

USP Library Cataloguing-in-Publication Data

Taboroši, Danko.

Agroforests : growing resilient communities / Danko Taborosi ... [et al.].

-- Palikir, Pohnpei : Island Research & Education Initiative, 2016.

102 p. : col. ill. ; 29 cm.

"Place-based resources for Pacific Island schools."

ISBN 978-982-9171-10-8

1. Agroforestry--Oceania--Juvenile literature. 2. Food Security--Oceania--Juvenile literature. 3. Climatic changes--Oceania--Juvenile literature.

I. Odango, Emerson. II. Barros, Corrin. III. Koh, Ming Wei.

IV. Island Research Education Initiative. V. Title.

S494.5.A45T33 2016

634.99099--dc23



Pacific islands Climate Education Partnership (PCEP)

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Funded by



National Science Foundation (NSF)
Grant #1239733

Published by



Island Research & Education Initiative (iREI)
PO Box PS 303, Palikir, Pohnpei, FM 96941
Federated States of Micronesia

This book is one in a series of environmental and climate education books prepared for schools in the Pacific islands. This and the other titles in the series can be obtained from iREI and PREL, including our on-line bookstore at www.islands.fm/bookstore. For more information, please visit PCEP at pcep.prel.org or contact iREI at irei@islandresearch.org or PREL at info@prel.org.

Citation:

Taboroši, D., Odango, E., Barros, C. and Koh, M. W. *Agroforests—Growing Resilient Communities*. Pacific islands Climate Education Partnership (PCEP), Place-based resources for Pacific Island schools. Pohnpei, Federated States of Micronesia: Island Research & Education Initiative, 2016.

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AGROFORESTS GROWING RESILIENT COMMUNITIES

Place-based resources for Pacific Island schools



DEDICATION

*For students, teachers, and communities
nurturing and nurtured by
the environments of their
Pacific islands.*



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WHAT IS THIS BOOK ABOUT?

Do you recognize this island? You probably do not, but the scenery must look very familiar. No matter what island in the Pacific you live on, the trees and other plants you see here—coconut, breadfruit, banana, and many others—are a part of the landscape you call home. Whether you are in Palau in the Western Pacific, Marshall Islands in the Central Pacific, or American Samoa in the South Pacific, you can see all of these trees and small plants if you just look out your window or take a short stroll around the neighborhood.

Our islands are thousands of miles apart, so why is the scenery so similar? It is because much of it was created by people, by past generations of Pacific Islanders, who worked hard over hundreds of years to make sure they had plenty of useful plants to meet all of their needs and the needs of generations to come.

This book takes you on a journey to discover how plants and landscapes inherited from elders make our islands and lives better. We'll learn about plants that made human life in the Pacific islands possible, explore landscapes that our ancestors created, and understand why we need them today and for the future just as much as they were needed in the past.

This book is about the trees, other plants, and the land that give us the local foods and many other things we need. As you read the book, you will learn that plants are essential to life and that we grow many of them for a variety of reasons. You will see that many plants around us are not something that is simply there and can be taken for granted, but must be appreciated and looked after. You will realize that the scenery around our houses and communities looks as it does because people take great care of the plants and have been doing so for hundreds, even thousands of years. You will learn that our gardens and forests are complex environments that support our way of life, provide us with all the essentials to make a living, and help keep our culture strong. You will find out who cares for and works in gardens and forests. You will get to know the different trees and other plants that grow there. Finally, you will learn about what is harmful to these places and how we can maintain those places and use them to help us adapt to **climate change**. The activities in this book will help you to explore the useful trees, other plants, and landscapes in your local environments.

Let's look at our land and the trees and other plants—the precious living resources we have inherited from the people who came before us—and find out why they are especially important today in a world where the climate is changing.

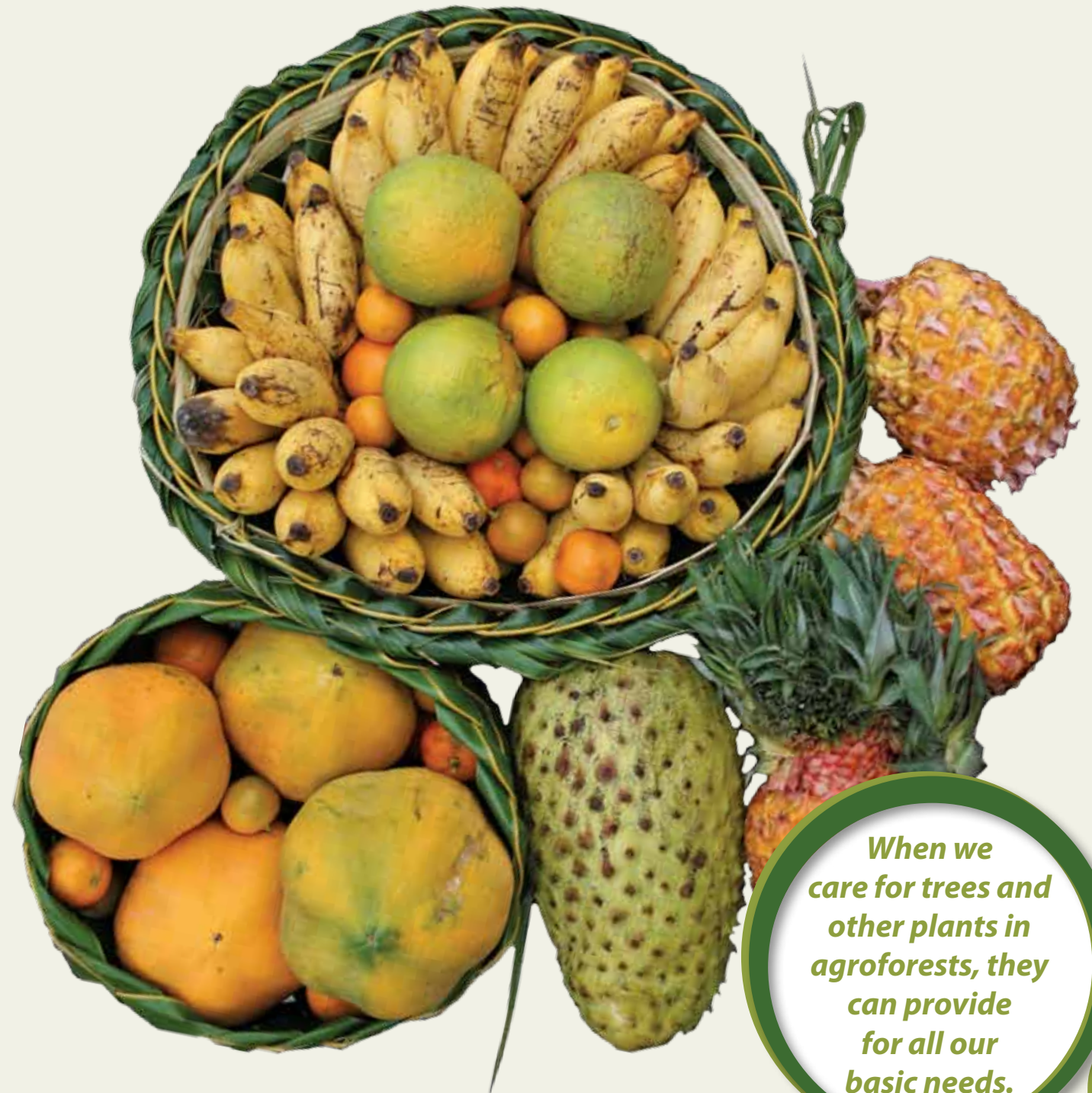
Have you heard this story?

Do you remember hearing stories, songs, or chants that include trees and other plants? On many islands there are stories about important food plants. For example, a story may explain how coconuts first came to an island or why they grow in some places and not others. There are even stories in which plants become people, like one about a special coconut that grows into a child who becomes the hero in his community. What stories do you know about coconuts and other important plants, such as breadfruit, taro, and banana? Ask your family or clan members to share with you a story, song, or chant related to a tree or other plant. Then, if you have permission, share it with your classmates. Compare and contrast what you have shared with each other. As you read through this book and learn about other aspects of agroforests, go back to your family/clan members and ask them for more stories, songs, or chants.

Let's get some delicious fruits

This delicious-looking gift would make anyone very happy. What fruits do you see in the picture? Do you have any of them in your garden or neighborhood? What fruits from your garden or your island could you add to the baskets? Discuss with your teacher and classmates the different kinds of fruits you have on your island and where you can find them.

Try this



When we care for trees and other plants in agroforests, they can provide for all our basic needs.

WHY DO WE NEED PLANTS?

Look at the trees and other plants around your home, school, and community. Why are they important to you?

Plants are essential to life. Plants engage in the process of **photosynthesis** to make the food they need to live. Animals can eat plant parts, such as fruits, leaves, and roots. Unlike plants, animals cannot make food inside their bodies and must eat other living things to survive. Animals would starve without plants.

Plants can live without us, but we cannot live without plants.

Plants take up **carbon dioxide** and release **oxygen** into the air and water. Plants maintain the air around us suitable for breathing. Animals get the oxygen they need thanks to plants. We could not breathe without plants.

Humans have learned to use plants for other needs, like medicine, fuel, shelter, clothing, and materials. Some plants are important for ceremonies or have other cultural significance. Finally, we appreciate plants as a source of beauty. We use plants to decorate our gardens and villages and their leaves, flowers, and fragrances to make our bodies more attractive.



PLANTS ENABLE US TO BREATHE. Oxygen in the air around us comes from plants.



PLANTS FEED US. Food comes from plants. Even meat is from animals that originally ate plants.



PLANTS SHELTER US. Many houses are made of plant materials: wood, rope, thatch.



PLANTS CLOTHE US. Most clothes, from grass skirts to cotton shirts, are made of plant fibers.



PLANTS HEAL US. Plants are the key ingredients in local and Western medicine.



PLANTS GIVE MATERIALS. We use plants to make tools, rope, mats, baskets, canoes, and many other things.



PLANTS GIVE US FUEL. We burn firewood and oil from plants to make heat and power engines.



PLANTS ARE BEAUTIFUL. We use flowers and other plant parts to decorate our places and ourselves.

WHAT IS AN AGROFOREST?

Pacific Islanders have traditionally depended on the land and ocean for all their needs—food, medicine, materials, and more. Most of our food and materials from the land come from trees and other plants that are grown and cared for by people. Traditional **agriculture** (farming) in the Pacific islands generally involves growing many kinds of trees and other useful plants together in the same area. Some **wild** plants can grow alongside **cultivated** plants. The result is a mixed garden of different trees and other plants. A productive area of land like this can be called a tree garden or an **agroforest**.

In general, an agroforest is a farm, garden, or **agricultural area** that includes at least one kind of tree, several other cultivated plants, and sometimes wild plants growing together. People also raise animals, like chickens and pigs, there. Most agroforests in the world are planted by **indigenous peoples** to grow food and other resources. Such agroforests are maintained for long periods of time, often over many human lifetimes.

An agroforest is a forest that people make and manage. It does not grow by itself.

On the Pacific islands, agroforests are where people produce most of the local food and the other things they need.



Try
this

Where are your agroforests?

There are agroforests on almost every Pacific island. Some islands are nearly completely covered by agroforests, and most have at least a little bit of it somewhere. For the people living in the house in the picture, finding an agroforest is an easy task. Their house is surrounded by an agroforest with many breadfruit trees, banana trees, taro, and other useful plants.

Can you find an agroforest like this near you?

Try this

Agroforest... more familiar than it sounds

In English, the word "agroforest" is a term made by combining two word parts: **agro-** (from agriculture, to indicate cultivated land) and **forest** (to indicate land with many trees). Despite the strange name, agroforest is something that you know very well. You may have a more familiar word in your own language. Check the list below, or ask your teachers and family, for words with a similar meaning to agroforest. Now that you know what to call this kind of place in English and in your own language, you might realize that you pass through agroforests every day. It is the most typical kind of cultivated land in the Pacific islands and surrounds most villages. Look at the three photos to the right — one is an agroforest, one is a wild forest, and one is a cultivated area that is not an agroforest. Can you tell which is which?



- | | | | |
|-------------------|---------------------|----------------|--------------------------|
| • Carolinian: | leemat | • Nukuoro: | lodo henua |
| • Chamorro: | guálo' | • Palauan: | telemetaml |
| • Chuukese: | tánnipi | • Pingelapese: | nah sapw |
| • Hawaiian: | kihāpai | • Pohnpeian: | nansapw |
| • Kapingamarangi: | lodo henua | • Pulowatese: | irá ffót |
| • Kosraean: | inmwetak | • Samoan: | fa'atoaga fifiloi |
| • Marshallese: | jikin kallib | • Satawalese: | nepwiuneog |
| • Mokilese: | mwoaswel | • Sonsorolese: | maat |
| • Mortlockese: | leemal | • Ulithian: | faael irea |
| • Namonuito: | man ffót | • Woleaian: | nimale |
| • Ngatikese: | nan mwaht | • Yapese: | milaey' |

Just as the name suggests, tree gardens or agroforests depend on trees. Some agroforests are small and simple, with just a few kinds of trees. Others are more complex and have many different kinds of trees and other plants, both cultivated and wild. Regardless of the combination trees and other plants in an agroforest, they all rely on one another like members of a family. Trees serve many purposes and are important to the well-being of people, animals, other plants, and our environment (see pages 56–67). These trees are like the parents in a family, and smaller plants are like children under their protection. The large and strong tree roots hold the soil in place, allowing all other plants to grow. Their trunks and branches are home for many animals, from small insects to birds and bats. Trees provide people with fruit, wood, and other things we need.

In agroforests, people work with different kinds of plants and animals in mutually beneficial relationships. Plants use sunlight, air, and water to carry out photosynthesis and release oxygen to **produce** food that people and animals need. People manage the land, take care of the soil, and cultivate trees and other plants. In return, people **harvest** plant leaves, fruits, roots, and other parts and use them for food and other things. Animals also support and benefit from the agroforest. They help plants **reproduce** by spreading the seeds of fruits they eat. Animals also spread their own waste, which worms and other small organisms in the ground break down along with dead parts of plants. This process recycles nutrients and supports **fertility** of the soil. In return, various animals have safe places to live and food to eat.

Because plants, animals, and people work together, agroforests can be more **productive** than other types of cultivated land. They provide food and other things people need, while also benefiting and protecting the island **ecosystem** (overall environment with all its living things). As the **climate** of our islands and the rest of the world is changing, it is very important that our environment is healthy and **resilient** enough to recover and thrive under new conditions. Agroforests may be a way for our communities to adapt and remain or become more **self-sustaining**.

Title of activity

Use PCEP high and low island environment posters to help you identify the kinds of places where agroforests can be found on different types of islands. What other types of environments do we see near agroforests? What differences and similarities do you see in agroforests on the side of your island that faces the predominant wind and the side that is usually protected from wind?

* If these posters are not available in your classroom, they can be downloaded here: pcep.prel.org/resources/?resource_type=poster



Try this

WHY ARE AGROFORESTS IMPORTANT?

Plants in agroforests provide us with fruits, vegetables, roots, nuts, and other forms of **sustenance**, which are the food and drink that we need to grow and be healthy.

Plants also give us **resources** like medicine, fuel, fertilizers, and materials for building and making things for us and our families to use. We also sell some of these things, such as copra, coconut oil, seedlings, and handicrafts, as sources of income.

Agroforests also provide **habitat** for a variety of plants and animals. Wild plants continue to grow among cultivated plants, while insects, crabs, lizards, birds, and bats live alongside our chickens and pigs.

Trees in agroforests enrich the soil with fallen leaves and other plant litter. They provide shade from the hot sun and reduce the strength of wind. Their roots hold onto soil and prevent it from being washed away by rains. Soil holds water in the ground for plants to use and removes **pollutants** from water going into streams, wells, and oceans. Thus, agroforests protect land from **erosion** and improve **water quality**. Also, plants and soil in agroforests store carbon—a process that scientists call **carbon sequestration**. Carbon sequestration is important for reducing **global warming**. Finally, by providing habitat to a great variety of living things, agroforests help our islands keep their **biodiversity**. Biodiversity makes our ecosystems more resistant to problems and better able to recover from storms, droughts, and other disasters.

Pacific Islanders have been cultivating agroforests ever since the first people arrived on the islands. To this day, agroforests remain a part of island way of life, culture, and people's identities. Plants and animals play roles in our everyday lives, our ceremonies and stories, and our understanding of the world around us. When people talk about land as one of the most precious possessions, they talk about the land that supports agroforests—the land that sustains families and communities.

AGROFORESTS PROVIDE **SUSTENANCE**

Sustenance includes food that we eat and liquids that we drink.

We get from agroforests:

- ★ Nourishment (food)
- ★ Hydration (drink)

→ see pages
40–45



AGROFORESTS PROVIDE **RESOURCES**

Resources include anything we need to make things, from medicine to fertilizers, from building materials to everyday items. They give us:

- ★ Medicine
- ★ Fuel
- ★ Fertilizers
- ★ Building materials
- ★ Other materials

→ see pages
46–55



AGROFORESTS PROVIDE **HABITAT**

Habitat is the natural home for a plant or animal.

Agroforests provide space for plants and animals to live.

That includes both:

- ★ Habitat for wild animals
- ★ Habitat for domestic animals

→ see pages
56–59



AGROFORESTS PROVIDE **SERVICES**

Agroforests do many important things that benefit the overall environment. That includes:

- ★ Keeping soil healthy
- ★ Shading and windbreaks
- ★ Reducing erosion and improving water quality
- ★ Sequestering carbon
- ★ Supporting biodiversity

→ see pages
60–63



AGROFORESTS HAVE **CULTURAL SIGNIFICANCE**

Many parts of our way of life, language, stories, memories, cultural practices, and beliefs are connected to agroforests. They help us with our:

- ★ Connection with land
- ★ Connection with people
- ★ Connection with culture

→ see pages
64–67



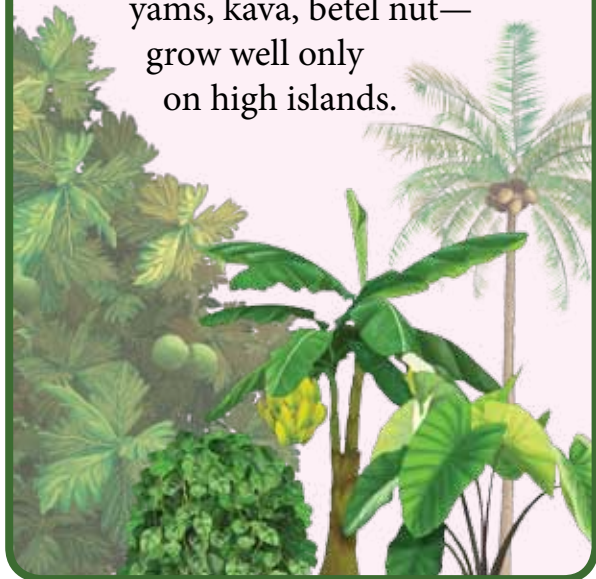
WHAT KINDS OF AGROFORESTS ARE THERE?

Agroforests are not the same everywhere. They differ from place to place. They contain different combinations of trees and other plants, depending on people's needs and the local environment. Agroforests especially differ between high islands and low islands. With some exceptions, agroforests on high islands are in coastal areas, valleys, and wherever people live. On low islands, where land is more limited, agroforests cover most land.



HIGH ISLAND AGROFOREST

High island agroforests have many different kinds of plants. Large trees like breadfruit, coconuts, mango, local apples, and terminalia shelter smaller plants like taro, bananas, citrus, papaya, and various vegetables. Several culturally important plants—yams, kava, betel nut—grow well only on high islands.



LOW ISLAND AGROFOREST

Compared to high islands, low islands have thinner soil and more salt spray in the air. Because of that, fewer types of plants can grow on low islands. Key trees in low island agroforests are coconut palm and breadfruit. Growing in their shade are taro, swamp taro, pandanus, pumpkin, sweet potato, papaya, arrowroot, and others.



Mixed trees
(photo from Woleai Atoll, Yap State)



Coconut grove
(photo from Effen Island, Chuuk)



Taro patch
(photo from Pingelap Atoll, Pohnpei State)



Pandanus grove
(photo from Tarawa Atoll, Kiribati)

Try this

Kinds of places

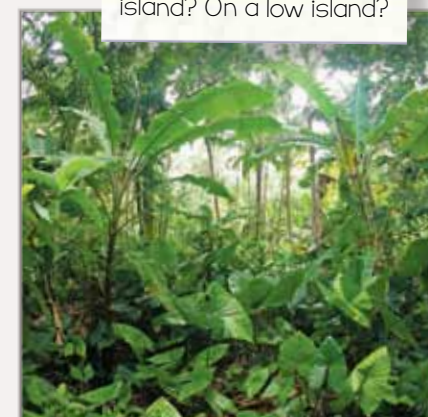
These pictures show different kinds of places found in agroforests. Imagine that you are an adult and need to grow your family's favorite local foods on your land. What combination of pictures best describes your agroforest? Would your agroforest look different if you were located on a high island? On a low island?



Fishpond
(photo from Majuro, Marshall Islands)



Vegetable plot
(photo from Babeldaob, Palau)



Mixed garden
(photo from Ifalik Atoll, Yap State)



Decorative plants
(photo from Kolonia, Pohnpei State)

WHO CARES FOR AND WORKS IN AGROFORESTS?

Typically, agroforests are found on lands that surround a village. Agroforests consist of land that belongs to different families in a community, who all play roles in caring for and working in them. The roles are often divided by gender and age. For example, on many Pacific islands, care of certain plants is the responsibility of women or men. Women usually work in taro patches and vegetable gardens, whereas men raise yams and take care of large trees, from harvesting breadfruit to cutting trees for timber. Children learn from their elders by participating in these everyday activities.

Caring for and using plants in agroforests also depends on local cultural rules. Agroforests tend to be grown on private property, so in close-knit island communities everyone knows which plants belong to whom. People respect each other's **crops** (cultivated plants and the things we get from them). Even something as simple as climbing a palm to get a refreshing coconut requires asking permission first.

It is a part of island culture to share with family and neighbors the things they produce. This is especially true during festivals and “first fruits” feasts when foods grown in our agroforests are presented to traditional leaders in special ceremonies and shared with the community.

Many kinds of work

Try this

The following page shows pictures of some of the many kinds of work that people do in agroforests. What kinds of farming work have you seen on your island? Who does it? How? When do they do it? Discuss with your teachers and classmates.

Kinds of work

Try this

Think about the work shown in these pictures. Can you write a step-by-step guide that explains how these kinds of work are done? Make a list of many different actions that describe the work.



Farmers harvesting yams
(photo from Tanna, Vanuatu)



Students examining vegetable seedlings at their school garden
(photo from Angaur, Palau)



A young man using a pole to pick breadfruit
(photo from Ifalik Atoll, Yap State)



Planting bananas
(photo from Nett, Pohnpei State)



Children picking limes from a tree
(photo from Mwoakilloa, Pohnpei State)



Children helping mother add compost to taro patch
(photo from Ifalik Atoll, Yap State)

WHEN DO PEOPLE DO WORK IN AGROFORESTS?

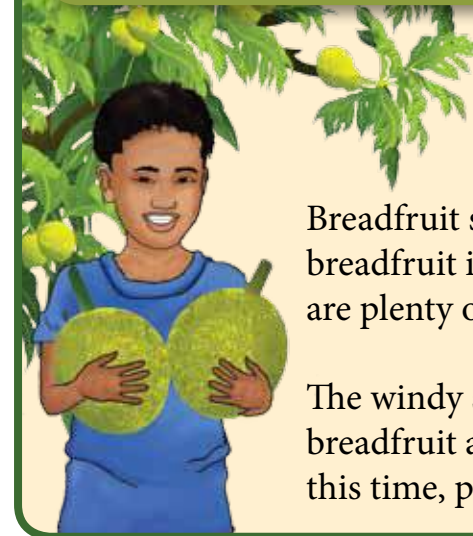
Think about your favorite local food. Can you eat it whenever you want, or only during a particular time of the year? When a local dish can be made depends on when the ingredients are available and can be harvested. Many plants—like breadfruit, mango, or citrus—only produce fruits during certain parts of the year. Because different plants grow and are ready for harvest at different times of year, our jobs in the agroforest change throughout the year, too!

Though people work in agroforests year-round, the kind of work they do depends on the seasons. In the Pacific islands, we recognize two main **seasons**. The names and timing of the seasons vary from island to island. On many islands, some months of the year are wetter than others and the year is divided into a **rainy season** and a **dry season**. For example, the rainy season in Hawai'i and American Samoa is from November to March, and in Guam from July to November.

Some islands do not have a pronounced wet and dry time of the year. For example, Pohnpei and Kosrae get a lot of rain throughout the entire year. On those islands, as in most of Micronesia, people have divided the year into a **breadfruit season**, when people harvest breadfruit and the ocean is relatively calm, and a **windy season**, when there is no breadfruit on trees and the weather is windy. The breadfruit season is generally from April to September and the windy season is from October to March.

The seasons determine the timing and the kind of work that people do in agroforests. Planting, caring, harvesting and other tasks must be done at the appropriate time for each crop. Many Pacific cultures use a moon calendar, which is based on the cycles of the phases of the moon, to keep track of time and seasons.

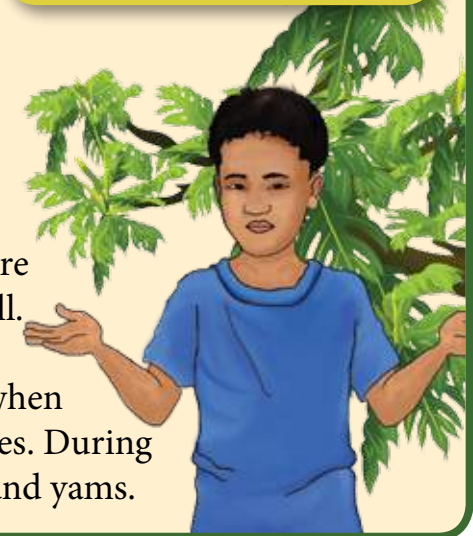
BREADFRUIT SEASON



Breadfruit season is the time breadfruit is harvested and there are plenty of other foods as well.

The windy season is the time when breadfruit are no longer on trees. During this time, people harvest taro and yams.

WINDY SEASON



Keeping track of time lets farmers determine the best days for planting crops, taking care of them, harvesting, making various products, and all other associated tasks. For example, at harvest time, crops are not only picked, cleaned, and cooked, but are also **preserved** in different ways to be stored and used later. One popular food is preserved breadfruit, which is made during the breadfruit season and saved to eat during the windy season, when fresh breadfruit is not available. Farmers know what needs to be done at different times of the year. However, some of our elders are noticing that the timing and characteristics of seasons are changing from what they used to be. Climate change (see pages 82–87) is affecting the weather patterns, the life cycle of plants, and the timing of different kinds of work that we do in agroforests.



Seasons on your island

- When are the seasons on your island?
- Talk with an elder, your teacher, or your classmates to create a calendar of events, marking seasons and typical weather conditions (rainy, dry, windy, etc.), special community events, and when your favorite foods are available. When are different fruits in season?

- Chamorro:
- Hawaiian:
- Palauan:
- Samoan:
- Yapese:

RAINY SEASON

- Chamorro: *fanuchānan*
- Hawaiian: *ho'oilo*
- Palauan: *bilel ngebard*
- Samoan: *vaipalolo*
- Yapese: *sarbul*

DRY SEASON

- Chamorro: *fañomnāgan*
- Hawaiian: *kauwela*
- Palauan: *bilel ongos*
- Samoan: *vaito'elau*
- Yapese: *doofiyeeg*

BREADFRUIT SEASON

- Carolinian: *leerāgh*
- Chuukese: *neeres*
- Kosraean: *pacl in mos*
- Marshallese: *ien rak*
- Mortlockese: *leerek*
- Pohnpeian: *nanrek*

WINDY SEASON

- Carolinian: *leeyefāng*
- Chuukese: *neefeng*
- Kosraean: *pacl in muhtah*
- Marshallese: *añōeañ*
- Mortlockese: *leafang*
- Pohnpeian: *nanpar*

WHAT KINDS OF PLANTS GROW IN AGROFORESTS?

Agroforests contain a rich mix of trees and other plants. Some are small and some are big. Some are wild and occur in the area naturally, but most are those that people cultivate to provide food, medicine, building materials, or other resources.

Imagine that you are standing in an agroforest. As you walk between the trees, you are stepping on soil. Beneath your feet is the bottom-most layer in an agroforest and the base from which everything grows (see pages 28–29). Staying close to the soil are **herbaceous plants** (see pages 30–31). Most of them are small but some can grow taller than a person. You will also see **shrubs** and **small trees** (see pages 32–33). They all grow well in the shade because they are adapted to grow under the cover of taller trees. As you look up, you see the branches and leaves of the **medium trees** and **large trees** (see pages 34–37). They catch most of the direct sunlight above you and make shade for the plants below.

As you look back down on the ground, you realize that the agroforest is **multilayered**. It seems to consist of different layers: the bottom layer with soil and plant roots, the **understory** layer made of herbaceous plants and shrubs and small trees, and the **canopy** layer of medium trees and tall trees at the top.

Agroforests have different sizes of plants.

Plants of different sizes form layers: short ones stay near the bottom, tall ones reach to the top.

LARGE TREES

MEDIUM TREES

SHRUBS AND SMALL TREES

HERBACEOUS PLANTS

SOIL AND ROOTS

CANOPY

UNDERSTORY

The variety of **species** in an agroforest depends on the local environment and the local people's needs. By **intercropping**, or growing different plants and trees together, we make the best use of land and get lots of different crops from a limited area. People carefully arrange trees and other plants so that they grow well together and do not negatively affect each other's needs for space, nutrients, water, or sunlight. For example, crops with deep roots are planted next to crops with shallow roots so that their roots do not huddle together. Short crops that like shade are planted beside tall crops that provide shade. Vines, such as yams and pepper, are placed next to small trees on which to climb. Fast-growing plants, especially bananas, are planted to provide shade for seedlings of other plants that might be hurt by too much sunlight or strong rain. Salt-resistant plants are grown near the shore to control erosion and prevent salt spray from getting to more sensitive plants.

Can you find me?

At the bottom of this page is a picture of an agroforest with many different trees and other plants. Note how they differ in height and belong in different layers.

Do you see breadfruit? Pandanus? Banana? Taro?

Different plants will be easier to notice if you look at the pictures on pages 28–37. Each set of facing pages is about a particular agroforest layer. It features some of the key crops from that layer and highlights them in the agroforest picture shown at the bottom. Can you match the key crops from each layer with the plants shown in the agroforest picture?

Try
this

LAYERS IN AN AGROFOREST

- 
LARGE TREES
Layer at the top, where the tallest trees are.
- 
MEDIUM TREES
Layer consisting of trees, except for the tallest ones.
- 
SHRUBS AND SMALL TREES
Layer consisting of small woody plants, not as big as the majority of trees.
- 
HERBACEOUS PLANTS
Layer nearest to the ground, where small plants without woody parts grow.
- 
SOIL AND ROOTS
Layer at the bottom, where the roots of all plants grow.



SOIL AND ROOTS

Trees and most other plants grow from the soil. Soil is where the roots are and from where plants get water and nutrients they need. Farmers **propagate** (multiply and spread) plants by taking certain parts that can develop into whole new plants and carefully placing them in the soil. People use **seeds** to grow papaya, watermelon, pumpkin, tomato, coconut, and other plants. **Shoots** are young branches or “suckers” that grow from the main plant and **cuttings** are pieces cut by people from the main plant. They can be placed in the soil on their own to grow banana, cassava, sugarcane, and other plants. Some plants have **tubers** and similar enlarged roots. People cut and place them into soil to grow taro, yams, cassava, and other **root crops**.

Root crops are those plants where the part we eat is underground. Some of the key root crops in the Pacific islands are highlighted in the picture below and outlined on the next page. Root crops are an essential kind of food, something that Pacific Islanders could not survive without. Next time you eat, look at the local food on your plate and think about which comes from roots. There are good reasons why many of our most important kinds of foods are root crops. Tubers and other enlarged roots are where plants store their extra energy in the form of carbohydrates. When we eat these roots, we take in that energy and many important nutrients, vitamins, and fiber. These roots are especially valuable because they can be stored for long periods of time, making them important resources during droughts and after storms. Root crops like yams, taro, kava, and turmeric also have special cultural significance on many islands.



TARO

Colocasia esculenta

Taro is one of the most important foods grown in the Pacific. Its roots and leaves are cooked in many ways. It also plays an important role in culture.



SWAMP TARO

Cyrtosperma merkusii

The swamp taro is a huge relative of taro. It is one of the main foods on atolls. It grows in wet places, especially pits dug by people for that purpose.



GIANT TARO

Alocasia macrorrhizos

Giant taro grows in moist and shady places. It is less popular than other kinds of taro because its roots may need to be cooked for long to get rid of the bitter taste.



TANNIA

Xanthosoma saggitifolium

This relative of taro is originally from South America, but it is now popular in the Pacific. On most islands people think of it as a variety of taro.



YAMS

Dioscorea spp.

The yam is a high-climbing vine. Its roots are a valuable, prestigious food. On some islands, large yams are featured in ceremonies and presented to chiefs.



KAVA

Piper methysticum

Kava roots are used to make a drink that helps people relax. Kava is grown all over the Pacific and is locally important to the culture and economy.



ARROWROOT

Tacca leontopetaloides

Arrowroot grows easily, almost wild. Its nutritious roots are a source of starch. They can be ground into flour for making bread.



CASSAVA

Manihot esculenta

Cassava grows best on high islands. Its roots are rich in starch. The starch we get from cassava is known as tapioca and can be used to make flour.



SWEET POTATO

Ipomoea batatas

The sweet potato has starchy tubers and vitamin-rich leaves. It comes in many varieties and is popular on both high islands and low-lying islands.



ISLAND GINGER

Zingiber zerumbet

Varieties of ginger grown in the Pacific are used as medicine, to add flavor to foods, and to make cosmetics such as soap and shampoo.



TURMERIC

Curcuma longa

Turmeric roots add color and flavor to food and have a great cultural value. On many islands, people mix grated turmeric with coconut oil and decorate their skin on special occasions.



HERBACEOUS PLANTS

Herbaceous plants are plants that do not have woody parts. A **stem** (main body) of herbaceous plants is often green and soft. This makes herbaceous plants very different from shrubs and trees, both of which have woody parts. Herbaceous plants can more simply be called **herbs**, but this can sometimes be confusing because many people use that word to refer only to those herbaceous plants that are used to add flavor to food.

Unlike shrubs and trees, which can live for many years, herbaceous plants live only one to several years. They die after they have produced fruits once or a few times and grow again from seeds or, sometimes, from parts that survive under the ground. This is why herbaceous plants are easily “rotated” by farmers. **Crop rotation** is when people change what they grow in a particular place and plant different kinds of crops each year or every few years. This rotation practice keeps the soil fertile and prevents pests and diseases from taking hold.

Herbaceous plants in the Pacific islands include those that have been locally grown for many generations, as well as relatively new plants brought in from other places. Some of the popular herbaceous plants used as food in the Pacific islands are highlighted in the picture below and outlined on the next page. The root crops described on pages 28–29 are also herbaceous plants. In addition to food, herbaceous plants also include plants that are important in local medicine, as well as many decorative plants that people grow for their flowers and beauty.



SUGARCANE

Saccharum officinarum

Sugarcane is a kind of tall grass. It can be processed to make sugar. Many people enjoy sugarcane by chewing on its sweet fibers.



PEPPER

Capsicum annuum

There are many varieties of peppers and some are very spicy. They grow well in different climates and are used in cooking all over the world.



KANGKONG

Ipomoea aquatica

Kangkong is also called “water spinach.” This plant grows in water or in moist soil. It is often mixed into dishes like soups and salads.



LONG BEANS

Vigna unguiculata

Long beans are a nutritious vegetable originally from Southeast Asia. They are becoming common in gardens in the Pacific islands.



PINEAPPLE

Ananas comosus

The pineapple’s tasty, juicy fruit make it a popular addition to many gardens. It is an important crop in Hawai’i, from where it is exported to other countries.



EGGPLANT

Solanum melongena

The eggplant is a close relative of the tomato. Its long, purple fruits can be cooked in many different ways.



TOMATO

Solanum lycopersicum

The tomato is originally a tropical plant from Central America, but is now grown all over the world. It can be eaten raw or cooked.



HOLY BASIL

Ocimum sanctum

Usually found growing around homes and alongside roads, the holy basil is valued for its pleasant smell. It is used as food, tea, and medicine.



SQUASH AND PUMPKIN

Cucurbita pepo

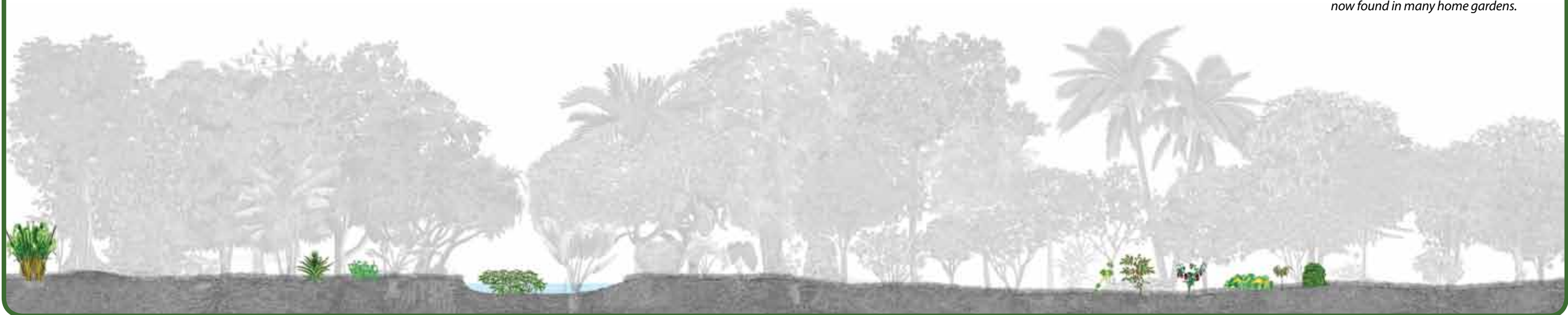
Squash comes in many varieties, some of which are called pumpkins. People eat the fruit and also young leaves and flowers of this plant.



CUCUMBER

Cucumis sativus

Like beans, eggplants, tomatoes, and similar vegetables, the cucumber is not a traditional plant in the Pacific. It is a delicious and refreshing vegetable now found in many home gardens.



SHRUBS AND SMALL TREES

Shrubs are plants that have woody stems, like trees. While a tree has one very long stem (called a **trunk**), a shrub has several stems. Shrubs are sometimes simply called **bushes**.

Shrubs and small trees grow taller than most herbaceous plants, but still have many bigger trees extending above them. In general, a shrub or small tree can be lower than a person or grow up to a few times taller than a person. Because they are taller than herbaceous plants, they get better access to sunlight. They live much longer than herbaceous plants. Only a few herbaceous plants, notably bananas and their relatives, grow tall enough to be thought of as small trees. Technically, though, they are not trees because they have no woody stems.

Among the many shrubs and small trees cultivated in agroforests are those used for food, medicine, materials, decoration, and other purposes. They include plants with deep cultural value. For example, the ti plant is highly respected in Hawai'i and throughout Polynesia for its spiritual power and numerous practical purposes. It is also valued in Melanesia, where it is used in rituals. Some of the shrubs and small trees common in the Pacific islands are highlighted in the picture below and outlined on the next page. They include plants brought to the islands in canoes in ancient times, as well as new introductions.



BANANA

Musa spp.

Bananas grow on small trees, which have no wood and are actually herbaceous plants. Bananas have been grown in the Pacific for a long time; there are many different colors, shapes, sizes, and flavors.



PLANTAIN

Musa spp.

Plantains are varieties of bananas that are less sweet and must be cooked before eating. They are an important food on many islands and are a great source of fiber for weaving.



PAPAYA

Carica papaya

The papaya is well known for its sweet fruit, but its young leaves and flowers are also a healthy food. Papayas grow well on atolls and other low islands because they prefer sandy soil.



PREMNA

Premna serratifolia

Premna grows well in sandy soil along shorelines. In the Pacific islands, it is used as medicine for headaches and other problems. In parts of Asia, people also boil and eat the leaves.



CHAYA

Cnidocolus aconitifolius

Chaya is also known as "tree spinach" because its highly nutritious leaves taste like spinach. The leaves must be cooked before eating to destroy a powerful poison they contain.



BELE

Abelmoschus manihot

This plant is one of the main leafy green vegetables on many islands. Its leaves are very nutritious and can be eaten raw or cooked.



TI

Cordyline fruticosa

Ti plant roots are eaten or used as medicine. The leaves make excellent thatch and local skirts. It is a culturally important plant. In ancient Hawai'i, only chiefs were allowed to wear it around their necks.



GUAVA

Psidium guajava

Guava has delicious, sweet fruit. It is also an ingredient in local medicine and is effective to treat diarrhea.



PLUMERIA

Plumeria spp.

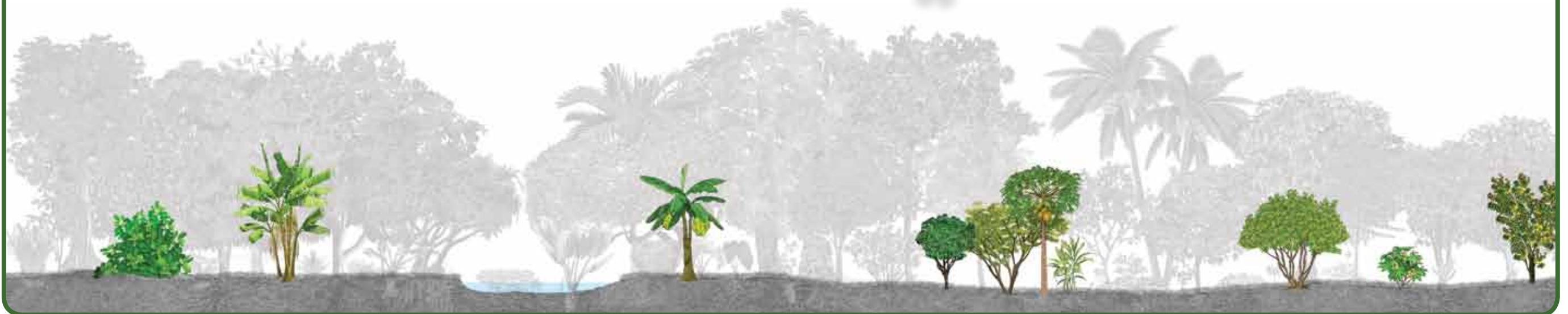
The plumeria tree is known for its beautiful and fragrant flowers, used to make head and neck garlands and to wear behind the ear.



STAR FRUIT

Averrhoa carambola

This plant makes tasty, juicy fruits whose cross-sections look like stars. The leaves of star fruit trees fold together each night, and also if touched.



MEDIUM TREES

Trees rise above other plants thanks to their very long and strong trunks. At a certain height above the ground, branches grow out from the trunk and spread out to hold numerous leaves. The tree spreads roots beneath the ground to anchor itself firmly so that it can grow upright and tall.

Medium trees grow tall enough to rise above shrubs and small trees, but they are still not the tallest trees in the agroforest. Medium trees in an agroforest include fully grown trees of many species, as well as trees that will continue to grow taller. Medium trees live for many years, and are adapted to grow under the shade of larger trees.

Like other plants in agroforests, medium trees are cultivated for different purposes, including food, medicine, and materials. Medium trees provide shade and protect smaller plants from too much sun or wind. They are especially important on low islands and in any other places where there are few large trees, or where large trees may be missing due to frequent storms or other reasons. Some of the medium trees that are important in the Pacific islands are highlighted in the picture below and outlined on the next page. Among them is pandanus, one of the most versatile medium trees in agroforests. It is prized on low islands because it grows well in sandy soil and tolerates salt in the air. It provides excellent food and useful materials, including thatch for roofs and mats for sitting and sleeping on.



PANDANUS

Pandanus tectorius

Pandanus grows well in many places, from beaches and wetlands to the mountains. Its fruit is an important food, especially on atolls. Leaves are used for medicine and for weaving.



CITRUS

Citrus spp.

Citrus is a group of fruit plants that includes limes, tangerines, oranges, grapefruit, and others. People eat raw fruits or make refreshing juices from them.



GARLIC PEAR

Crataeva speciosa

The garlic pear is an ancient crop grown on some Pacific islands. It is especially important on atolls. Its fruit can be eaten raw or cooked.



CACAO

Theobroma cacao

Cacao is famous worldwide because chocolate is made from its seeds. Cacao is grown on some islands to export and make money.



MORINGA

Moringa oleifera

Moringa is originally from India but is now found all over the Pacific. It grows very well on atolls. All parts of this plant are edible and full of vitamins and nutrients.



BEACH HIBISCUS

Hibiscus tiliaceus

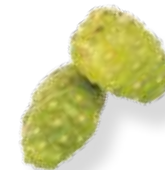
Beach hibiscus is native to the Pacific islands. Since ancient times, this plant was used to make canoe parts, ropes, and clothing. It is still very important today and has many uses.



SOURSOP

Annona muricata

Soursop is found more commonly on high islands. The white inside the fruit can be eaten raw or made into a juice. The leaves can be used as medicine.



NONI

Morinda citrifolia

Noni is one of the Pacific's most important medicinal plants. All parts of the tree have a use. The fruit can be eaten as a food, but is mostly used to cure skin problems, stomach troubles, and other sicknesses.



PAPER MULBERRY

Broussonetia papyrifera

This tree is very important in the culture of Hawai'i and other Polynesian islands. Its bark is pounded with water to create traditional fabric.



YLANG YLANG

Cananga odorata

The sweet-smelling flowers of ylang ylang are used to make garlands for people to wear on special occasions. The oil from the flower gives a pleasant scent to perfumes, soap, and cosmetics.



LARGE TREES

Large trees are the tallest plants in the forest. Some of them have wide, leafy branches that provide full shade and keep the lower layers of agroforests cool. Shade helps soil to retain moisture and makes a better environment for understory plants. However, while understory plants tolerate shade, they also need some light to grow well. That is why farmers plant large trees like breadfruit and mango farther apart so that plants below have enough sunlight. Other very tall trees, such as the coconut palm, create less shade below and can be planted closer together without blocking too much light. Planting large trees with enough space between them ensures that the understory gets the right amount of shade, and is kept at the right temperature and humidity level to grow well. In addition, large trees have large roots, which means they hold the soil well and keep it from being eroded into streams, rivers, and the ocean. In this way, large trees keep water clean and benefit the things that live in the water, especially corals, which die if the water is not clear enough. Large trees are also a habitat for many living things, especially the kinds of birds that like to nest high above the ground.

Large trees grow slowly and live long lives, often longer than the people who plant them. When farmers plant large trees, they do so thinking of their children and grandchildren. Some of the common large trees in the Pacific islands are highlighted in the picture below and outlined on the next page. They may not always be tall and may be smaller depending on variety and local conditions. These trees provide many things for people—food, medicine, materials, especially building materials for large houses and canoes.



BREADFRUIT

Artocarpus altilis

Breadfruit is one of the most important Pacific plants. There are hundreds of varieties. It is the source of food, medicine, wood for construction, and other materials.



TERMINALIA

Terminalia spp.

Terminalia is a tall, native tree, especially common on atolls. It is a source of great quality timber, used in the building of canoes and houses.



LOCAL CHESTNUT

Inocarpus fagifer

This tree has been planted since ancient times. Its highly nutritious fruit is eaten boiled or roasted. Leaves and bark are useful as medicine.



BEACH MAHOGANY

Calophyllum inophyllum

This large, native tree usually grows near the shore. Its very hard wood is highly valued for canoe building. It also has medicinal uses.



CORAL TREE

Erythrina variegata

This tree is planted as a living fence or decoration because of its beautiful, large red flowers. Its leaves have use in medicine. The wood is light and can be used to make outriggers, floats, surfboards, and other things.



COCONUT

Cocos nucifera

This is one of the most useful plants in the world and a true “tree of life” in the Pacific. It is a source of water, food, medicine, and materials. Every part of the coconut tree has various uses.



MANGO

Mangifera indica

The mango tree was introduced to the Pacific islands. It gives great shade. The delicious fruit is eaten raw or pickled, and wood can be used for construction.



BETEL NUT

Areca catechu

Betel nut grows on palm trees and is mainly chewed for recreation. This is not healthy, but it is a custom on some islands.



LOCAL APPLE

Syzygium spp.

The Pacific islands have several species of native and introduced plants with apple-like fruits. These fruits are eaten raw and are sweet, juicy, and refreshing.



CANDLENUT

Aleurites moluccana

The nuts of this tree are roasted for food or medicine. Long ago, nuts were burned like candles and used to make ink for traditional tattooing. In Hawai'i they call it *kukui* and people use it to make moisturizer oil.



WHY IS SOIL IMPORTANT?

Soil is a thin layer that covers the land. It comes from the breakdown and decay of rocks, which naturally fall apart into smaller pieces. Soil is full of stones, pebbles, sand, mud and **minerals** (the tiniest piece of rock) from which it came. However, soil is not only crushed rock. There is air and water in the soil, and there are also significant amounts of **organic matter**—remains of living things.

When you take a close look at soil in the ground, you will see that it is full of life. The underground portions of plants, their roots, are all embedded in soil. But soil contains more than plant roots. It is also home to other living things, especially **microorganisms** (bacteria and other very tiny living things) and **fungi** (mushrooms and their relatives).

Microorganisms are so small that we need a microscope to see them. There are so many of them that a few teaspoons of soil can contain more microorganisms than there are people in the entire world. There are also larger creatures we can see in the soil, such as insects, worms, snails, and other small animals. All these living things inhabit the soil and take part in its formation.



Plant growth begins when seeds **germinate** in the soil. Soil drives plant growth by providing water and nutrients for plants. The better the soil, the bigger and healthier the roots will grow to build bigger and healthier plants.

Living things in the soil are very important. Microorganisms feed on organic matter—fallen leaves and fruits, twigs, pieces of bark and roots, waste from animals, things that died—and turn it into nutrients that can be used by plants. Plants take up those nutrients along with the water they get from the soil through their roots. Microorganisms that decompose (break down) organic matter and allow nutrients to be recycled are called **decomposers**. This organic matter enriches the soil and makes it **fertile** (capable of supporting plants). People can improve soil health by adding organic matter (see page 51). Without soil, there can be no agroforests, and almost no other life on land. Nearly all land plants in the world grow from soil and depend on it.

Soil supports all life in an agroforest and is vital to life on earth.

Microorganisms have other important roles. Some of them make additional and essential nutrients from **nitrogen** they get from air. Others break down pollutants and clean up water as it moves through soil. Some microorganisms eat **pests** that can attack plants and limit outbreaks of plant **diseases**. Some microorganisms become food for bigger living things, which also contribute in positive ways. Worms and small animals dig through the soil as they crawl around. They create air pockets that allow water and air to flow through the soil. This helps plants take in the air, water, and nutrients they need through their roots.

Finally, in addition to supporting plants and other living things in agroforests and elsewhere, soil greatly affects the environment and reduces global warming and climate change (see pages 60–63 and 78–79).

WHAT FOOD DO WE GET FROM AGROFORESTS?

Nearly every plant in an agroforest has one or several uses. Over the centuries, people have worked hard to grow exactly those plants that they needed. As long as we take care of agroforests and learn from our elders how to maintain and use them, we can turn to them for food, drink, medicine, fuel, and a variety of materials.

Agroforests provide us with food to eat.

AGROFORESTS PROVIDE SUSTENANCE



NOURISHMENT (FOOD)

Fruits, roots, and leaves of various plants in agroforests contain nutrients to keep us healthy and strong.



HYDRATION (DRINK)

Many fruits, vegetables, and nuts have high water content. Eating them gives our bodies water.

NOURISHMENT (FOOD)

We cannot live without eating. Our bodies and minds need nutrients to function. A **nutrient** is anything that nourishes a living thing—like carbohydrates, fats, proteins—and gives it energy to live. People get nutrients from things they eat. Many local fruits, vegetables, root crops, and nuts we eat in the Pacific islands come from agroforests.

STAPLE AND NON-STAPLE FOODS

A staple is food that is eaten often, nearly every day. It is a major part of our diet and is the greatest source of nutrients. Staple foods vary with place and culture. The key island staples are breadfruit, taro, coconut, pandanus, and yams. We eat other, non-staple foods as well, but not as much and not as often. Agroforests are the source of both staple and non-staple foods.



Breadfruit is an island staple.



Cucumber is not a staple.

PRESERVED FOOD

Preserving food to use later is a life-saving island tradition. We can preserve food by drying, fermenting, pickling, and making flour. Preserved food ensures a food supply in the off-season, on canoe voyages, and after disasters.



Preserved breadfruit is a respected food. It is known as **maare** (Yap), **bwiro** (Marshall Islands), **maar** (Chuuk), **mahr** (Pohnpei).



In Pohnpei, yams (called **keh**) are presented to leaders during feasts (called **kamadipw**).

PRESTIGE FOOD

Certain plants, such as yams and kava, have great cultural value on some islands. They are offered to chiefs during special times of the year. Farmers who grow them successfully earn prestige in their communities.

EMERGENCY FOOD

Some plants are not normally eaten, but can be when other foods are not available. If there is a major food shortage for any reason, these plants can help people survive.



The air potato is a relative of the yam. Though poisonous, it can be eaten if specially prepared and cooked. Micronesians have eaten it during wars and other difficult times.

ANIMAL FOOD

Agroforests do not feed just people. They provide food for chickens, pigs, and even chum for fish.

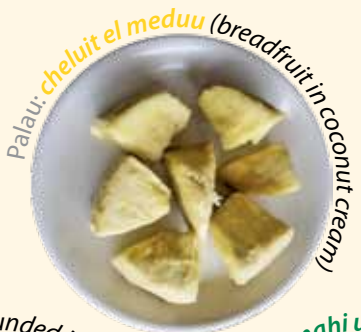


Copra (dry coconut meat) is the chief export of many small islands.

ECONOMIC SIGNIFICANCE

Food made in agroforests can be sold for cash at local markets, as well as exported across the globe. The income supports many families and benefits the local economy.

Pounded breadfruit (known as **kkón**), sold at a local market in Chuuk.



Some popular island dishes made from breadfruit, a staple food.

HYDRATION (DRINK)

Most of a person's weight is water. Water is the main component of every cell and participates in every function of your body. Most functions, nearly everything we do, from breathing to getting rid of waste to walking, causes the body to lose water. A person must replace that water in order to stay alive.

We get water not just by drinking water itself, but also from the food we eat. Many fruits, vegetables, and nuts from agroforest have a high water content. Eating them replenishes the water in our bodies.

COCONUT "WATER"

The "water" inside coconuts is actually about 95% water, naturally enriched with nutrients. It is a refreshing and healthy drink.



A young coconut contains up to 1 liter (quarter of a gallon) of water.

Coconuts are an important source of water, especially in emergencies.

On islands where there are many coconuts, children drink them every day. Where supply is more limited, coconuts are consumed mostly when there is no clean water available.

Coconut tree is one of the world's most useful plants. Nuts provide drink, food, oil, medicine, husks to make rope or burn as fuel, and shell material from which we make utensils, decorations, and jewelry. Leaves have endless uses when woven into baskets, mats, roofs, hats, and more. Trunks provide building material and firewood.



JUICES



Juice is obtained by squeezing fruits. Even fruits that might not seem "juicy," contain lots of liquid. For instance, pandanus juice is a popular local product in the Marshall Islands.



We can make juices from agroforest fruits. We can squeeze oranges to make orange juice or mix lemon juice with water to make lemonade. We can also blend fruits, like mango and soursop, to make smoothies. Local fruit juices taste sweet and are healthier for us than bottled drinks because they retain the fruit's nutrients and have no added sugar or artificial flavors and colors.

Noni juice is too bitter to make a tasty drink, but is appreciated for its health benefits. It is produced on many islands and exported to other places, which helps the local economy.



INTOXICANTS

Some liquids we get from agroforest plants are used for reasons other than quenching thirst. They produce different effects on the body—some bring relaxation, while others dull or heighten senses. They may cause health problems if consumed too much.



Sweet sap that drips from the cut coconut flower bud is a delicious and highly nutritious drink. It is known as **jekaro** (Marshall Islands), **áchi ngar** (Chuuk), **gachiimëm** (Yap), **sikaliwi mom** (Pohnpei). Some people ferment it to make an alcoholic drink or cook it to make sugary syrup and candy.



Bark of cinnamon tree makes a relaxing tea.



In many communities, a drink of kava is consumed at special cultural ceremonies.



Roots of kava plant are pounded to make a sedative drink. It is known as **sakau** (Pohnpei), **seka** (Kosrae), and **'awa** (Hawai'i).

WHAT RESOURCES DO WE GET FROM AGROFORESTS?

Agroforest trees and other plants are not just sources of food. Nearly every tree in an agroforest is a **multipurpose** tree.

This means the tree has more than one use. For example, the coconut palm gives us food, drink, medicine, firewood, fertilizer, and materials for building houses and making things. Over the centuries, people have worked hard to promote the growth of multipurpose trees and any other plants that they needed. As a result, the agroforest is essentially a living collection of food and resources that serve many purposes.

Agroforests provide us with resources to use.

AGROFORESTS PROVIDE RESOURCES



MEDICINE

Plants can provide many forms of healing when we are sick or injured.



FUEL

Plant materials are used as fuel for cooking, heating, and even to power engines.



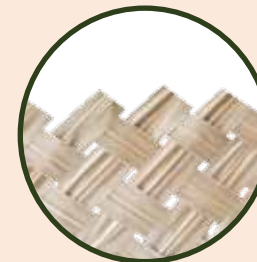
FERTILIZERS

Plants are used to improve soil by adding nutrients to it.



BUILDING MATERIALS

Wood and other plant parts are used to build houses and canoes.



OTHER MATERIALS

Plants are used to make fiber, rope, fabric, clothes, baskets, mats, tools, and other things.

MEDICINE

Plants are the source of almost all medicines that people use. That includes local as well as Western medicine. Though Western medicine comes in the form of a pill or something else made in a factory, it also contains medicinal ingredients from plants. Agroforests are like living pharmacies, with many plants that people with appropriate knowledge can use to treat illnesses and improve health.

Many plants have medicinal properties and can be used to treat health problems.

TRADITIONAL HEALING

Many local plants are used to treat specific conditions and restore health. Some are eaten, some are made into drinks, some are applied on the skin and body or used for massage. People grow healing plants in agroforests so that they are readily available if needed. People with knowledge how to use the plants to heal are called **healers** and some of their knowledge is kept secret.

Banana is a versatile medicinal plant. Its fruit is rich with vitamins and potassium. Its small shoots can be boiled and made into a drink to alleviate pains and body aches. Its leaves can be pounded and mixed with coconut oil into a cream to reduce swelling. Larger leaves and the trunk can be crushed into bath water for a healing soak for injuries. Its roots can be mixed with ash to ease a toothache.

HEALTHY DIET

Traditionally, in the Pacific islands, all food was from the local land and ocean. Nowadays, much of what we eat is imported. We may not know where it comes from, how it is made, or what is in it. Our local food is familiar, safe, and healthy. A diet of local fruits, vegetables, root crops, and water instead of sugary drinks is a form of medicine. It keeps the body healthy and strong.



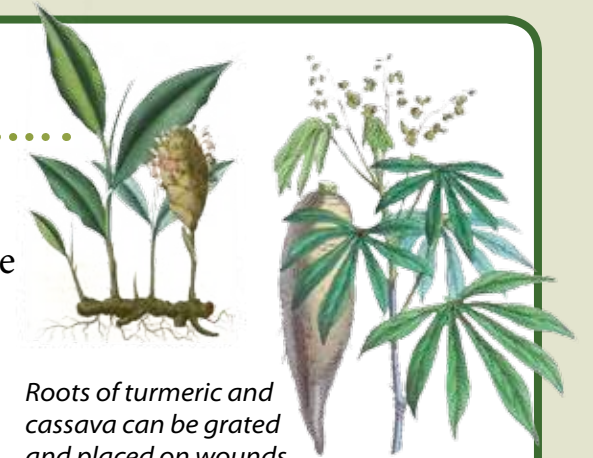
POULTICES AND DRESSINGS

Plants from agroforest can be used to make **poultices** (to draw toxins from stings and reduce inflammation) and **dressings** (to cover wounds, cuts, and burns).



Noni leaves can be used as a dressing or bandage for sprains.

Papaya can be applied to jellyfish stings to take the poison away from the skin.



Roots of turmeric and cassava can be grated and placed on wounds and sores for healing.

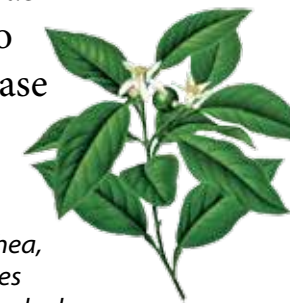
MASSAGE

On some islands, experts in traditional massage use oils from local plants to help when someone breaks a bone, hurts a muscle, or has a similar injury.

HERBAL TEAS

Many agroforest plants can be made into teas that we can drink to ease pain and increase comfort.

Tea from pandanus leaves can be used to treat diarrhea, and tea from citrus leaves can be used to ease headaches.



Massage oil is often made from coconuts or beach mahogany, with added medicine from other plants.



Exploring local ways of healing

Try this

Ask an elder in your community about traditional medicine.

What are some of the diseases that local plants can prevent or treat?

For what are some of the plants used? Where do you find them?

How do you make the medicine — which parts of the plants can you use?

How do you give the medicine to the person(s) who need it?

FUEL

Just like eating plants gives us energy, burning them releases energy. Plants can be used as fuel for heat and power.

FIREWOOD

On many Pacific Islands, making fire is the only way to boil water and cook, especially in rural areas where other fuel or electricity is hard to find or expensive. People use coconut husks and dry twigs, branches, and logs as **firewood**—fuel to make fire.



*The most popular firewood in Pohnpei comes from a tree that was brought from Asia and is not native to Pacific islands. It is locally known as **tuhke kerosin** ("kerosene plant") because it burns well.*



Starchy foods and large portions of meat must be cooked well and for an extended time. People traditionally bake such foods in a **ground oven**, lined with hot rocks that were previously heated by burning firewood. This is an ancient Pacific practice, as you can tell by the similar names used to refer to it in different places.

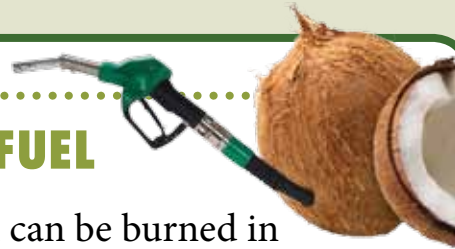
- Chuukese: **uumw**
- Hawaiian: **imu**
- Kosraean: **um**
- Marshallese: **um**
- Palauan: **klum**
- Pohnpeian: **uhmw**
- Samoan: **umu**
- Yapese: **wum**



Preparing meat to be cooked in a ground oven.

ENGINE FUEL

Coconut oil can be burned in diesel engines and some lamps and stoves. It can power our cars and boat motors and give us lighting and heat for cooking. This is cheaper, cleaner, and better for the environment than fuel made from oil.



FERTILIZERS

Agroforests provide natural materials that keep soil fertile. Plant debris is food for living things in the soil and provide nutrients to plants. Some trees are planted in agroforests specifically to improve soil conditions.

PLANT LITTER

Leaves and other plant parts that fall on the agroforest floor naturally recycle nutrients and keep soil healthy.



COMPOST

Plant remains, including leftover food, can be used as **compost**. Added to soil, compost boosts plant growth, especially for banana, taro, and various vegetables and seedlings.



MANURE

Animal waste is rich in nutrients and organic matter. This **manure** is collected and later added to soil to boost its fertility.



MULCH

Decaying leaves, bark, and chopped up wood can be spread over soil as **mulch**. Covering the soil with mulch enriches it with nutrients, and also protects it from rain and too much sun. Doing so lets soil stay cool and moist, which is good for plants.



Adding compost to a taro patch.

BUILDING MATERIALS

Plants from agroforests are used also to build houses and make canoes and furniture. **Timber** is wood prepared from trees for building and carpentry. Different trees are used for different purposes and shaped in different ways. Traditional builders know exactly what tree in the agroforest to use for the materials they need.

Houses and canoes

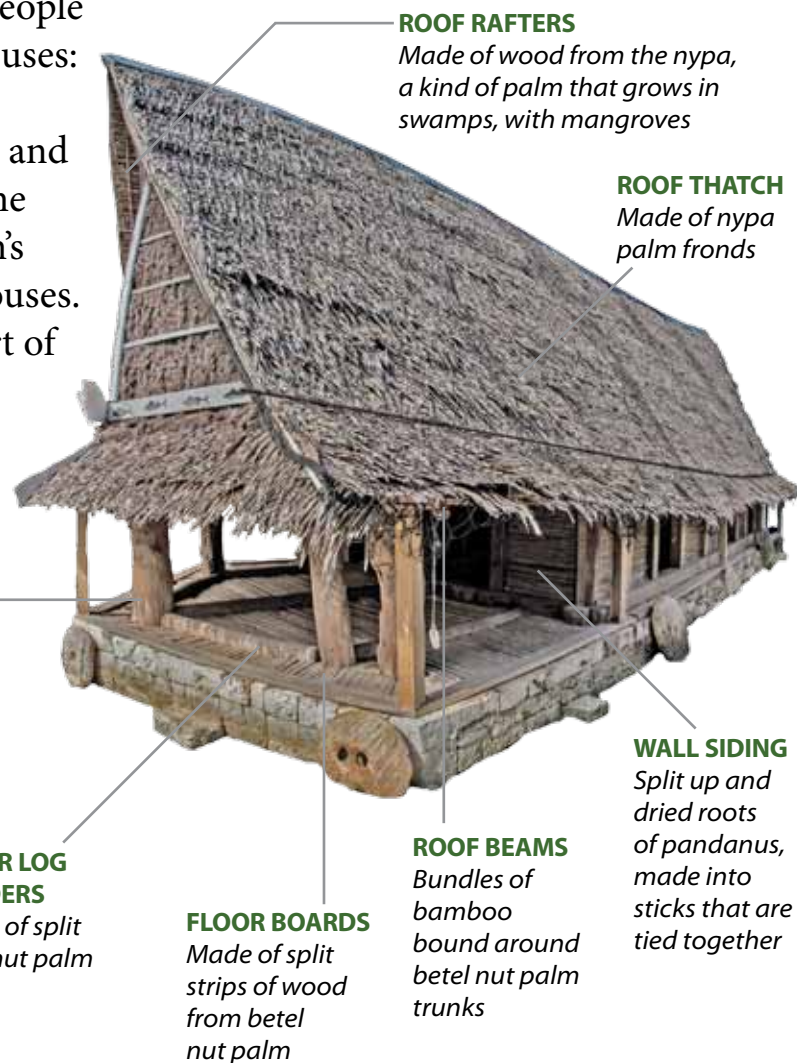
Compare and contrast the house from Yap and the canoe from the Marshall Islands with houses and canoes from your island. How are they similar and different? What plants are used on your island to make the different parts needed?

Try this

HOUSES

In the Pacific islands, people build many kinds of houses: family dwellings, cook houses, storage houses, and meeting houses. In some places we also find men's houses and women's houses. Traditionally, every part of these houses was built using local materials, many of which come from agroforests.

YAPESE MEN'S HOUSE
PEBAEY



ROOF RAFTERS
Made of wood from the nypa, a kind of palm that grows in swamps, with mangroves

ROOF THATCH
Made of nypa palm fronds

POSTS AND COLUMNS
Made of beach mahogany, the hardest and most termite-resistant wood on Yap. Breadfruit and mangrove wood are also used.

FLOOR LOG DIVIDERS
Made of split coconut palm logs

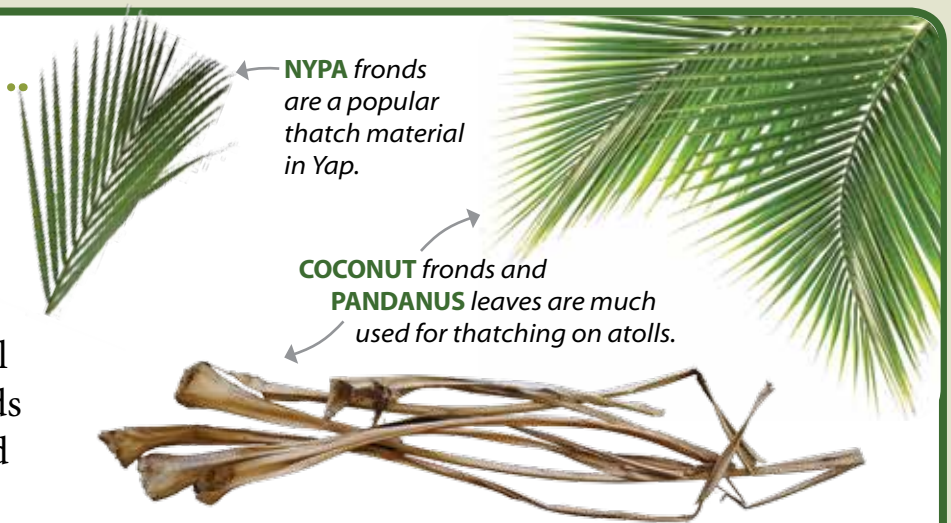
FLOOR BOARDS
Made of split strips of wood from betel nut palm

ROOF BEAMS
Bundles of bamboo bound around betel nut palm trunks

WALL SIDING
Split up and dried roots of pandanus, made into sticks that are tied together

THATCH

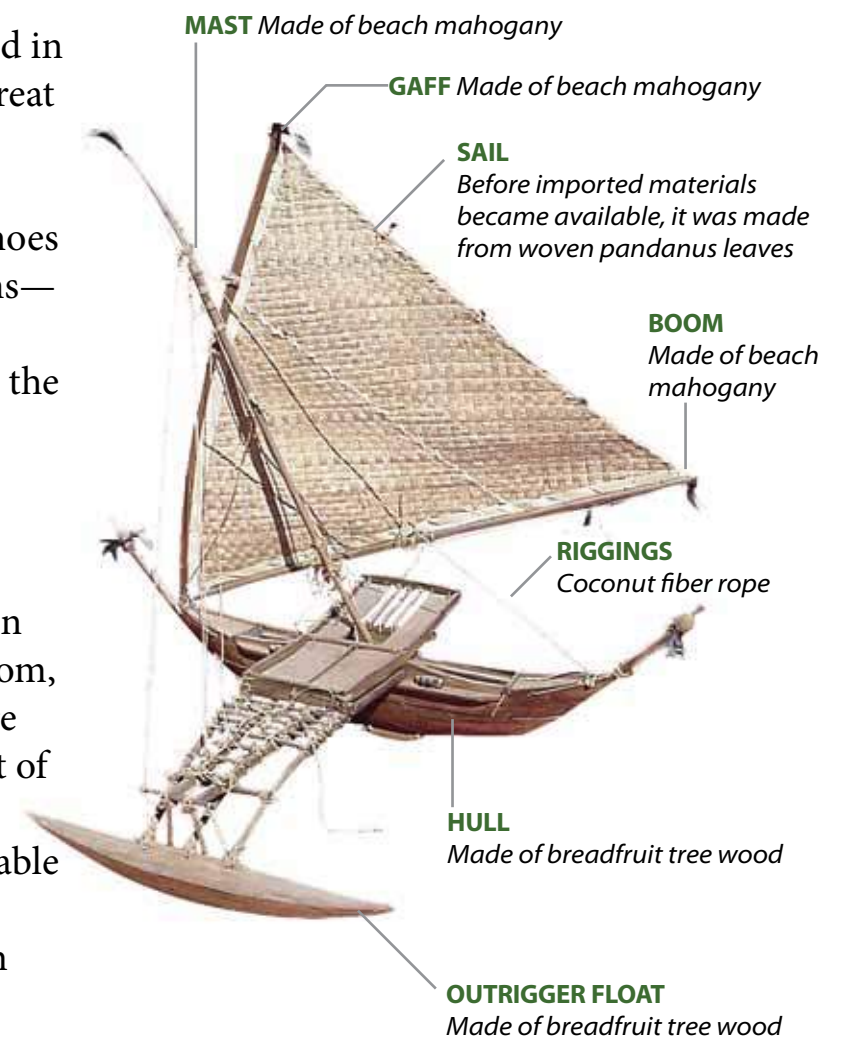
House roofs can be made from **thatch**, a natural building material made from fronds of palm trees and similar plants.



CANOES

Before there were airplanes, we travelled in canoes, sometimes great distances. Just like houses, there are different kinds of canoes for different functions—from small paddling canoes for fishing on the reef to huge sailing canoes for voyaging across open ocean. Canoes have unique features depending on the island they are from, but the basic parts are similar. For each part of the canoe, people choose the most suitable material from what they have available in agroforest.

MARSHALLESE SAILING CANOE
TIPÑŌL



MAST Made of beach mahogany

GAFF Made of beach mahogany

SAIL
Before imported materials became available, it was made from woven pandanus leaves

BOOM
Made of beach mahogany

RIGGINGS
Coconut fiber rope

HULL
Made of breadfruit tree wood

OUTRIGGER FLOAT
Made of breadfruit tree wood

OTHER MATERIALS

We have explored the uses of plants for nourishment, hydration, fuel, medicine, and building materials. Plants also provide materials for other things in our daily lives. These pages present a few examples. There are many more, so as you read on, think about how agroforest plants are used in your own life at home, school, and in your community.

FIBER, ROPES

We extract fiber from different parts of plants and twist it to make ropes. Accessible sources of fiber are husks of coconuts, skin of banana tree, bark of paper mulberry and hibiscus trees, and leaves of pandanus.



Coconut husks are soaked in water for days and then beaten to separate the fibers. They are then dried and twisted into cords, which are further twisted to make rope.

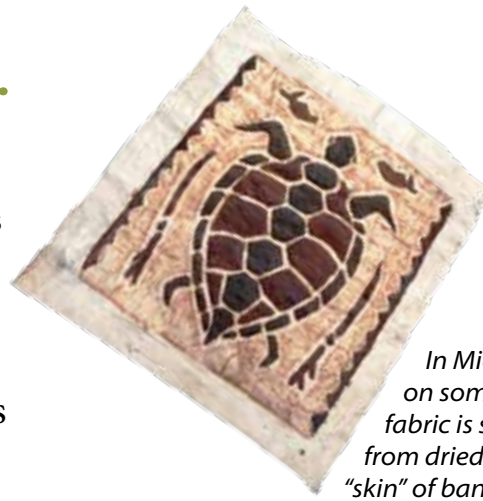
BASKETS, MATS



A lady in Kosrae weaving a mat from coconut fronds.

FABRIC, CLOTHES

In the old times people wore clothes they made themselves from agroforest plants. Even today, people wear grass skirts and lavalavas made of fabric woven from hibiscus or banana fibers on special occasions.



In Micronesia, on some islands fabric is still made from dried outer "skin" of banana trees.

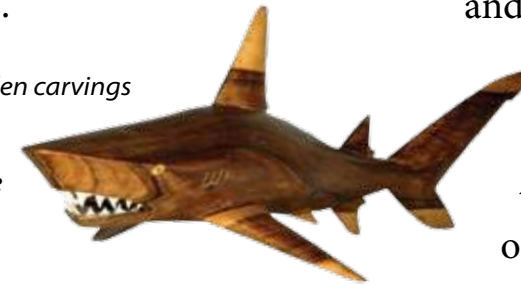
In Polynesia, the bark of paper mulberry tree is pounded to make paper-like cloth for wearing and using in ceremonies. These especially prized cloths are called *siapo* in American Samoa and *kapa* in Hawai'i.

Leaves of pandanus, coconut, and different palm trees are woven to make baskets and mats. Some baskets and mats are for everyday use at home. Some are given as gifts or ceremonial offerings during special occasions.

TOOLS, CRAFTS

Wood from many trees—such as breadfruit, terminalia, beach mahogany, coconut—can be made into tools, boxes, fishing gear, traps, utensils, statues, combs, necklaces, toys, handicrafts for sale, and many other things.

The sale of wooden carvings and handicrafts is an important source of income on many islands.



EXTRACTS

Different plants feel, smell, and taste differently because the chemicals inside them are different. We extract chemicals from some plants and use them to make many things—dyes, paints, cosmetics, resins, glues, oils, fragrances, deodorants, insect repellent, flavorings, and even poisons.

The sticky, milky sap from the breadfruit tree was traditionally used to seal joints on canoes.



Oil made from candlenuts was used in Hawai'i as a protective coating for the canoe hull.

Coconut oil is used as medicine, as a cosmetic, for massages, for cooking, and even as fuel for lamps.



Barringtonia is also known as "fish poison tree" because people used to pound its seeds and other parts to extract a chemical that can stun fish in small streams and pools on the reef.

DECORATION

We appreciate plants as a source of beauty and plant them to decorate gardens and villages. We use leaves and flowers to make colorful garlands to adorn our bodies.



People have spread some plants with beautiful flowers throughout the Pacific.



The flowers of certain trees, like ylang-ylang and plumeria, give off pleasant fragrances. We add those fragrances to soap, coconut oil, cosmetics, and other local products.

WHO LIVES IN AGROFORESTS?

Agroforests are a habitat for many living things besides plants. There are also microorganisms, fungi, and animals. Animals include **invertebrates** (animals without a backbone, such as worms, snails, insects, crabs) and **vertebrates** (animals with a backbone, such as lizards, birds, bats). All these living things live, feed, grow, interact, and reproduce in agroforests. They also do many things for the agroforest and make it better and more productive. For example, we have already learned the importance of living things in the soil and what they do for the entire ecosystem (see pages 38–39). Other animals also do their part to keep the agroforest healthy. Insects, birds, and bats **pollinate** flowers, which makes it possible for those flowers to develop into fruits. Some insects and birds are also a natural form of **pest control**. They eat pests and protect the plants from damage. Many birds feed on fruits and excrete the seeds they have eaten. That is advantageous for the **dispersal** of plants so that they can spread across wider areas and to other islands.

People also use the space available in agroforests to raise their **domestic animals**. Pigs are tied under trees or sometimes allowed to roam around. Chickens range freely and forage. On larger islands, cattle graze under the canopy of coconuts and other trees. These animals perform a service to agroforest: they eat **weeds** (unwanted plants) and **fertilize** land with their waste. They also provide meat, eggs, and milk for people.



AGROFORESTS PROVIDE HABITAT



WILD ANIMALS

Animals, such as insects, lizards, birds, and bats, can find living space and food in agroforests.



DOMESTIC ANIMALS

Animals that people keep, such as chickens and pigs, stay and feed in agroforests.

Try this

Getting to know animals in agroforest

Look at the photos on this page. Which are invertebrates and which are vertebrates? Which are wild and which are domestic? What does each of them eat and what does it do in the agroforest? Which ones pollinate flowers, eat pests, disperse seeds, eat weeds, and fertilize the land?

On the next two pages, look carefully at the illustration of living things in their agroforest habitat. Which plants and which animals do you see in the picture? How many kinds of insects, lizards, and birds can you find in the picture? Now imagine or go visit a cleared area, such as a lawn or a field with only one kind of plant planted everywhere. Would you see many kinds of animals living there? Are there more or fewer kinds of animals in such places compared to agroforests? Why is that?

ANIMALS IN AGROFOREST

Agroforests provide places for many plants and animals to live.



BIRD

BAT

BIRD

INSECT

BIRD

LIZARD

BIRD

INSECT

SNAIL

INSECT

SPIDER

BIRD

CRAB

CHICKEN

SNAIL

LIZARD

MILLIPEDE

PIG

TOAD

WORM

WHAT DO AGROFORESTS DO FOR ISLAND ENVIRONMENTS?

Though agroforests are man-made, they are valuable not just to people, but also to the environment. They have been around for centuries and have become a part of the Pacific islands as we know them.

Agroforests are beneficial for the environment.

AGROFORESTS PROVIDE SERVICES



KEEPING SOIL HEALTHY

Leaves, twigs, and other plant litter fall on the ground and are naturally recycled by decomposers. This process keeps soil rich in nutrients and supports healthy decomposer communities.



SHADING AND WINDBREAKS

The shade made by trees keeps moisture in the ground and makes land more fertile. Trees also shelter villages from wind and block salt spray from the ocean.



REDUCING EROSION AND IMPROVING WATER QUALITY

Soil filters water that passes through it, and this soil is kept in place by tree roots. Without trees, soil would wash away, especially on sloping land. Thus, agroforests keep streams, wells, and coastal areas clean by reducing soil erosion.



SEQUESTERING CARBON

Gas **carbon dioxide** (CO₂) in the air increases global warming. Plants reduce the amount of carbon in the air by turning it to **biomass** (roots, trunks, branches, leaves), organic matter, and soil. Carbon that is sequestered (stored) in this way does not contribute to global warming.



SUPPORTING BIODIVERSITY

By providing habitat for many kinds of animals and plants, agroforests preserve biodiversity (variety of living things) on our islands.

BENEFITS OF AGROFORESTS

The primary reason people engage in agriculture is to produce food. We have to grow food to survive, and when we do it, we alter the natural environment. Agroforests are a way to ensure that the changes we make to the land do not drastically change the environment. Agroforests preserve healthy soil, clean water, and biodiversity. When a wild forest is changed to an agroforest, its services to the environment do not end. The agroforest functions as a part of the ecosystem while also providing healthy food and other things we need.

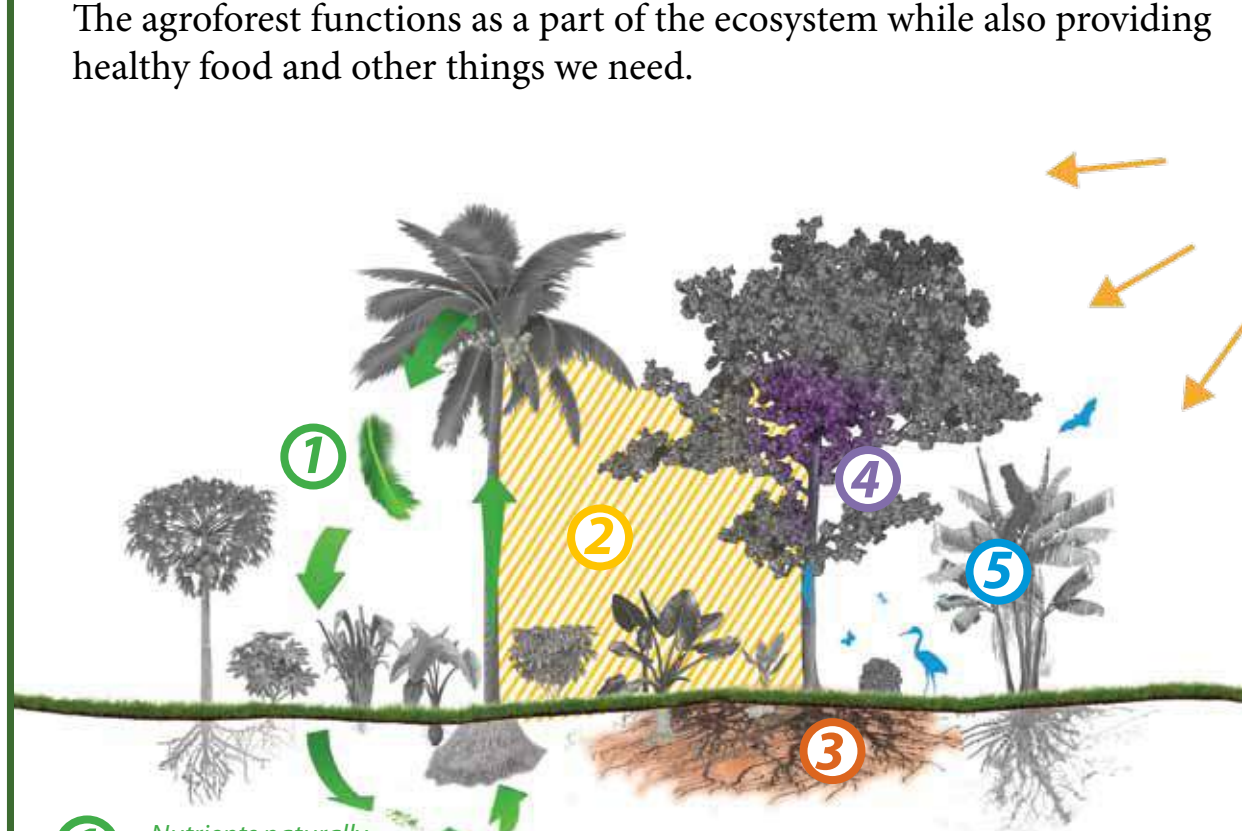
Other types of farming are not as beneficial for the environment. This is especially true of **monoculture**, a method of farming in which land is completely cleared to plant a single crop over a large area. It is an efficient way to grow as much of one kind of plant as possible, but it destroys the habitat for nearly all other living things in the area.

Without plants and animals, the land is poor and vulnerable. Crops are more susceptible to pests and diseases and require man-made chemicals:

pesticides for pest control,
herbicides to kill weeds, and
artificial **fertilizers** to replenish soil.

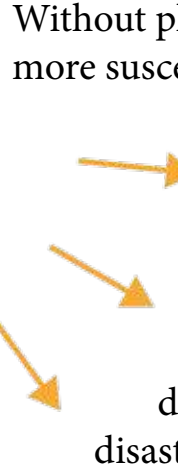
Food grown in the presence of these chemicals is not as healthy as the natural food from agroforests.

In addition, monoculture plantations are at higher risk of destruction due to outbreaks of pests and diseases, natural disasters, and the effects of climate change. This is because they lack the biodiversity and flexibility of agroforests and natural ecosystems.



- ① Nutrients naturally recycle. Soil remains fertile.
- ② Tall trees provide shade for plants that need it and help keep soil moist.
- ③ Tree roots hold soil in place. That prevents it from being washed off by rain into streams, wells, and ocean.

- ④ Plants, especially large trees, absorb CO₂ from air and transfer it to biomass and soil.
- ⑤ Availability of habitat supports biodiversity, which makes the agroforest more resistant to diseases and other problems.



- X Soil is being depleted, so people add fertilizers and other chemicals.
- X No shade for the crops. Soil must be irrigated so that it does not dry up.
- X Soil is easily eroded. Rainstorms carry soil into streams and the ocean. Muddy water and chemical fertilizers from the soil harm living things and damage ecosystems, especially rivers and coral reefs.
- X Intensive harvesting and impoverished soil means that not much CO₂ is stored.
- X When land is cleared, habitats are destroyed and many living things disappear. Low biodiversity makes the crops highly vulnerable to pests and diseases. People spray crops with pesticides and other poisons, which harms the environment and can make food unhealthy for people.

AGROFOREST

MONOCULTURE

WHAT DO AGROFORESTS DO FOR ISLAND WAYS OF LIFE?

Long before there were stores and imports, all the food and things that Pacific Islanders needed came from the land and the surrounding ocean. It is not an accident that agroforests have exactly the plants that we need to survive. Generation after generation, our ancestors selected the useful trees and other plants and promoted their growth in the forests on the island. Over time, the agroforests became a part of the island environment that is closely interwoven with our own needs. In the process, the plants themselves changed too. People consistently nurtured those specific plants they found the most desirable and useful. After a long time, this selection process led to the many **varieties** of trees and other plants we have today (see pages 66–67).

But it is not only agroforests and plants that were shaped by people and our needs. Agroforests affect people, our way of life, and our cultures. Work in agroforests requires contributions of all community members, which keeps families strong and united. Different plants grow well in specific kinds of places, which influences how we divide land into sections and how we use the land. For example, land on some islands is divided into long strips. In Hawai‘i, such land sections extend from the shore to the mountains. On many atolls, they extend from the lagoon side to the ocean side of an island. In this way, each family or clan gets access to a variety of places to grow their crops.

The specific times and seasons when different tasks must be performed, such as planting and harvesting, influences the timing and kinds of special occasions we celebrate. When we work in agroforests, we are continuing the work that was started by our grandparents and their grandparents before them. When we take care of agroforests, we are doing it not just for us and our families today, but also for our children some day and their children’s children into the future.

Agroforests are a part of island culture.

AGROFORESTS HAVE CULTURAL SIGNIFICANCE



CONNECTION WITH LAND

By maintaining agroforests and getting the food and other things we need from them, we get to know the land that belongs to us and show that we value it and take care of it.



CONNECTION WITH PEOPLE

Working together in agroforests makes families and communities stronger. In many places, a person’s role and skills in farming and producing food determines her/his position in society.



CONNECTION WITH CULTURE

Agroforests influence the way we live, what we do and when we do it, our roles in family and community, traditions, beliefs, and languages.

Describing a tree or other plant in your own language

Try
this

To see just how important different plants are in our culture and way of life,

consider the many words we use for them. Look at a common tree or other plant —

such as breadfruit, banana, taro, coconut, pandanus, and yams — and write down all the words

you know that describe its various growth stages, various parts, and various uses.

Compare this vocabulary with English. Did you find more words in your language or English?

Why do you think that is so?

If you have classmates or friends who speak another language, ask them to tell you the names

in that language. Compare the names between languages. You will see that the names for basic

food plants are similar across the Pacific. Why do you think that may be?

CULTIVATED VARIETIES



When we say that agroforests are home to many species of plant life, we only begin to describe the diversity of living things they contain. Each species—especially if it is a staple food or otherwise culturally important—can include numerous distinct varieties. For example, the picture above shows bananas and the picture to the right shows yams sold in a local market in Pohnpei. The two words—banana and yams—are not enough to describe the produce seen there or hundreds of other banana and yam varieties found on the island. Each variety has its own name and differs from others in color, shape, texture, taste, or some other way. Different varieties are used for different purposes and have become a part of our way of life and culture. Some of the varieties are so unique that they exist only on one or few islands and nowhere else in the world. Each variety is the result of careful selection by people over a very long period of time and should be appreciated and cultivated, especially if it is becoming rare.

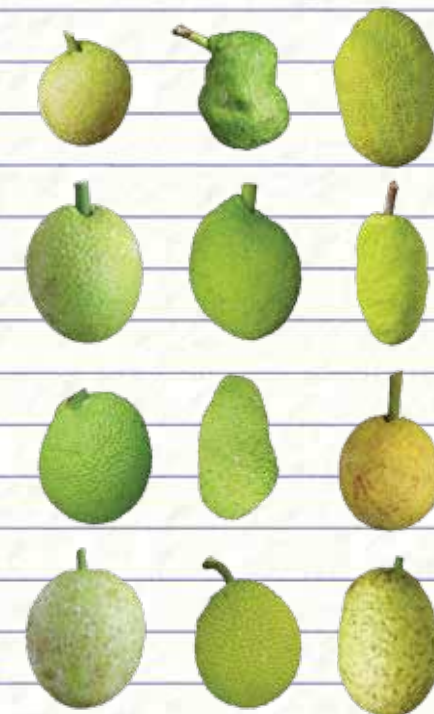
Try
this

Exploring varieties

Discuss with your teacher and classmates the varieties of breadfruit, bananas, taro, coconut,

pandanus, yams, and other important plants. Choose one of those species and ask your family and neighbors about the varieties that exist on your island.

Make a list of varieties you find out about and compare the list with those of your classmates. In addition to collecting names of varieties, you can take pictures, note special characteristics and ways different varieties are used, and share information with others. Each student can bring a fruit and a leaf of some variety to school and help the class make a collection. Because fruits and leaves will not stay preserved for a long time, make sure to take pictures of your collection. You could even make a poster for your classroom. Make sure that each photo on your poster is identified by name, such as in the example to the right, which shows some varieties of breadfruit from different parts of the Pacific.



WHAT CAN HARM AGROFORESTS?

Agroforests are man-made places and exist in a healthy state only as long as people take care of them and protect them from harm. They can be harmed by certain human activities and changes in the environment.

The key threats to agroforests are:

- ★ land clearing
- ★ cash crops
- ★ neglect
- ★ pollution
- ★ pests and diseases
- ★ invasive species

Agroforests are also at risk from climate change driven by human activities (see pages 72–75 and pages 82–87).

LAND CLEARING

destruction of agroforest

People clear land before they want to build something there. That means that trees are cut down and a forest gets destroyed before something else can be put in its place. Typical examples include the change from forest to monoculture farmlands or use of cleared space to build houses, shopping centers, hotels, parking lots, and other structures. This means a total loss of all agroforest benefits, from food and resources to habitat and services.



CASH CROPS

erosion, soil damage, diseases

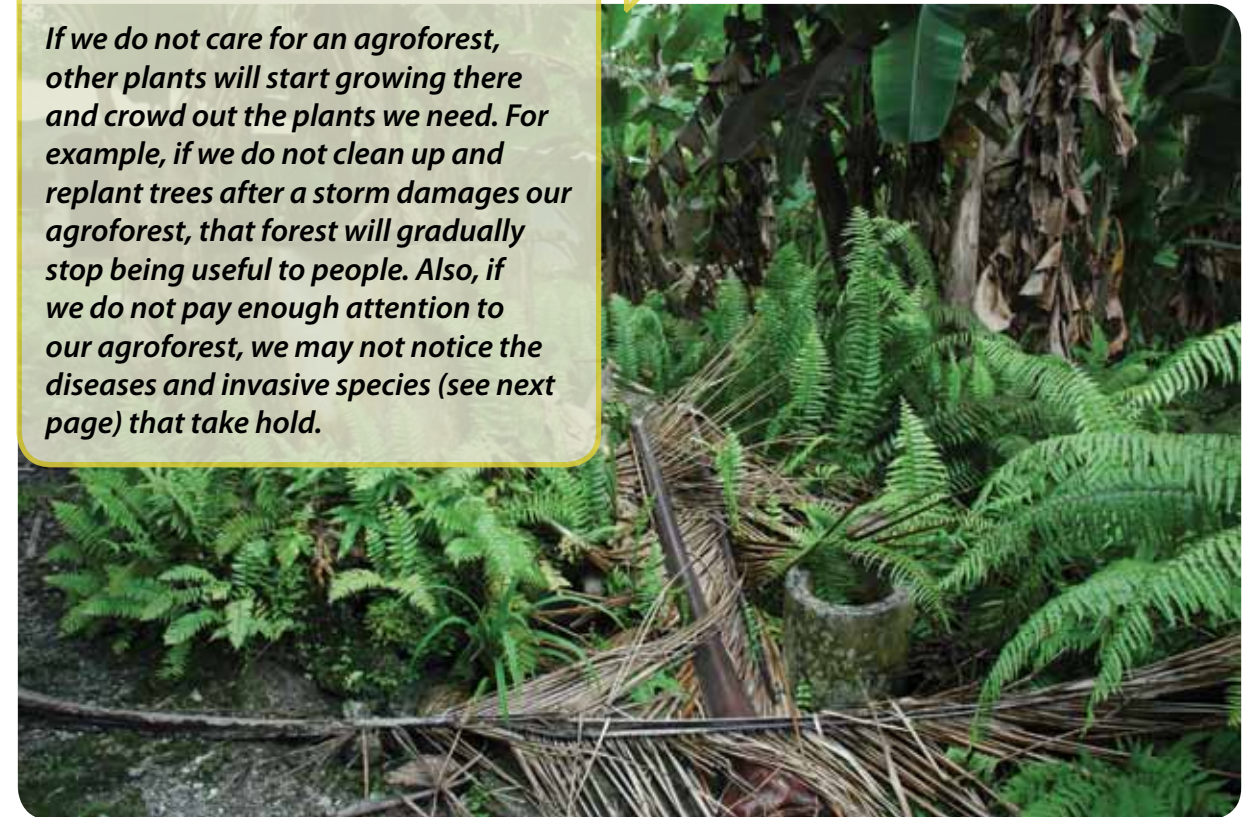
Sometimes people cut down forests and agroforests to plant crops that can be sold easily for cash. Cash crop farms often take much more space than we would need for personal use and create a series of problems. Removing trees leads to increased erosion. With no large plants, shade, or habitat left for other living things, soil retains fewer nutrients and moisture and becomes less fertile. In addition, land planted with a single crop—instead of the variety we see in agroforests—is at much greater risk of pests and diseases.



NEGLECT

fewer useful plants

If we do not care for an agroforest, other plants will start growing there and crowd out the plants we need. For example, if we do not clean up and replant trees after a storm damages our agroforest, that forest will gradually stop being useful to people. Also, if we do not pay enough attention to our agroforest, we may not notice the diseases and invasive species (see next page) that take hold.



PESTS AND DISEASES

plants damaged or killed

Plants can get diseases from pests, including viruses, bacteria, fungi, worms, snails, and insects. Diseases can cause deformities, such as bumpy or curly leaves, or even damage to basic plant functions, such as the ability to grow or produce fruits. Pests and diseases spread when people move soil and plant parts—flowers, leaves, roots—from place to place on airplanes or boats. Agroforests naturally resist the spread of pests and diseases because they contain many kinds of plants, and some of them may be resistant to a particular pest or disease.



INVASIVE SPECIES

major changes to ecosystem

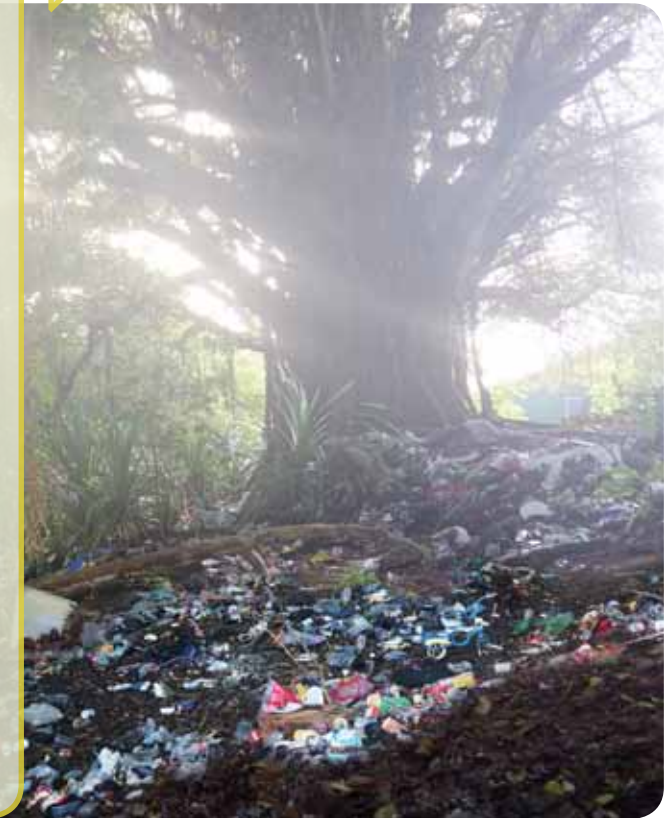
Plants and animals that are not native to a certain area can get there by accident or be introduced by people on purpose. Some of them grow and reproduce quickly and affect the local ecosystem. These rapidly spreading and harmful organisms are called invasive species. They can damage agroforests by competing with local plants and animals for space, light, water, and food. Invasive plants tend to spread quickly, take up space, climb and cover trees and shrubs, and keep light from reaching the plants below. Invasive animals, especially various insects, can feed on local crops and damage or kill them. Invasive species are extremely difficult to control, so it is best to always avoid bringing new plants and animals to islands.



POLLUTION

unhealthy plants and food

Long ago, all waste that people left behind would break down and be naturally recycled in the environment. In contrast, much of our garbage today is not bio-degradable. That means that it does not break down and persists in the environment. Plastic garbage can stick around for thousands of years. Even worse, a lot of chemicals leak out from garbage and from other things we use and throw away—old batteries, broken appliances, motor oil, cleaning supplies, household chemicals, paint, pesticides, cigarette butts, and many other things. When these things and substances get into the environment, they can kill plants and animals and pollute the soil. Plants that grow from polluted soil are unhealthy and can harm people who eat them.



HOW DOES CLIMATE CHANGE AFFECT AGROFORESTS?

Earth's climate is changing because humans are changing our planet's atmosphere. We burn lots of gas, oil, and coal. That produces gases (especially carbon dioxide) that trap heat in the **atmosphere**. This is causing Earth's climate to get warmer and change in other ways. You can learn more about climate change on pages 82–87.

A warmer climate is changing our planet. We are seeing **increasing temperatures** of air and water at the ocean surface. In distant cold parts of our planet, the warming is causing polar ice caps and glaciers to melt. Water from the melting ice flows into the ocean, and causes the water level to rise all over the world. The **sea level rise** will flood some low-lying areas and erode coastal lands. Tides and surging water that comes with storms will reach higher than before and hurt plants by bringing salty water onto land and into groundwater.

In addition, an ongoing **change in rainfall** patterns is causing some places to have more frequent and longer periods of drought and other places to experience more rain than before. Though the change in climate is global (happening all over the world), the specific impacts of climate change on specific places vary and are difficult to predict. For example, we know that **storminess** will change, but we do not know if a particular island will get fewer or more storms or if the wind there will be weaker or stronger.

Agroforests are affected by climate change.

All the different impacts of climate change can negatively affect agroforests. They can directly harm agroforests or make it more difficult for people to maintain them in a healthy state.



INCREASING TEMPERATURES

Higher temperatures can cause plants to produce flowers or fruits at times that are unseasonal based on past history. Warm weather can also cause insect pests and plant diseases to become more numerous and spread more easily.



CHANGES IN RAINFALL

Agroforests ease the impacts of droughts because the shade the trees provide helps keep moisture in the soil and protects smaller plants from losing water. However, long periods without rain can make the land dry, slow the growth of trees, and even kill plants.



SEA LEVEL RISE

Rising sea levels threaten agroforests along coasts and low-lying areas. Higher sea levels lead to a greater risk of flooding and intrusion of salty water from the ocean onto land and into the ground (see pages 74–75). Most plants are sensitive to saltwater and die if exposed to it.



STORMINESS

Trees protect smaller crops from harm during storms, but very strong winds can break trees and severely damage agroforests. If climate change causes storms to be more powerful or more frequent, it can wreck agroforests and not give them enough time to recover from damage.

Climate change may have the most negative effect on agroforests that are neglected, partly replaced by cash crops, or damaged in other ways. Healthy, well-maintained agroforests are much more likely to survive, adapt to changes in temperature and rainfall, and recover from storms.

The times are changing...

Try this

One of the common indicators of climate change is a change in fruit harvest and fishing seasons. Ask your parents, grandparents, or other family members if they have noticed a change in harvest and fishing seasons. If possible, ask elders from at least two different generations. When did these seasons occur before? When are fruits and fish available now? How are these changes impacting your family and neighbors? Compare and contrast the responses you get from your elders.

SALTWATER INTRUSION

When the **sea level** rises, so does the level of water in the ground. You can see this every day on many islands, where the level of water inside wells or ponds rises and falls as the tides in the ocean change. This is an absolutely normal thing. For example, a taro patch may look dry or full of water depending on the weather and tides.

However, if the weather is dry for a long time, there might not be a lot of water from the rain to fill small holes in the ground. Seawater from deeper inside the island comes up to take that space. In low-lying areas, especially in taro patches, this **saltwater intrusion** may reach the roots of plants and kill them. If the place gets too salty, taro and most other plants will no longer grow there.

A similar thing can happen if very high tides, waves, or storms cause seawater to spill over the land.

HEALTHY TARO PATCH



A healthy taro patch.

DAMAGED TARO PATCH



A damaged taro patch with few taro plants left.

DESTROYED TARO PATCH



Destroyed former taro patch that has been taken over by ferns that grow wild and can tolerate salty conditions in the ground.

WHAT CAUSES SALTWATER INTRUSION?



Sea level rise

Higher sea levels make it easier for waves and tides to flood the land with seawater.



Drought

During long periods of little or no rain, there is less fresh water in the ground. Seawater moves underground and enters into spaces that were previously taken up by fresh water.



Human activities

If people use pumps to take out more fresh water from wells than rains can replace, there will be less and less fresh water available in the ground. Fresh water from underground gets replaced by seawater.

Try this

Experiment with water and plants

Almost all plants are harmed by seawater. You can demonstrate this through an experiment. Take three plants of the same kind and the same size and put them in separate pots. Label the pots with numbers: 1, 2, and 3. Each morning, pour a glass of water into soil in the pots. Always use fresh water for pot 1, seawater for pot 2, and an equal mixture of fresh water and seawater for pot 3. Continue this for one week. What happened? What caused it? Describe the differences between the plants.

Not all plants react to the presence of seawater in the soil in the same way.

Farmers and scientists are observing that certain varieties of trees and other plants continue to do well and produce food even if salt levels in the soil increase. These varieties are adapting to saltwater intrusion better than others. Agroforests help this process because they have many varieties of trees and other plants. People study how they adapt and use that knowledge to help more trees and other plants survive and produce food under different conditions.

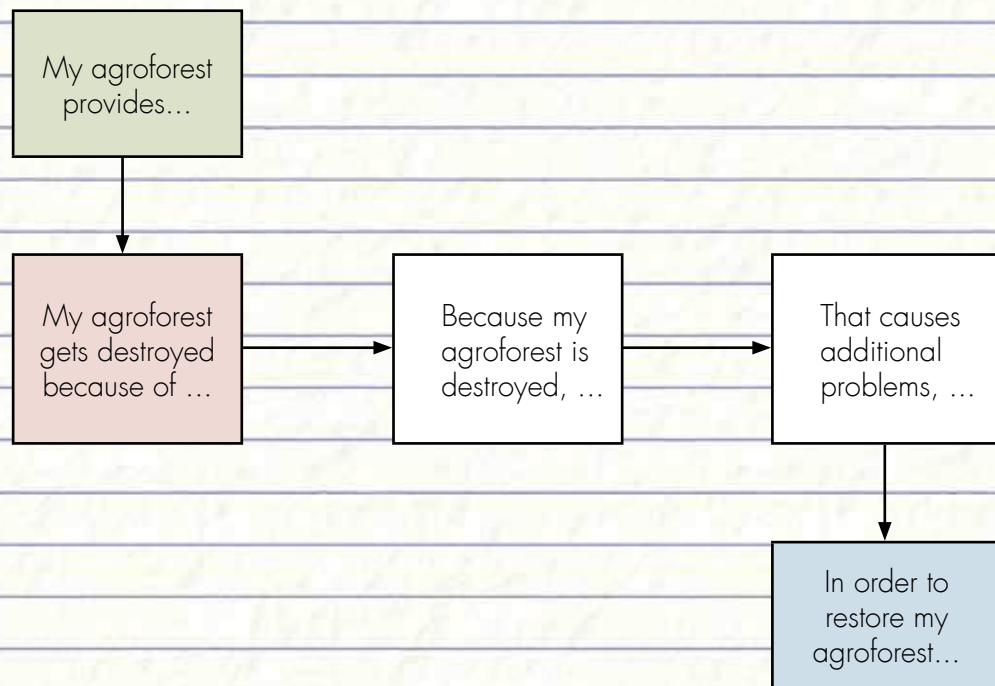
HOW WOULD DAMAGE TO AGROFORESTS AFFECT YOUR ISLAND?

Damage to agroforests or their loss can have devastating effects on a particular area or even an entire island. To get an idea of what could happen, let's imagine an island where agroforests are destroyed.

Our community without our agroforests

Try this

Picture an agroforest near your home or your school. What kinds of foods and materials do you and your family get from your agroforest? Now imagine a scenario in which the agroforest is destroyed. For example, a storm blew down all of its trees and no one came to replant it. Where would you get these foods and materials if your agroforest was gone? Then imagine that it rains—a lot! What do you think would happen to the ecosystems downhill? To your neighbor's house, the beach, the coral reefs in the ocean? Talk with your classmates and use this graphic organizer to plot a possible sequence of events.



WE WOULD SEE MORE RUNOFF AND EROSION, CAUSING HARM TO SOIL, LAND, AND OCEAN

When land is not covered by forest, most of the rain that falls does not get absorbed by soil and plants. Instead, it flows over the land, increasing **surface runoff** and washing away more soil and other **sediments**. This makes rivers and coastal areas muddy, which harms living things there, especially corals and other reef creatures. Runoff increases the risk of floods and landslides, which makes life in some places dangerous.

WE WOULD HAVE LESS FOOD AND RESOURCES

When agroforests are damaged or destroyed, we cannot rely on that land to provide food and resources. In addition, seafood becomes scarce because increased soil erosion damages reefs that are normally home to fish and other marine animals that we eat.

WE WOULD HAVE LESS BIODIVERSITY AND FEWER VARIETIES OF CROPS

Without healthy agroforests, plants and animals that need such habitats would disappear from the area. If they are not found in other places, they would become **extinct**. Extinction is a real risk for cultivated varieties, which do not grow wild and cannot reproduce without our help.

OUR COMMUNITIES WOULD SUFFER

Without agroforests, we cannot produce our own food. We must buy imported food that is often expensive and unhealthy. Without working the land, families and communities may lose local knowledge needed to properly care for their island. No longer able to make a living from our own place, we would depend on outside help to survive. Working in agroforests is also an important way of getting daily exercise, keeping our bodies and communities healthy.

HOW DO AGROFORESTS HELP US ADAPT TO CLIMATE CHANGE?

Because we live on islands, many of which are far from other islands and continents, our access to food and supplies from other places could be influenced by world events. Impacts of climate change, natural catastrophes like droughts and tsunamis, and man-made catastrophes like economic crises and wars, can all disrupt shipping routes and make it difficult for us to import goods. Healthy agroforests can provide additional **food security** at such times. With agroforests, we do not need to rely as much on outside sources for food and basic needs.

Being **self-reliant** makes our islands and communities more **resilient** and able to adapt in the face of climate change. For example, people of an island with rich agroforests and knowledge on how to manage and use them could survive for years without supplies coming by ships. People on an island without agroforests would experience starvation. We cannot control climate change and other world events, but we can control how we as humans affect the land and surrounding resources in order to ensure that our agroforests are healthy and resilient to changes in temperature, rainfall, storminess, and other impacts of climate change.

We can adapt to climate change and reduce its impacts on our islands and communities in different ways. That includes visiting agroforests and working in them, maintaining and gaining local knowledge about living things and the environment, intercropping, keeping soil fertile, nurturing plant varieties, promoting multipurpose trees, ensuring that soil and smaller plants are shaded by bigger trees, replanting damaged or harvested plants, not overharvesting or clearing land, and engaging in other land management techniques that we learn from our elders. In what other ways can you adapt to climate change in your island community?

HOW CAN A COMMUNITY START TO ADAPT?

We use the term **climate adaptation** to describe the things that individuals, communities, and governments can do to help protect local ecosystems from harmful climate impacts. The best ecosystem climate adaptations are activities that help ecosystems return to and keep their natural conditions. Though agroforests are made and managed by people, they are functioning ecosystems.

If human activities are damaging agroforests, people need to decide as a community what they can do to restore and maintain them. We know that healthier ecosystems are more resilient with respect to climate change. Healthier agroforests may suffer less damage from various impacts of climate change, and after suffering damage, recover faster.

As important members of society, schools and students can share information about agroforests and climate change with their communities. For example, pages 68–71 describe major threats to agroforests: land clearing, cash crops, neglect, pollution, pests and diseases, and invasive species. Using their lifelong knowledge of their own agroforests and the kinds of information in this book, communities can start by identifying the most damaging activities in their area and decide how to manage and reduce them.

Communities can also identify the most important agroforest areas and other ecosystems on their island, from the coastal wetlands to the highest mountains, and work together to take

care and protect them from any harm. This is especially important for areas damaged by human activity. Having broad areas of healthy agroforest surrounded by other well-protected ecosystems can help make an entire island and its communities much better prepared for changes that the future will bring.



By caring for agroforests we improve their resilience and our own resilience to climate change.

BIG IDEAS

Agroforests are ancient systems of agriculture, where many kinds of trees and other plants are cultivated together. They are productive lands in balance with the wider environment, interspersed with wild plants and animals, and interwoven with people's needs for food, medicine, and resources.

KEY BENEFITS OF AGROFORESTS

Sustenance:

- ★ Food (everyday local food and emergency supplies)
- ★ Drink (coconut liquid, juices from fruits)

Resources:

- ★ Medicine
- ★ Fuel (firewood, oil, diesel)
- ★ Fertilizers
- ★ Building materials (timber for houses, canoes)
- ★ Other materials

Habitat:

- ★ Home for animals, wild and domestic

Services:

- ★ Keeping soil healthy and fertile
- ★ Shading, windbreaks, protection from bad weather
- ★ Reducing erosion and improving water quality
- ★ Carbon sequestration (storing carbon)
- ★ Supporting biodiversity

MAIN THREATS TO AGROFORESTS

- ★ Land clearing
- ★ Cash crops
- ★ Neglect
- ★ Pests and diseases
- ★ Invasive species
- ★ Pollution
- ★ Climate change
 - ★ Increasing temperatures
 - ★ Changes in rainfall
 - ★ Sea level rise
 - ★ Changes in storminess

STRATEGIES TO MAINTAIN HEALTHY AGROFORESTS

- ★ Helping elders work and learning from them
- ★ Increasing our knowledge about living things and the land
- ★ Observing the environment and sharing what we see
- ★ Preparing and enjoying local foods in traditional ways
- ★ Building and making things from local materials
- ★ Keeping connections with land, community, and culture strong

WHAT IS CLIMATE CHANGE?

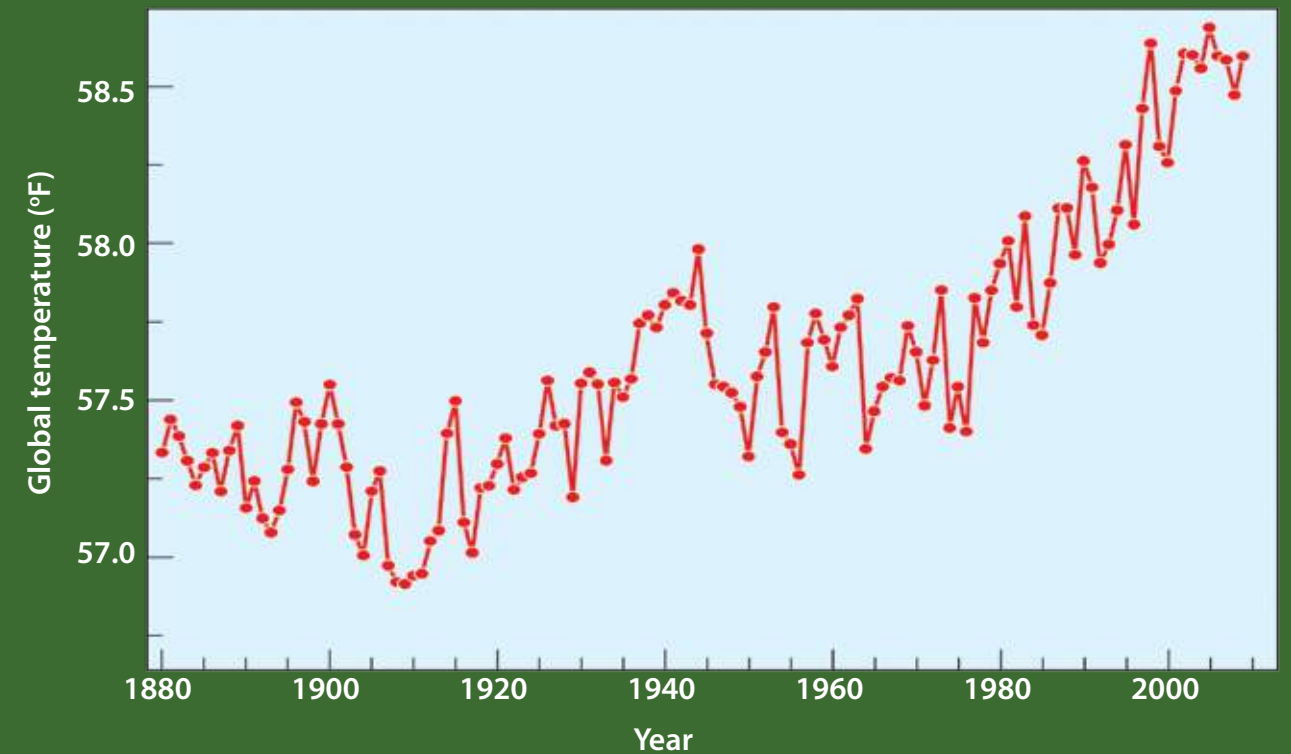
Many times in our planet's long history, Earth had a much colder climate than today. During an Ice Age, huge glaciers cover large amounts of land on continents. For example, 20,000 years ago, the area where New York City is located was covered by ice that was about 9,000 feet thick. The ice was six times taller than today's tallest buildings. So much of Earth's water was locked up in ice that the sea level was about 360 feet (120 meters) lower than today. Your island would be much bigger if today's ocean was that low.

During other times in our planet's long history, Earth had a much warmer climate than today. Even the poles had little or no ice covering them. During those warm times, the sea levels were much higher than today.

We use the term global climate to describe the general climate of the planet as a whole. For the past 10,000 years, the global climate has not changed that much.

Plants, animals, and other living things have all adapted to the climate conditions where they live. Different kinds of ecosystems depend on the different climate conditions in various places. In addition to different organisms and ecosystems, human communities are also adapted to climate. People have built their homes, agricultural areas, cities, and transportation systems to work well in the conditions of the local climate and geography, including the sea level.

Humans did not cause climate changes that happened previously in Earth's history. However, the current global warming is man-made. It is happening mostly because we burn huge amounts of fossil fuels. We use oil to make the gasoline that provides the power for cars, boats, and trucks. People also burn coal, oil and gas to keep warm, cook, and make electricity. This burning produces gases (especially carbon dioxide) that trap heat in the atmosphere.



Other activities, notably massive production of cattle for meat, also release harmful gases into the atmosphere. Trapping of heat by carbon dioxide and other gases is causing Earth's climate to get warmer.

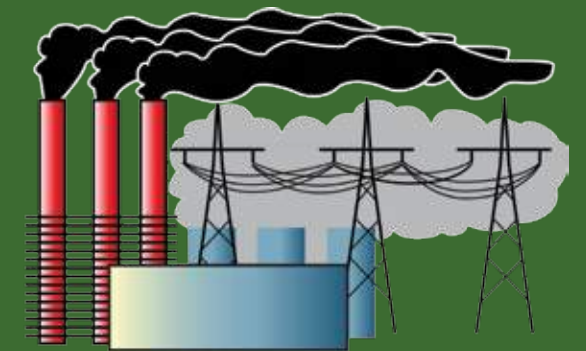
The graph of average global temperature since the year

1880 shows that the global temperature has been increasing. Over the past 100 years, Earth's temperature has increased about 1.6 °F (0.9 °C). We are already seeing changes such as higher sea levels and more flooding. In this century, sea levels could rise three or more feet.

A)



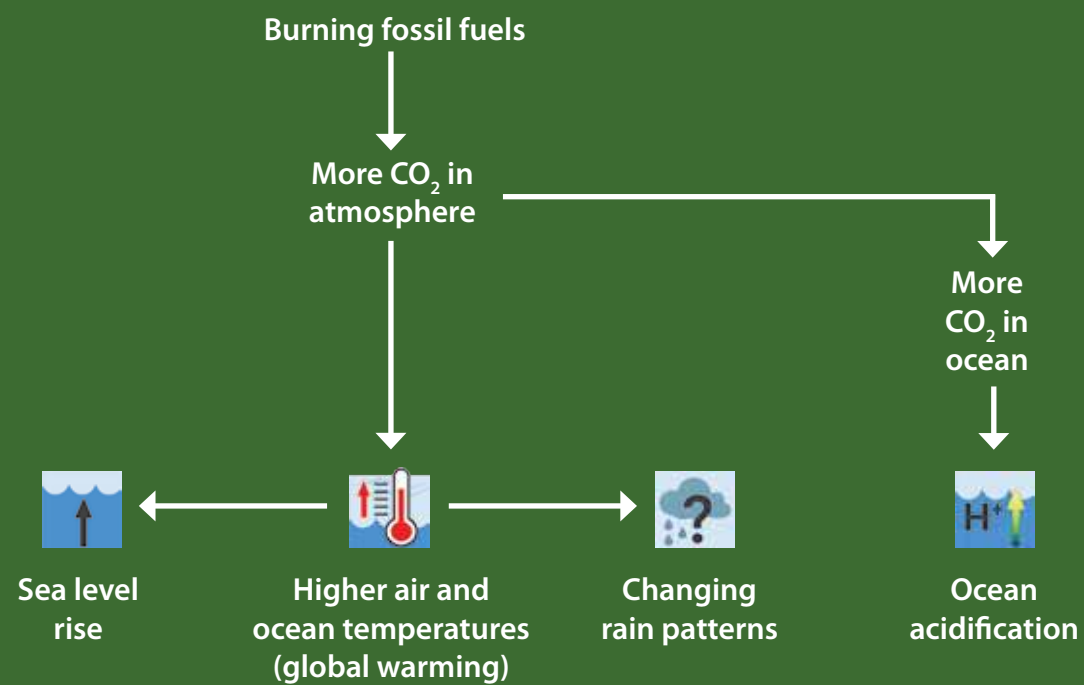
B)



△ When we burn fossil fuels (oil, coal, and natural gas), they produce gases that stay in the atmosphere and trap heat, causing global warming. A) Oil is used to make gasoline to run cars and trucks. B) Oil, coal, and natural gas are burned for heating, cooking, and to make electricity.

As shown in the diagram below, the increasing amount of CO₂ in the air is heating our planet and causing many other changes. As the ocean gets warmer, it increases in volume. In addition, melting land ice flows into the ocean and adds to the volume of the ocean. The resulting rise in sea level causes some of the biggest climate change problems for island ecosystems and communities.

Higher air and ocean temperatures also cause changes to the patterns of rainfall. Some places may experience more drought, while other island locations may have increased rainfall, especially heavier downpours. Scientists have some evidence that tropical cyclones in the Pacific may increase in strength but occur less frequently.

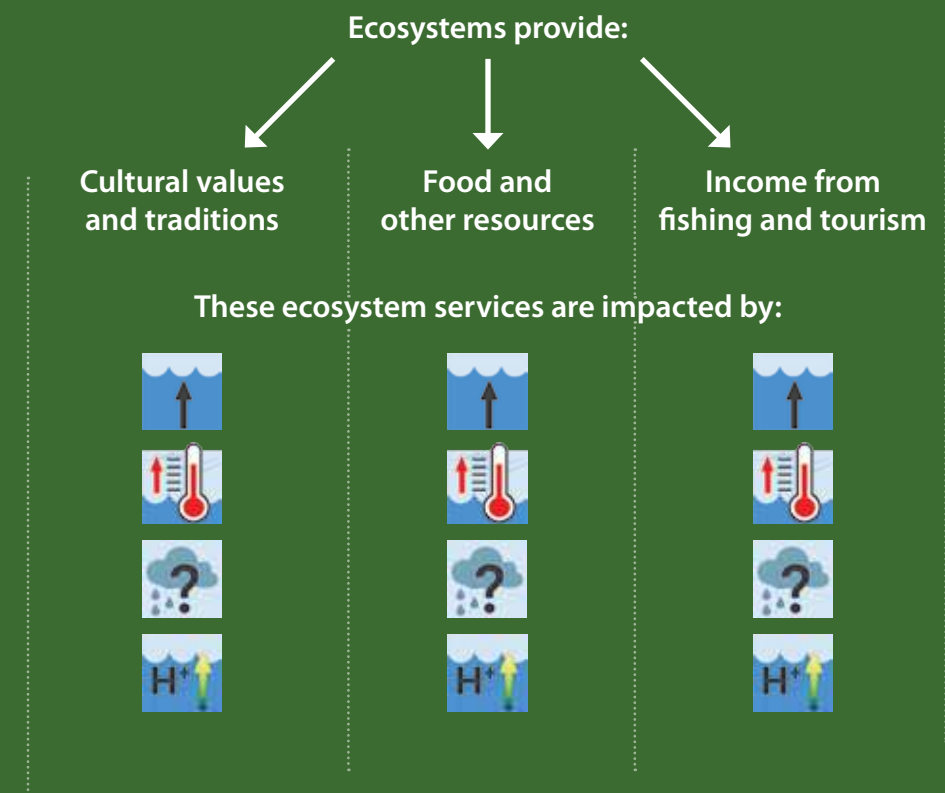


In addition, much of the extra carbon dioxide in the air dissolves in the ocean. This extra dissolved carbon dioxide forms a weak acid, and changes the ocean's chemistry. The extra acidity harms marine organisms that have calcium carbonate shells (such as corals and clams).

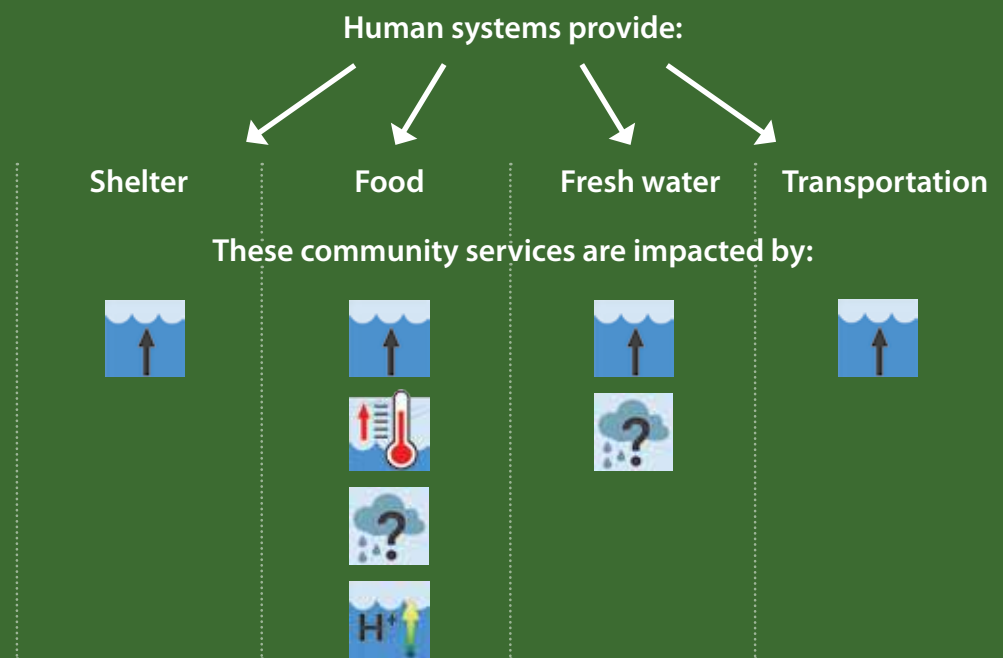
While there are other impacts of global climate change, we have focused on the four impacts that affect agroforests and island communities the most:

- ★ Higher temperatures
- ★ Higher sea levels
- ★ Changing rain patterns
- ★ Changing storm patterns

Each of these impacts of global climate change can directly harm at least some important island ecosystems. These ecosystems provide many services—such as support for cultural values and traditions, food and other resources, and opportunities for income from fishing and tourism. All four of the climate change impacts can decrease the benefits that humans get from island ecosystems.



We humans have been able to live in so many different places on the planet because we have developed construction systems that provide us with homes, and agricultural and fishing systems that provide us with food. We have also developed other systems that provide us with fresh water and transportation. Rising sea levels can harm each of these human systems. Because of their effects on ecosystems and agriculture, all four of these climate change impacts can make it harder for people to get food. Changing rain patterns can also make it harder to have a secure supply of fresh water.



Humans can reduce the amount of climate change by burning less fossil fuel and reducing other activities that put heat-trapping gases into the atmosphere. Communities can also reduce the harm caused by climate change by planning and practicing climate adaptations. For an ecosystem, the most effective climate adaptations are activities that help an ecosystem stay as close to its natural state as possible. These climate adaptation activities mostly involve protecting the ecosystem from other human activities that can harm the ecosystem. Climate adaptation activities include preventing and removing pollution, and carefully managing how we fish, cut trees, build roads, and develop on our lands. A healthy ecosystem is resilient to climate change; it tends to suffer less damage from climate change, and recovers more quickly from damages that do occur.

Pages 72–79 in the main text describe the effects of climate change on agroforests and ways that humans can help protect and maintain healthy agroforests in the future.

EXPLORE MORE ABOUT CLIMATE CHANGE

You can explore three “interactives” to learn more about the science of climate change and its impacts on Pacific island communities. An “interactive” is an educational resource on the Internet where you can interact with diagrams, images, and text to get more information.

Start exploring the “interactives” by going to:
<http://pcep.prel.org/resources/?collection=interactives>



- 1 **“Carbon Dioxide and the Carbon Cycle”**
 – how human activities change the carbon cycle and cause atmospheric carbon dioxide to increase



- 2 **“Earth’s Energy Flows and Climate”**
 – how higher carbon dioxide levels cause global warming



- 3 **“Impacts of Climate Change in the Pacific Region”**
 – climate change impacts and adaptation strategies for ecosystems and human communities

You can also find these interactives and associated lesson plans at:
<http://pbslearningmedia.org> and search for “PCEP.”



GLOSSARY

A

Agricultural area – farmed area; cultivated land

Agriculture – farming (the practice of growing plants and raising animals, to provide food and other products)

Agroforest – agricultural area where several different plants—at least one of which is a tree—grow together [see page 14 for local terms on different Pacific islands]

Atmosphere – mixture of gases surrounding the Earth

B

Bacteria – extremely small and very simple living microorganisms

Biodiversity – variety of living things; the number of different kinds of organisms in a particular place

Biomass – amount of living matter in a particular area, usually measured as the weight of living things per unit area

Breadfruit season – time of year when the fruits of breadfruit trees are plentiful; this is when people harvest, cook, and preserve breadfruit

Bush – another name for *shrub*

C

Canopy – uppermost branches of the trees in a forest, together forming a layer that makes shade in areas below

Carbon dioxide – gas that animals breathe out and plants use for photosynthesis

Carbon sequestration – process by which carbon dioxide is removed from the atmosphere and changed from a gas form to a solid or liquid form

Climate – overall weather patterns of a place over a relatively long period of time

Climate adaptation – actions people can take to help an ecosystem or their community become more resilient to climate change

Climate change – long-term change in the climate of a place, including change that is caused by the increase in the temperature of the atmosphere

Compost – mixture of decaying organic material that is used to fertilize the soil

Crop rotation – changing what is grown in a particular place, and planting different kinds of crops each year or every few years

Crop – cultivated plant and the products of the plant when harvested

Cultivate – to grow plants and to prepare and use the land for that purpose

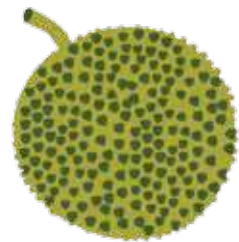
Cutting – piece of the main plant that is cut by people in order to grow a new plant

D

Decomposer – type of organism that breaks down waste and parts from dead plants and animals into simpler substances

Disease – illness or sickness of a living thing

Dispersal – scattering or spreading widely



E

Domestic animal – animal raised by humans; animal that does not live in the wild

Dressing – material used to cover a wound

Dry season – part of the year with notably less rain than at other times

Ecosystem – community of all the living organisms in an area together with their interactions with one another and with all the nonliving parts of the area

Erosion – process by which land is worn away by water, wind or living things

Extinct – no longer living or existing

F

Fertile – capable of producing abundant vegetation

Fertility – land's capacity to produce abundant crops or other vegetation

Fertilize – to make the land fertile, usually through the use of something added to the land, such as compost

Fertilizer – something added to the land to make it fertile

Firewood – plant parts that are used as fuel to make fire

Food security – having access to enough affordable and healthy food

Fungi – mushrooms, molds, and similar organisms that break down organic matter

G

Global warming – increase in the overall temperature of Earth that is currently caused by human activities, especially the burning of fossil fuels

Ground oven – method of cooking food by heating rocks with firewood, then covering the food with the hot rocks and other items such as leaves, and then letting the food cook for a long time; also called *earth oven*

H

Habitat – area where a certain living thing finds food and shelter

Harvest – to collect crops; collection of crops

Healer – person with the knowledge of how to use plants to heal

Herbaceous plant – plant that does not have a woody part

Herbicide – man-made chemical to kill weeds

Herb – herbaceous plant that are used to add flavor to food

I

Indigenous people – people who have lived in a specific place for a long term, especially people who have a connection to a place before any kind of contact from colonizers from other far-away places

Intercropping – growing different kinds of plants together in the same area

Invertebrate – animal that does not have a backbone, such as worms, snails, insects, and crabs

L

Large tree – plant with a woody trunk, and which grows to reach the highest layer in the forest

M

Manure – animal waste that is rich in nutrients and organic matter

Medium tree – plant with a woody trunk, and which is smaller than large trees



Microorganism – living thing that is so small it can only be seen with a microscope

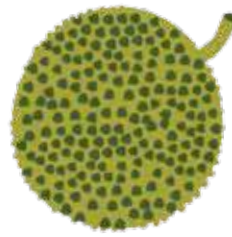
Mineral – solid, naturally occurring substance

Monoculture – growing only one kind of crop in a particular area

Mulch – covering on the ground around plants to help them grow, such as by preventing too much evaporation or keeping weeds from growing

Multilayered – consisting of different layers

Multipurpose – having more than one use



N

Nitrogen – colorless, odourless, and gaseous element that is present in the atmosphere and in many compounds in living things

Nutrient – substance that animals need to eat in order to live, and that plants need to absorb in small quantities to help them with their living processes (including production of food through photosynthesis)

O

Organic matter – principal material from which living things are made; the component of soil made of decomposing parts of living things

Oxygen – gas that plants release through photosynthesis and that animals need to breathe

P

Pest – harmful insect or other animal that attacks crops, food, and domestic animals

Pest control – way of controlling pests, such as by removing them or deterring them from a place

Pesticide – man-made chemical to kill pests

Photosynthesis – process by which plants and algae use energy from sunlight to make food from carbon dioxide and water

Pollinate – to transfer of pollen that causes flowers to develop into fruits and seeds

Pollution – harmful substances in the water, air, or soil

Poultice – soft, moist mass of materials (such as cloth or leaves) that are warmed and then put on the body

Preserved – prepared in a way such that the item will resist decomposing

Produce – to make

Productive – producing a lot or all the time

Propagate – to cause an organism to multiply

R

Rainy season – part of the year with notably more rain than at other times

Reproduce – how existing organisms make young copies of themselves, such as animal babies and plant seedlings

Resilient – to resist damage and recover quickly after difficult conditions

Resource – supply of materials or anything else that people and society need to function

Root crop – crop for which the part that people usually eat grows under the ground

Runoff – flow of water across the land's surface

S

Saltwater intrusion – entry of seawater into fresh groundwater areas

Sea level – height of the water's surface in the ocean

Sea level rise – increase in the average height of the ocean's surface

Season – period in the year that is characterized by specific conditions, such as the particular weather, winds, temperature, and crop harvests

Sediments – small pieces of soil, rock, and matter from organisms, often moved by flowing water from one area to another area, where they settle to the bottom

Seed – reproductive part of a plant, capable of developing into a new plant

Self-reliant – depending on one's own powers and resources rather than those of others

Self-sustaining – able to be healthy and well on its own, without outside help

Shoot – young branch that grows from the main plant; also called *sucker*

Shrub – plant that has many woody stems; also called *bush*

Small tree – plant with a woody trunk, and which is smaller than medium and large trees

Species – group of organisms that are very similar to one another and can produce young together

Stem – main body of a plant; the part of the plant that supports a leaf, flower, or fruit

Storminess – characteristic of a place in terms of how frequently storms occur

Sustenance – food and drink as a source of energy

T

Thatch – roof covering made of leaves or similar plant material

Timber – wood prepared for use in building or carpentry

Tree – plant with a single woody main stem or trunk

Trunk – long and strong woody stem of trees

Tuber – enlarged underground part of a plant that is often harvested as a crop or as a way to propagate the plant



U

Understory – underlying layer of plants in a forest, specifically the plants between the forest canopy and the ground

V

Variety – a type of living thing that is somewhat different from other types within the same species; it is often the result of artificial selection by humans over long periods of time

Vertebrate – animal that has a backbone, such as fish, lizards, birds, pigs, bats, and people

W

Water quality – condition of water; its chemical, physical, and biological properties

Weed – unwanted plant

Wild – living in a state of nature, not controlled by humans

Windy season – part of the year that is usually windier than other times



TEACHING TIPS

QUICK TIPS

Students and teachers in the Pacific islands have the advantage of visiting agroforests in their local environment when learning about island agriculture, local foods, and related topics. It is important that students go outdoors and explore agroforests as well as other habitats on their island. This will make it easier for them to connect concepts from this book with real life and understand the importance of agroforests to their own island and their everyday lives. Teachers can lead visits to agroforests near the school, exploring different areas, observing the work that people do there, and identifying different plants and animals seen there. Consider having the students explore the agroforest first before they read this book or use other classroom resources (e.g., computer, posters, other books).

Try
this

During the visit to the agroforest, take time to talk with farmers and others who work there. Ask as many questions as you can — about different plants, soil, seasons, foods — and take notes. Students can use these notes to write reports about what they have learned outside the classroom.

1. Students take a walk through an agroforest or imagine an agroforest or study photos of Pacific island agroforests in this book. They list the kinds of trees and other plants found there. They also note the local animals, from smallest insects to birds and domestic animals. Schools in different parts of the island, state, or country can communicate and compare their findings.
2. Students create an agroforest poster or mural. They draw different trees and other plants, and different animals, and explain why they chose those particular ones and how they decided where to place them in the agroforest they drew.
3. Students compare and contrast agroforests with other land habitats, especially wild forests that are not managed by people. They communicate this to others visually, orally, and by written report.
4. With a partner, students select an agroforest tree to personify (make it human) and create a story with the tree as the narrator. The narrator tells a story of life in the agroforest. Remember that some trees can live for a very long time!

IDENTIFYING PLANTS

Students practice identifying trees and other plants found in agroforests. They do this by looking at leaves and other parts. Students first review plant names in their own language and then compare with names in English and other languages represented in their class. Teachers use brainstorming techniques (like small group discussion, concept mapping, graphic organizers) to help students generate ideas about different trees and other plants and help them record and present what they know about them.

Our local names

Before getting into this activity, let's make sure that we are familiar with the names of different plants. Look at the kinds of plants highlighted on pages 29, 31, 33, 35, and 37.	Chuukese	English
Put the English name of each and every plant into a table and as a group work to add the name in your own language.	Óni / Woot	Taro
The example to the right uses Chuukese language and includes plants from page 29.	Pwuna	Swamp taro
	Kká	Giant taro
	Wooten Sapan	Tannia
	Eep	Yams
	Sakau	Kava
	Mwékúmwék	Arrowroot
	Tapioka	Cassava
	Pweteeto	Sweet potato
	Tunun	Island ginger
	Kúchún / Áfán	Turmeric

Try this

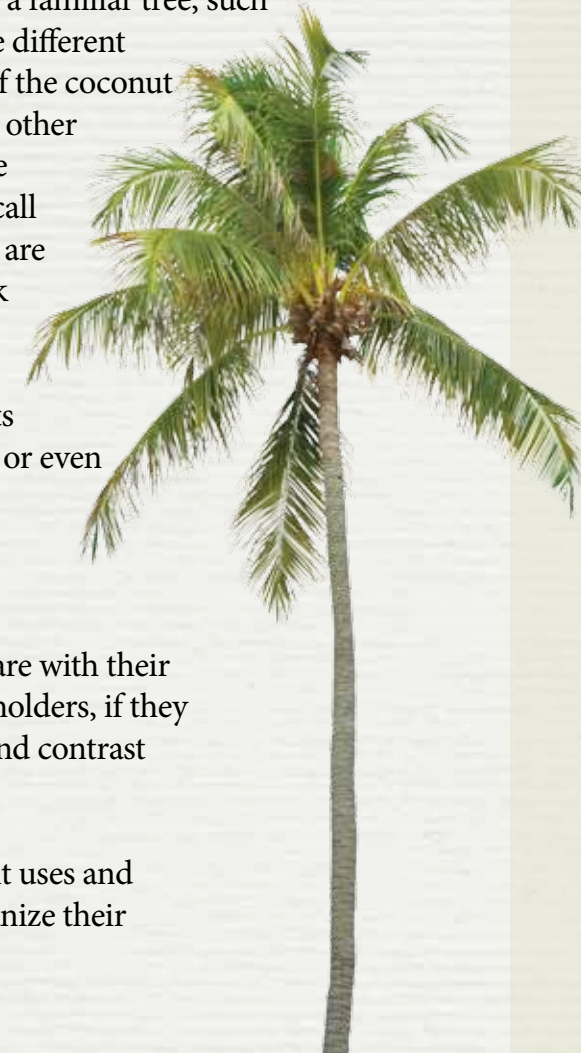
Once the students complete the exercise above, assign one tree or other plant to each student and ask that they bring a leaf or another piece of that plant (such as a seed, flower, root) to the class next time. Mix up the leaves and other plant parts that students brought to school and reassign them to different students to identify in small groups. Below is an example of how different kinds of taro can be identified based on the shape and orientation of leaves.

When the plants have been successfully identified, each leaf or other part is returned to the student who originally brought it and that student gives a brief introduction of that plant to the rest of the class. If a student is unsure of her/his plant characteristics, significance, or uses, the teacher and other students assist by brainstorming together.



UNDERSTANDING MULTIPURPOSE TREES

Students explore, document, record, and share information about the different ways people use specific plants. To do this, start with a familiar tree, such as a coconut. Students brainstorm together about the different ways people use coconuts. They discuss what parts of the coconut are used as food and drink and how, and brainstorm other uses, such as medicine, fuel, fertilizer, and as a source of materials. Teachers then encourage students to recall stories, songs, or chants that feature the coconut and are familiar within their community. Students may think of stories where the coconut is part of the setting of the story, as well as stories where the coconut is the main focus (such as stories that explain why coconuts flourish on some islets in an atoll but not on others), or even the protagonist (the main character in a story).



Teachers can motivate students to ask their family/clan members to teach them a new insight, story, song, or chant related to the coconut. Students can also share with their classmates what they have learned from knowledge holders, if they receive permission to do so. Students can compare and contrast what they have learned and shared.

Finally, teachers suggest that students explore the different uses and significance of trees other than the coconut and organize their knowledge in tabular form.

Try this

Exploring many uses

Almost every tree in an agroforest is grown for more than one use. Look at the kinds of trees highlighted on pages 33, 35, and 37. Select some of the most important ones among them and list them in a table. Work as a group to brainstorm the different ways these trees are used by people. Put tree names in rows and different uses in columns, as shown in the table below, which uses coconut as an example.

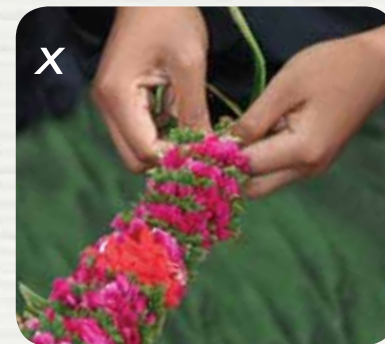
Tree or other plant	Different ways we use it						
	Food	Drink	Medicine	Fuel	Fertilizer	Building materials	Other materials
Coconut	Coconut "meat"	Coconut "water"	Oil used for massage	Husks as firewood	Dry fronds as mulch	Trunks as house posts	Fronds for weaving
...							

WHAT IS EVERYONE DOING?

Students engage in group discussion about different types of work that people do with trees and other plants from agroforests. The group discussion can be facilitated by pictures shown on these pages.

Try this

Each photo shown here presents a close look at a person's hand as it is doing something with parts of trees or other plants or with things made from them. All of it is for an important purpose: to prepare as food, to use as medicine, or to create something. Can you recognize what each person is doing?



WHAT IS IN YOUR SOIL?

Healthy soils contain a mix of air, water, and different materials—rocks, sand, silt, clay, and organic matter. The proportion of these different sized materials affects the amount of air, water, and nutrients available for plants.

Students can create a “mudshake” to explore soil composition and texture.

Materials needed:

Clear plastic or glass containers with lids

A scoop of soil

Ruler

1. Fill a clear container about two-thirds full of water, then add enough soil so that the water level reaches near the top of the jar.
2. Shake the jar vigorously, then observe the next couple of days as the particles begin to settle into layers.

After a couple days, students should expect to see 4 layers of materials in the “mudshake”—(a) large particles, the rocks and sand, will settle to the bottom; (b) smaller particles, called silt, will settle above; (c) clay, the smallest particles, will settle on top; and (d) organic matter will float on or near the surface of the water. Some clay particles may stay suspended in the water.

3. Use a ruler to measure the layers, then calculate the percentage (proportion) of each particle type. Proportion is calculated by dividing the height of each layer by the height of the whole sample.

Students can gather and compare soil samples from other places—in the mountains, near the ocean, under a tree, or near a house. Which place has the most sand? Silt? Clay? Organic matter? Students work in small groups to figure out if there might be a connection between the sample origin and the types of particles found in the sample.



Students examining soil

(photo from Angaur Elementary School, Palau)

AGROFOREST AS A FAMILY

Trees and plants in an agroforest work together like members of a family. Large and medium trees—like breadfruit, coconut, and pandanus—are the parents of this family. They protect the understory plants, provide homes for animals and insects, and provide many of the things that people need—like food, medicine, and building materials. Young trees and other understory plants are the children of this family. Under the parent-like protection of the canopy, they grow to provide food and resources now and in the future.

Just like human families have different combinations of people (one or two parents, many or few children, grandparents, and more), agroforests have different combinations of plants and trees. But no matter the combination, all of the trees and plants in an agroforest work together like members of a family to serve our communities now and in the future. Similar to a family that works together to operate a farm, run a store, or care for extended family and friends, agroforest trees and plants care for us.



Working together to make a new thatch roof
(photo from Walung, Kosrae State)

Students collaborate with classmates (pairs or small groups) to illustrate how relationships in an agroforest are similar to relationships in a human family. Each group should have at least one parent (large or medium tree) and two children (one young tree and one shrub, herbaceous plant, or root crop). Students imagine themselves as a tree or plant in an agroforest, then brainstorm their different roles in an agroforest and how these roles are similar to their roles in a family. For example, in the “What Kinds of Plants Grow in an Agroforest?” section, large trees like coconuts protect smaller trees like bananas and young breadfruits from the wind. This is similar to how a parent protects young children by providing a home. When relevant, create names for your plant / family member, first in the local language and then in any other languages of instruction (e.g., English). Students then create illustrations of these different roles and share out to the class.

Afterward, students create a skit in which different characters exemplify the different roles in an agroforest and a family. The plot might involve some kind of challenge, or a specific antagonist (e.g., a typhoon, a big polluter, or a construction project that threatens the forest) to the characters. Teachers guide the students in acting out the skits to the class, and then if there is potential, develop the skits into a play.

AGROFOREST DAMAGE

Healthy agroforests provide food and materials for us, while also preventing erosion and giving habitat to animals. But our agroforests can be damaged by neglect, choosing cash crops over forests, plant diseases, invasive species, and climate change.

Teachers and students visit or imagine an agroforest on their island, and explore the following questions:

Who uses the plants and animals in this agroforest?

What resources and foods are harvested here?

Now imagine this agroforest becoming damaged.

How would this affect the people that use this agroforest?

What if all the agroforests on your island were damaged?

How would that impact the people that live on your island?

What do you think can you do to keep your agroforests healthy?

Students brainstorm their own ideas and then interview a community elder about the best ways to manage a healthy agroforest.

YOUNG ETHNOBOTANISTS

Ethnobotany is the science that studies specific plants and the ways people use those plants. Much ethnobotanical research has been done around the world, but a lot remains to be explored about the complex relationships people have with plants. Many uses of plants—especially for healing sicknesses—are not general knowledge. Instead, they are carefully guarded secrets passed along from generation to generation, sometimes just one person at a time. Much of this highly useful knowledge is lost when elderly healers and plant experts pass away without sharing it, for various reasons. Ethnobotanists seek to document this knowledge for the benefit of future generations.

Teachers arrange class visits with both an ethnobotanist and a local plant expert in the community. Ideally, these two individuals have already worked together on a previous project. The two of them present their work and answer student questions. They can lead the students on a specific class project in a nearby agroforest. If there are no ethnobotanists in a nearby institution (e.g., university or non-governmental organization), then an ethnobotanist can join the class through video chat or pre-recorded video, and the students correspond with the ethnobotanist for further information.

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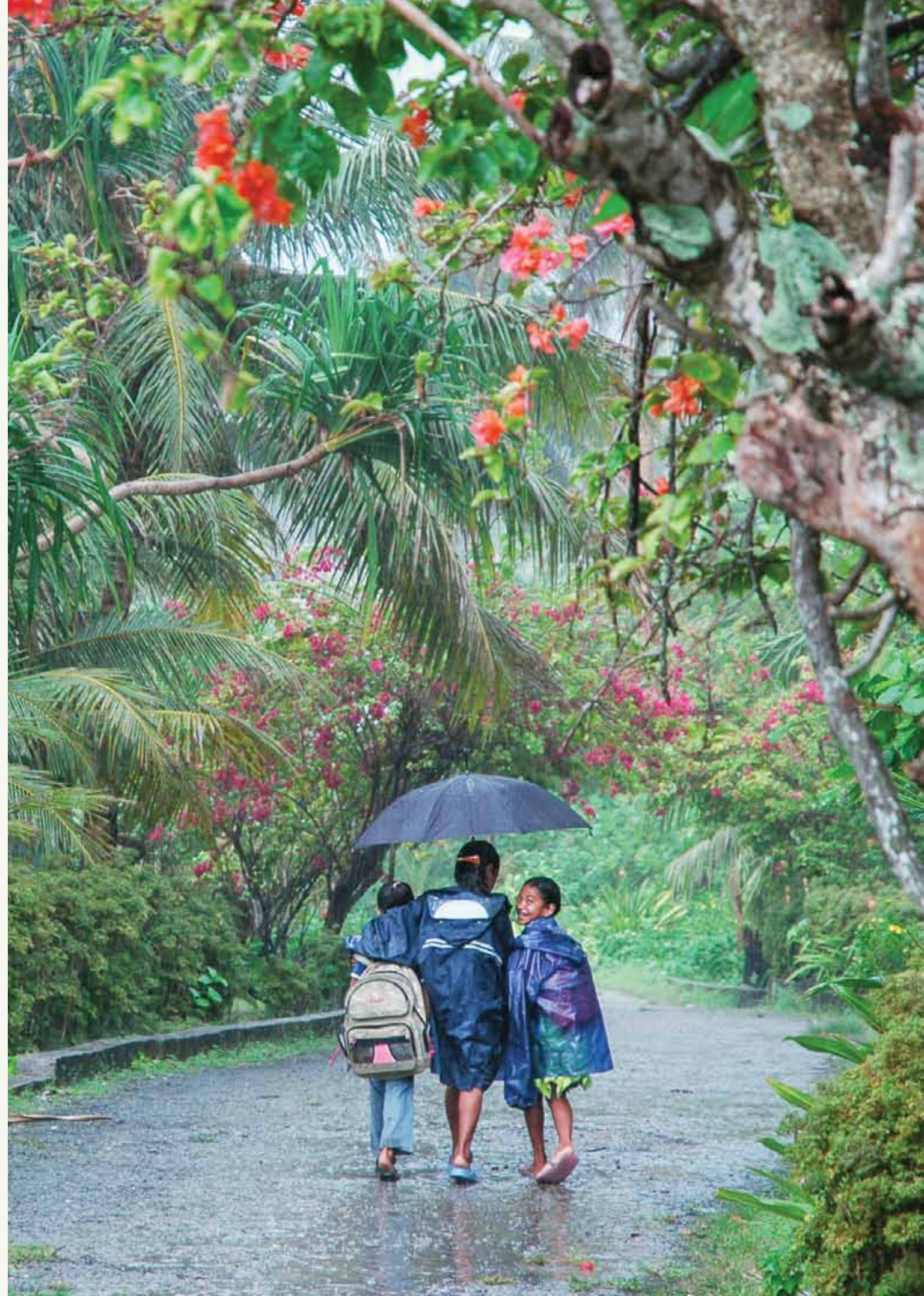
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OTHER BOOKS IN THIS SERIES

This book is a part of the series, Pacific Islands Climate Education Partnership (PCEP), Place-based resources for Pacific Island schools. The series also includes the following titles published thus far.



Our High Island Home is a book about natural island environments that Pacific children and their families will enjoy reading together. Highly visual images make familiar high island land- and seascapes come to life. Children living on high islands will recognize their everyday world and yet be amazed at the hidden treasures found within.



Our Low Island Home is a book about natural island environments that Pacific children and their families will enjoy reading together. Highly visual images make familiar low island land- and seascapes come to life. Children living on low islands will recognize their everyday world and yet be amazed at the hidden treasures found within.



Pacific High Island Environments is a book for those wanting to learn more about the places, plants, and animals on tropical high islands in the Pacific. The reader learns how high islands are formed and the various environments that create habitats for many species of plants and animals. From agroforests to mangrove swamps and lagoons, the reader is connected to island life and how important these environments are for the communities that live there.



Pacific Low Island Environments is a book for those wanting to learn more about the places, plants, and animals on tropical low islands in the Pacific. The reader learns how low islands are formed and the various environments that create habitats for many species of plants and animals. From atoll forests to patch reefs and the open ocean, the reader is connected to island life and how important these environments are for the communities that live there.



Mangroves—Living on the Edge in a Changing Climate offers readers of all ages a fascinating journey through the inner worlds of the mangroves. Intricate adaptations and unexpected habitats emerge from the pages of the swamp, unsettling the reader into realizing the incredible value of this island ecosystem. Mangroves provide many resources for local communities, and help reduce global warming by storing more carbon in the soil and its trees than other comparable ecosystems. This book also explains climate change, and how communities can help protect mangroves from climate change impacts such as rising sea levels.



Coral Reefs—Underwater World in a Changing Climate is an odyssey into a world just below the ocean surface, bursting with colorful coral colonies, giant schools of fish, graceful turtles and sharks, tiny microorganisms, and more. Readers will explore coral reefs that protect our islands, learn how they form and why they are important, and meet the living organisms that call our reefs home. This book also explains climate change, and how communities can help protect coral reefs from climate change impacts.



Adaptations—Finding a Fit in the Changing World is a book that children and their families will love. It is full of colorful pictures about how living things are adapted to meet their basic needs in the places they live. Children will be fascinated to learn that some plants have developed chemicals so that animals that share their environment will not eat them. Children will also learn that there are many different types of birds' beaks, all adapted to meet their need for getting food in different places. As children turn these pages, they quickly realize that all living things adapt to get what they need. It is this unique ability to adapt that help all living things survive.



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