed successfully and the credit does not include industrial sources and utilization technologies beyond EOR.

This issue is that CCUS projects remains very expensive to build and the $10 per ton credit for EOR and $20 per ton credit for geologic storage continue to be insufficient to stimulate any real financing of CO₂ capture or utilization projects. The IRS last indicated in 2014 that at least 35 million of the authorized 75 million tons have already been claimed by existing industrial CO₂ capture projects, but since then, it is not clear how many more credits have been claimed. In addition, the financial uncertainty created by a cap – whether or not there will be any credits remaining when the facility captures CO₂ – does not provide access to commercial capital necessary to finance CCUS projects.

Carbon Capture Utilization and Storage Act

The *Carbon Capture Utilization and Storage Act* would reform, enhance, and expand upon the current 45Q tax credit provision. The Act would more fully incorporate utilization – beyond just EOR – and direct air capture as critical components of developing carbon capture projects and technologies that will contribute to greatly reducing CO₂ and CO emissions and creating products of usable value – both in the U.S. and globally. The Act would provide greater certainty for project developers and potential financers, create more flexibility in credit qualified entities, encourage innovation and development of new projects, and incorporate the Department of Energy’s planned large-scale pilot demonstration projects, by:

- Putting in place language for new facilities or equipment to qualify for the credit if they have “commenced construction” within 7-years from the date of enactment;
- Allowing those who qualify to claim the credit for 12-years;
- Increasing the current credit values so that the EOR credit rises to $35 per metric ton and the secure geologic storage credit rises to $50 per metric ton;
- Opening up the $35 per metric ton credit to current and future utilization and direct air capture projects beyond EOR;
- Creating three separate capture threshold tiers for EGU’s, non-EGU’s, and pilot or early development projects;
- Maintaining the 75 million metric ton cap – and $20/$10 per metric ton credit amounts – for projects that are already using the credit or qualify and utilize the credit prior to enactment of this Act; and
- Authorizing transferability of the credit to the entity sequestering the CO₂ or using it in EOR (the credit initially goes to the entity that owns the capture equipment and captures the CO₂ from the facility).

CCUS is a vital component to addressing global climate change through increased carbon reduction – as stated by the EIA, IEA, IPCC, and world leaders from North America to Asia. It is imperative that we invest and continue to enhance existing – and develop new – technologies while also encouraging innovation and utilization if we are to provide a viable path forward for CCUS on a national and global scale.
FUTURE Act Proposal

![Graph showing Tax Credit ($/tonne CO₂) over years from 2018 to 2030 for New Equipment and Preexisting Equipment, with lines for Inflation Adjusted, Solid: Geological Storage Only, and Dashed: With Utilization.](image_url)
## Cost of CCUS

45Q sequestration limit = 75 Mt CO₂

<table>
<thead>
<tr>
<th>Gases</th>
<th>U.S. 2015 Emission</th>
<th>45Q Limit vs. Total (%)</th>
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<tr>
<td>CO₂-fossil fuel (ff)</td>
<td>5097 Mt CO₂</td>
<td>1.47</td>
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<td>CO₂-ff + CH₄ + N₂O</td>
<td>5986 Mt CO₂-eq*</td>
<td>1.25</td>
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<tr>
<th>Gases</th>
<th>U.S. 2009-2015 Cumulative Emission</th>
<th>45Q Limit vs. Total (%)</th>
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<tr>
<td>CO₂-fossil fuel (ff)</td>
<td>36614 Mt CO₂</td>
<td>0.20</td>
</tr>
<tr>
<td>CO₂-ff + CH₄ + N₂O</td>
<td>43103 Mt CO₂-eq*</td>
<td>0.17</td>
</tr>
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</table>

### Percentage of GHG emissions sequestered under 45Q

CO₂-equivalent (or CO₂-eq) emissions =

\[
\text{CO}_2\text{-fossil fuel emissions} + \text{GWP}_{\text{CH}_4} \times \text{CH}_4^{\text{EMISSIONS}} + \text{GWP}_{\text{N}_2\text{O}} \times \text{N}_2\text{O}^{\text{EMISSIONS}}
\]

CO₂-eq using GWP_{CH₄} = 28 & GWP_{N₂O}=265 for 100-yr time horizon, from latest IPCC

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Cost to sequester 75 Mt CO₂ under existing 45Q @ $20 / tonne is **$1.5 billion**

CCUS: Carbon Capture, Utilization, and Storage
Cost of CCUS

45Q sequestration limit = 75 Mt CO$_2$

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<th>Cost to sequester ($35 / tonne)</th>
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Cost to sequester 2015 emissions, new proposal

CCUS: Carbon Capture, Utilization, and Storage
## Cost of CCUS

45Q sequestration limit = 75 Mt CO$_2$

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How much is **210 billion** dollars?

CCUS: Carbon Capture, Utilization, and Storage
Cost of CCUS

45Q sequestration limit = 75 Mt CO₂

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How much is 210 billion dollars?

U.S. GDP in 2015 was 18.04 trillion dollars

\[
\left( \frac{210 \times 10^9}{18.04 \times 10^{12}} \right) \times 100\% = 1.16 \% \text{ of 2015 U.S. GDP}
\]

CCUS: Carbon Capture, Utilization, and Storage

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Cost of CCUS

Total Federal Spending 2015: $3.8 Trillion

(210×10^9 / 3.8×10^{12}) × 100% = 5.53% of 2015 Federal Spending

Source: OMB, National Priorities Project

Petra Nova Project near Houston Texas, jointly developed by Mitsubishi Heavy Industries, Ltd. (MHI), the Kansai Electric Power Co., and NRG Energy, Inc uses a solvent for CO₂ capture coupled to a 240 MW coal power plant.
Petra Nova

Petra Nova Project near Houston Texas, jointly developed by Mitsubishi Heavy Industries, Ltd. (MHI), the Kansai Electric Power Co., and NRG Energy, Inc uses a solvent for CO₂ capture coupled to a 240 MW coal power plant

Cost : $ 1 billion ; DOE support: $190 million

https://www.eenews.net/stories/1060053094

Petra Nova

The Carbon Capture and Enhanced Oil Recovery Project
The world’s largest post-combustion carbon capture and enhanced oil recovery project is located in Texas at NRG Energy’s coal-fired W.A. Parish Generating Station. Also known as the Petra Nova Carbon Capture Project, the development is scheduled for completion by the end of 2016.

Petra Nova

Petra Nova

Beneficial use of the captured CO2
The captured CO2 will be transported via an 81-mile pipeline to the West Ranch Oil Field in Jackson County, Texas, where it will be used in an enhanced oil recovery process to produce an estimated 60 million barrels of oil.

Allam Cycle

25 MW natural gas energy plant being developed in La Porte, Texas by NetPower

https://www.netpower.com/about-us/

that, if it works as designed, will greatly reduce atmospheric release of all pollutants including CO₂

Regional Greenhouse Gas Initiative (RGGI)

Background

- Voluntary Program
- 9 States Participate (maybe more soon)
- Regional Carbon Cap on Power Plants
- Most allowances sold at auction
- Auction proceeds fund energy programs
RGGI Prices, $ per ton of CO$_2$
<table>
<thead>
<tr>
<th>2016 Revenue Millions of $</th>
<th>Allocation</th>
</tr>
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<tbody>
<tr>
<td>39.7</td>
<td>Energy Assistance (DHR)</td>
</tr>
<tr>
<td>17.4</td>
<td>Renewable Energy, Climate Change, Resiliency, Energy Education</td>
</tr>
<tr>
<td>8.7</td>
<td>Energy efficiency, low and moderate income</td>
</tr>
<tr>
<td>8.7</td>
<td>Energy efficiency, other sectors</td>
</tr>
<tr>
<td>5.0</td>
<td>Administration</td>
</tr>
<tr>
<td>79.5</td>
<td>Total</td>
</tr>
</tbody>
</table>
Next RGGI Stakeholder Meeting a Week from today, downtown Baltimore

Meeting 25 Sept 2017, 12:00-4:30 pm
at Public Service Commission HQ, 6 St. Paul St., Baltimore

https://www.rggi.org/design/2016-program-review/stakeholder-registration
Extra Slides to Follow
Carbon Capture & Sequestration Chemistry

MEA-monoethanolamine \((\text{CH}_2\text{CH}_2\text{OH})\text{NH}_2\) in an aqueous solution will absorb \(\text{CO}_2\) to form ethanolammonium carbamate.

\[
2\text{RNH}_2 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow (\text{RNH}_3)_2\text{CO}_2
\]

MEA is a weak base so it will re-release the \(\text{CO}_2\) when heated

Allam Cycle

25 MW energy plant being developed in La Porte, Texas by NetPower
https://www.netpower.com/about-us/

Smoke out
A new power plant will use carbon dioxide (CO₂) instead of steam. Rather than venting CO₂, it can sequester the greenhouse gas underground. And it approaches the efficiency of the best conventional natural gas plants.

The Allam cycle
Invented in 2009, the Allam cycle can achieve a near 60% efficiency while emitting no CO₂ or other pollutants.

http://science.sciencemag.org/content/356/6340/796/tab-pdf
Consensus Agreement

RGGI states recently announced an agreement to improve the program in the 2020s:

1. Reduce the cap by 30% from 2020 to 2030
2. Adjust for excess allowances remaining in 2020
3. Improve and maintain Cost Containment Reserve (CCR)
4. Implement a new Emissions Containment Reserve (ECR)
Adaptive Cap

Bank Adjustments remove surplus from the market early on.

The ECR tightens the cap further if reductions are inexpensive.

If market disruptions cause a price spike, the CCR increases supply.
Price Triggers

Graph showing the price triggers for CCR and ECR, modeled price range, and auction reserve price over the years 2021 to 2031.
Allowance Allocation

- Most allowances sold at quarterly auctions
- Anyone can purchase allowances
- States receive the proceeds and fund energy programs.
- Maryland has historically devoted most funds to Bill Assistance and Energy Efficiency. Proceeds allocation is set in statute.

[Pie chart showing the allocation of proceeds:]
- Energy Efficiency (28.7%)
- Clean & Renewable Energy (9.2%)
- GHG Abatement (6.5%)
- Direct Bill Assistance (50.1%)
- Administration (4.8%)
- RGGI, Inc. (0.7%)