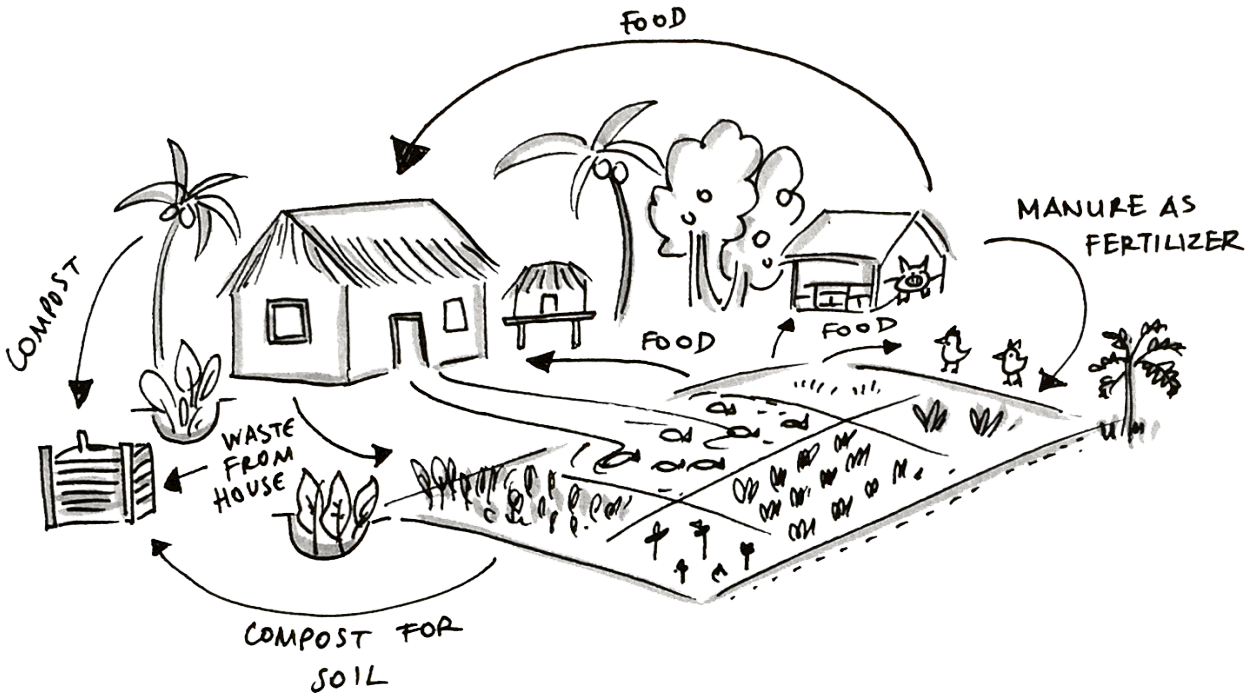
INTEGRATED FARMING SYSTEMS

TRAINING MANUAL

A pathway to
introduce, design and utilize
Integrated Farming Systems (IFS)
for food security in Kiribati



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Tanaea, Ministry of Environment, Land and Agriculture Development (MELAD), Republic of Kiribati

Ministry of Agriculture, Food and Rural Affairs

Cover image:
Integrated farming system (IFS) is a system of farm practice which concurrently utilizes the same unit area of land for the production of animals and crops.

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The Babai Pit model featured in this manual builds on the work led by the Secretariat of the Pacific Community (SPC) under the Atoll Soil Health project funded by The Australian Centre for International Agricultural Research (ACIAR)

TABLE OF CONTENTS

1 INTRODUCTION

This training manual will assist farmers in becoming food secure by providing guidance on how to set up an Integrated Farming System (IFS), which produces a range of foods including local crops and vegetables, livestock (chicken and pigs) and fish. These foods are important for a healthy, balanced diet and income generation.

The manual is also an introduction to how you can construct IFS in a way that complements other systems rather than competes. Together, these will assist you to start and operate your own IFS.

You do not need to be a genius to run a successful IFS. Adequate basic knowledge of the system, diligent work and keen observation while using it, will enable you to succeed. Sharing experiences with other IFS users will also enable you to excel.

THIS GUIDE WILL COVER

- What an IFS is/are and how it works
- Types of IFS and what to grow/raise in them
- How to construct such a system
- Introduction to conservation agriculture practices

TARGET AUDIENCE

- Agricultural Extension Officers
- Agricultural Assistants
- Community & Island Facilitators
- Island Water Technicians

etc.

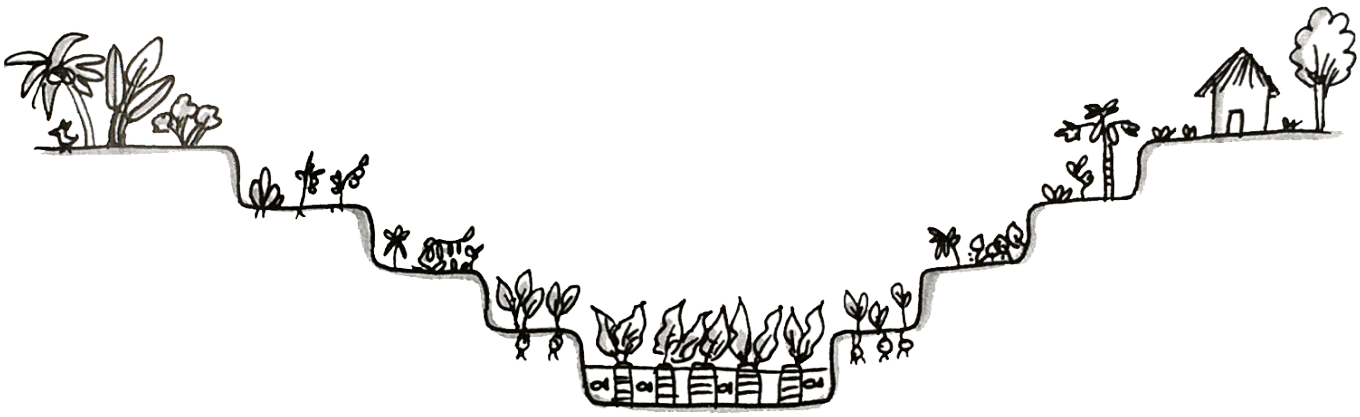


Fig. 1 The Babai Terraced Pit System is a typical IFS in Kiribati with four terraces going from ground to water level.

2 CHALLENGES

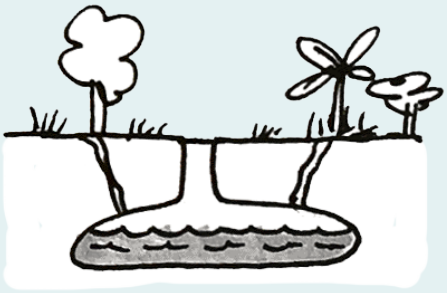
for crop production in Kiribati

1 NATURE OF SOILS

Kiribati soils are calcareous, shallow, alkaline and coarse textured. Nitrogen and phosphorus are also generally limited. Soil fertility is dependent on the amount of organic matter content.

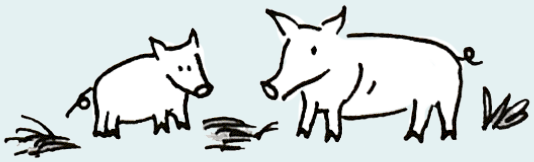
2 WATER AVAILABILITY

On the atolls, water is a critical challenge, both in terms of quantity and quality — drought is a major concern. Rainwater catchment is the main source of water but underground freshwater lenses are also at risk of contamination and salinization due to sea level rise.



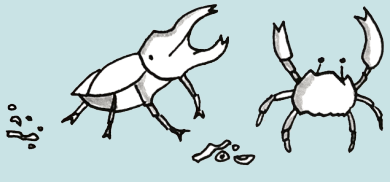
3 LIVESTOCK MANAGEMENT

Making use of piggery waste is growing among iKiribati, especially along coastal areas. The waste could be used as an ingredient for composting so that it can benefit crop production. In addition, livestock feed is expensive, therefore local ingredients are an alternative option to consider.



4 PESTS & DISEASES

Some species varieties such as pandanus, taro, breadfruit, dwarf banana and other traditional medicines are now endangered. For example, rhinoceros beetles are a threat to coconut palms; *Erwinia papaya* bacteria cause rot in papaya and breadfruit; crabs are a common source of crop damage. It is important to understand these threat so that they can be mitigated.



3 WHAT IS IFS?

An integrated farming system (IFS) is one that looks at the whole farm as a system and how different components work together to enhance ecosystem functions of the land at local and possibly landscape levels. For example, taking considerations where 'animal waste' from one area can become 'resources' for another area, e.g. organic fertilizer for home gardens.

In Kiribati, a small backyard home garden with IFS principles is likely to include breadfruit, dwarf coconuts, *te bero* (a variety of fig), pandanus and papaya along with other selected tree species for forage, food and fuel.

Trees are typically spaced out with an understory of vegetable and root crops. In favourable conditions, crops such as bananas, dragonfruit, wax apple, noni and hibiscus may also be integrated.

HOW DOES IFS WORK?

IFS is based on improved local recognition and understanding of mixed crop-livestock interactions, as well as selecting appropriate seed varieties due to local climatic risks. In such a system, the objective is to maximize the yield of crops, livestock and fish, which are combined to complement each other.

For example, livestock provides fertilizer to crops and crops are fed to livestock. Fish can be fed crop or livestock waste and in turn their waste becomes part of the compost used by crops. Crops can be grown in complementary mixtures to achieve maximum yields.

Legumes, when mixed with non-legumes will transfer nitrogen fixed from the air to increase the yield of other crops planted. Mixed cropping can also reduce the number of pests and diseases that affect crops, thereby increasing total yield. The rotation of legumes and non-legumes after each crop cycle will also increase yields.

Leafy vegetables such as chaya, beach cowpea, purslane, pumpkin and kangkong are good sources of iron, nutritious and rich in protein, minerals, vitamins (e.g. A, B, C, K) with beneficial phyto (plant) compounds and fibre.

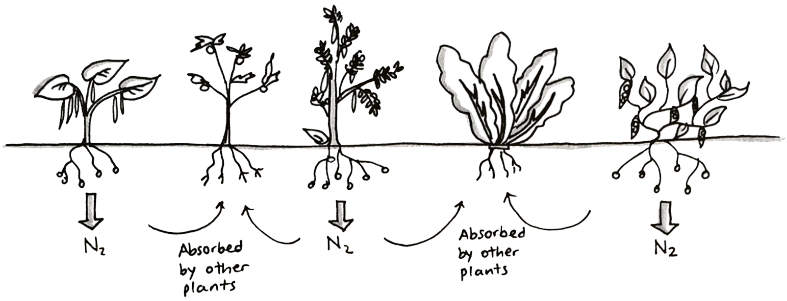


Fig. 2 Legume fixes nitrogen from the air into the soil and helps provide nutrients to non-leguminous plants

ADVANTAGES OF INTEGRATED FARMING SYSTEMS

IFS HAS THE POTENTIAL TO BENEFIT YOU AND YOUR FAMILY IN MANY WAYS

1. Increase yield and food production
2. Increase and diversify farm income
3. Increase household access to diverse and nutritious foods.

   For example, increasing stability for coconut farms through diversification and reduced dependence on products with unstable market prices such as copra, coconut oil, coir and others
4. Increase soil quality and fertility by using legumes and animal waste (manure and urine animal)
5. Reduce the use of chemical fertilizers, which is healthier and saves money
6. Reduce waste by integrating by-products into inputs for improved on-farm management and yields
7. Help to conserve local species and varieties by supplying the domestic market with essential food products and reducing challenges due to seasonality.

These advantages help to increase food security and reduce dependence on food imports in Kiribati, which is often affected by shortages.

The use of IFS will impart knowledge on land and water resources management and agriculture. It could also provide employment, particularly for young graduates, as an IFS system requires paid workers to run it properly. As such, it is important to consider the increased labour costs of managing an IFS model.

The most relevant type of IFS model in Kiribati is the terraced Babai pit system. This system can be adapted with different layouts of planting material and components.

Fig. 3 The Babai Pit system is made from multiple terraces

4 TYPES OF IFS

suitable for Kiribati

SYSTEM 1
BABAI TERRACED PIT

Babai pits are the most effective and well adapted IFS system in Kiribati. Crops and fish are raised together in a modified babai pit or a newly dug one. In Kiribati, it is common for babai pits to be close to homes.

For example, swamp taro (*Pulaka*) is planted in 10m x 20m pits in between houses. These pits are 2–3m deep, with taro corm placed in "organic baskets" of pandanus and coconut and anchored in holes 60cm below the water level.

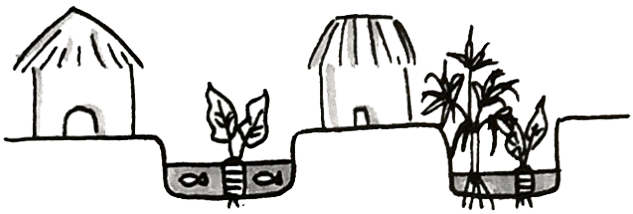


Fig. 4 In a Babai system, pits are dug in between houses.

SYSTEM 2
ZONING

Alternatively, the farming system is set up separately from houses, or what we call a different "zone".

In a 2-hectare unit for example, crop, livestock and fish are divided into 8 plots — 7 plots for mixed cropping and 1 plot for living quarters of the farmer, his family and other aspects like a livestock shed and compost pit. This system may still use Babai pits.

In general, sites should be flat, with good drainage and good rainfall. However, it is important to note that atoll soils are low in nutrients — especially nitrogen and potassium. Composting is therefore a key practice to improve soil organic matter and nutritional content. Compost also improves the water retention capacity of soils. Some material that can be widely used include a mixture of brown leaves and/or dry, woody chips, green leaves (grass clippings) and copra cake.

See section 6 for further details.

Fig. 5 In a zonal system, the land is divided into different functions.

5 BABAI PIT DESIGN

This design is based on the use of existing or abandoned Babai pits.

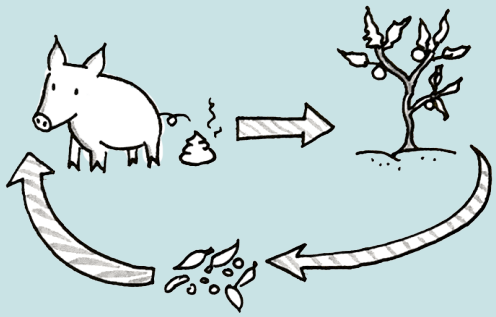
The Terraced System consists of 4 levels, the highest level is “ground level”, followed by 3 lower terraces. The lowest level or third terrace is deep enough to be 1–2m below water level, where fish can be kept among the *babai*. An additional element is to include livestock (pigs and chicken), usually at ground level. It is important that the animals are stalled and not roaming around thereby reducing waste management issues and contamination of groundwater resources.

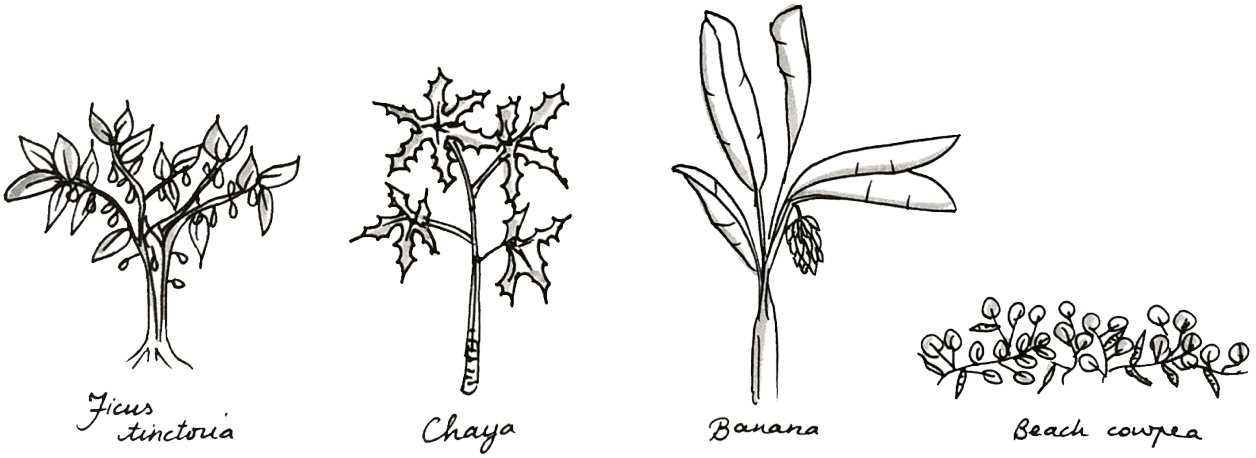
1 GROUND LEVEL

At the ground part of the system, crops that could be planted include pandanus, bananas, breadfruits, papaya, swamp taro, native fig (*te bero*), pumpkin, pisonia (*te buka)*, chaya and beach cowpea. Reason being that most of these plants can survive drier weather conditions and are more resilient to prolonged drought periods.

If possible, it is recommended to plant other species near or around the IFS system in order to maximize the organic material available from these crops, such as husks, fruit peel and leaves, which can be fed to the livestock (i.e. pigs, chicken, fish).

Their animal waste then provides fertilizer for the crops. Chicken and fish manure are high in nitrogen, phosphorus, and potassium. Together with mixed cropping, it can significantly increase yields and improve soils.

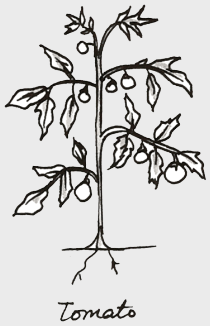




2 FIRST TERRACE

The first terrace should be planted with crops such as Chinese cabbage and tomatoes planted in alternate rows. The distance between each row is fixed at 50cm. This allows adequate room for walking and management of the crops. Chinese cabbage should be planted 20cm apart from each other. Tomatoes should be planted 30cm apart from each other.

Crops that can be grown on terraces forming the pit walls include: moringa (drumstick plant), *ofenga*, hedge panax and beach cowpea. These can be planted around the pit at ground level. Other crops, such as bananas, papaya, sweet potato and annual vegetables can also be included.

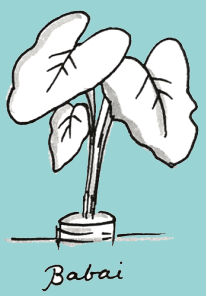


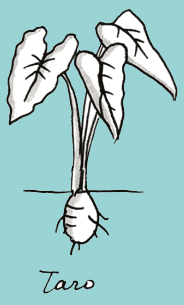
3 SECOND TERRACE

The second terrace should be planted with beans and legumes because they can fix substantial quantities of nitrogen (N) and this can be maximized in the soil at sowing. The suggested crops to plant here are long beans and beach cowpea. The distance between rows here is also fixed at 50cm. Long beans should be planted 30cm apart from each other and cowpea at 50cm apart.

4 THIRD TERRACE

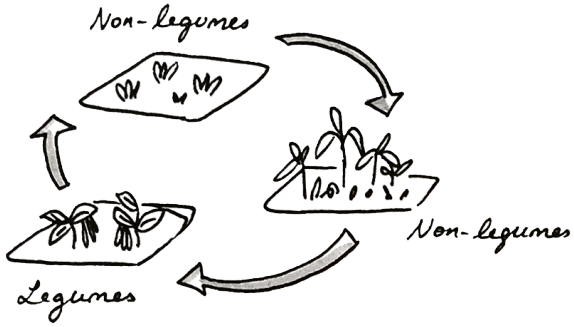
The third terrace should be planted with taro and *babai*, either a *te kaatutu* type or small early maturing type. Watercress (kangkung) can also be planted on the edges. The distance between the rows here remain at 50cm. For both crops, the distance between the plants along the row is also 50cm. Fish can be kept in this pit if the water level is at least 30cm. The most common is milkfish which is a traditionally important coastal food fish species in Kiribati.





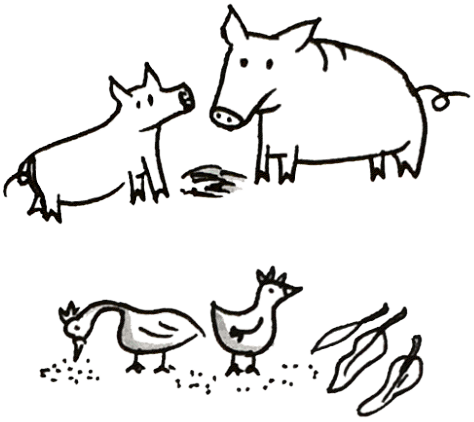
5 CROP ROTATION

Crops in the terraces should be rotated, that is, after each crop cycle, new plants should be planted in a different site so that the nitrogen left by legumes will be utilized by the non-legumes and increase their yields. Rotate short-term crops among themselves and between plots.



6 LIVESTOCK

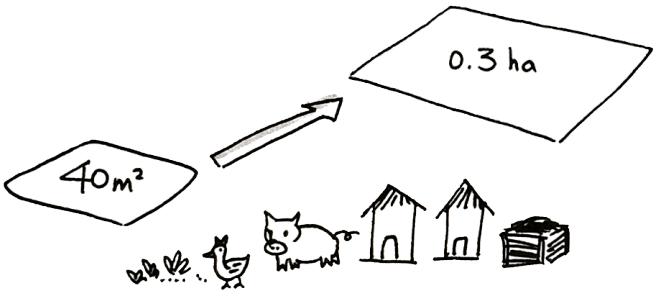
Livestock should be around 30m from the household and the Babai pit. Local food and scraps can be fed to both pigs and chickens. Animals should be fed twice a day, once in the morning and once in the evening, in clean troughs. Leaves and vegetables should also be fed at least 3 times a week to boost animal immunity to diseases. Water for drinking should be available 24 hours a day.



7 SCALABLE SYSTEM

The size of the system can be as small as 40m^2 or as large as 0.3 hectares, with 0.1 hectares the ideal size in Kiribati. A large unit could potentially include small livestock — 25 chickens and 3 pigs with 2 houses built of local material, and a compost pit.

An additional element could be the inclusion of a fish pond for milkfish or tilapia that can be fed from on-farm crop waste supplemented with off-farm feed such as copra meal and fish food.



6 HOW TO CONSTRUCT

a Babai Pit Terraced System

PIT CONSTRUCTION

STEP 1
Use an abandoned Babai pit or dig a new pit.

STEP 2
Create a pit of appropriate size depending on the size of the land to be used. In Kiribati, this can range from 1.5m of hard limestone to reach the freshwater lens, up to 15 feet deep.

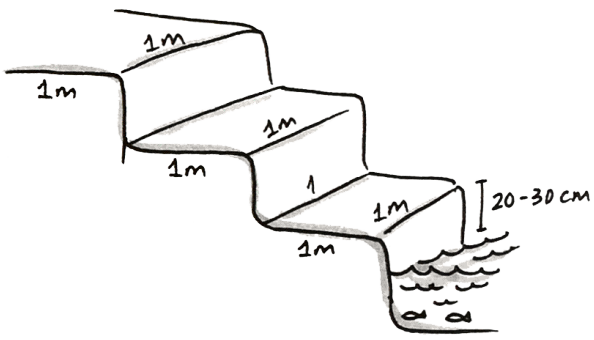
STEP 3
Construct 3 terraces to grow crops on in the pit, each terrace should be at least 1m high and 1m wide.

STEP 4
The third (lowest) terrace should be about 20cm to 30cm above the water level in the pit to ensure access.

STEP 5
Make sure the water at the bottom of the pit is deep enough to hold good sized fish (tilapia or milkfish).

STEP 6
Create a path, roughly 50cm wide, enough to descend to the bottom of the pit and ascend to ground level.

STEP 7
The terraces should be wide enough to allow the farmer to plant crops and attend to the fish.



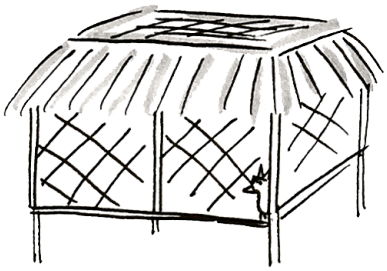
LIVESTOCK HOUSES

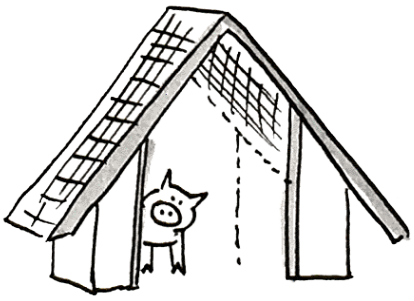
STEP 1
Two livestock houses are to be built from local materials — one for chickens and another for pigs. It is important to avoid flood-prone areas.

STEP 2
The size required depends on the number of animals. For poultry sheds, each bird should have enough space (around 2 sq. ft per bird)

STEP 3
Ensure that proper waste management measures are taken. Tethering animals during the day is fine, it is important not to leave the animals loose. This will improve community sanitation and avoid manure leaching into the soil and causing groundwater contamination.

STEP 4
Consider the possibility of installing additional rainwater harvesting and storage facilities.





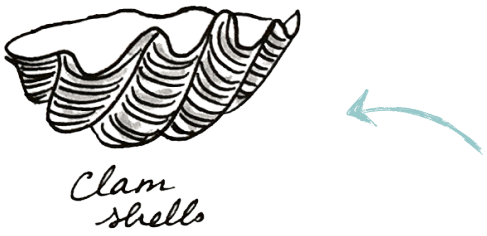
CURRENT METHODS FOR PIG AND POULTRY MANAGEMENT

Pigs and poultry are an important source of protein and key micronutrients such as iron and zinc in the diet of Kiribati people. They also have value in the traditional customs and culture of the Ikiribati. Pigs are traditionally kept in pens made of coconut logs and chickens usually roam freely unless kept in small coops made from local materials. They are fed mainly on coconuts, food scraps and greens.

PIG PRODUCTION

There are three types of pigs in Kiribati, local breeds, cross breeds and pure hybrids produced from mating with improved exotic breeds. The hybrids are bigger than the local breeds and are the preferred type.

A traditional pig pen can be established using coconut logs. Shelter consists of a thatched roof over the pig house to provide shelter from rain and sun. The shed also protects the animal from getting affected by seasonal changes and from falling sick.

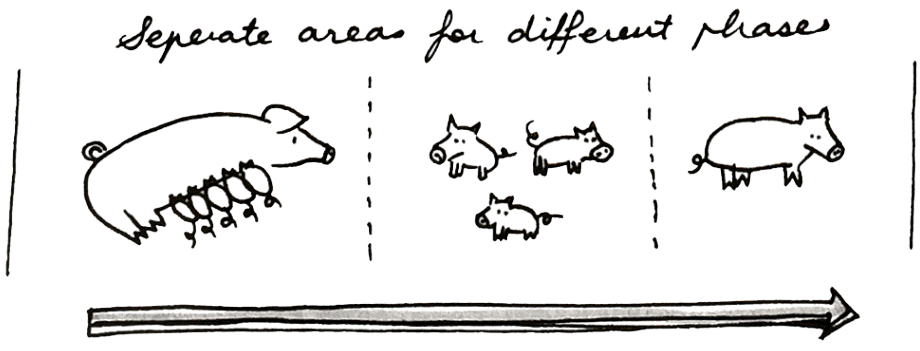


PIG HOUSING

A pen is an enclosure for holding livestock. The pig pen needs to be divided into different areas for each phase of the production cycle. Pigs should therefore be kept separately, depending on age of the pig and if they breed piglets.

The number and size of the pen depends on the expected numbers of pigs to be housed in each production phase. It is important that each adult pig has roughly 1m x 2m of space. Contrary to belief, pigs are clean animals if given a proper shed and conditions that give them enough space to defecate in one area and feed at other.

Feed and water can be provided in empty large clam shells (*aobunga*) that are kept clean. Ideally, plants should be grown nearby so that scraps can also be fed to the pigs.



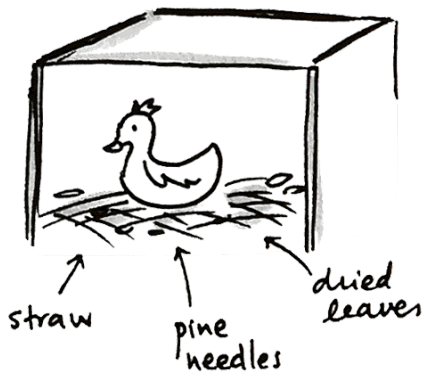
CHICKEN PRODUCTION

There are 3 types of chicken in Kiribati: local, exotic and hybrids. The preferred types are exotic breeds and hybrids since they give more meat and eggs compared with local chickens. Chickens should be housed in locally-built coops made from coconut fronds, thatch strings and timber. Empty clam shells should also be used to contain food and water.

Egg-laying boxes should be made of local materials such as straw, pine shavings, dried leaves, shredded paper and pine needles from Beach sheoak trees (*Casuarina equisetifolia*).

Chickens should be fed in the morning and evening and clean drinking water should be available all the time. About 25 to 50 chicken can be put in a chicken house.

Some examples of organic feed include green fodder (which form a valuable source of protein but may require some processing); peels from swamp taro, spoiled papaya and bananas. Make sure these do not compete with household consumption needs.

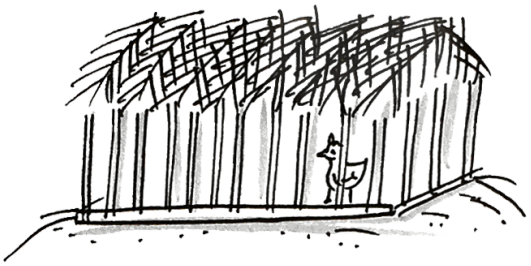


CHICKEN HOUSING

Chicken housing can be built on the ground with a raised floor to prevent flooding, or off the ground on stilts to allow for better ventilation and to prevent dogs or other animals from breaking into the house.

If possible, it is important to create a fence from either woven thatch, sticks or wire to prevent chickens from escaping. An adult chicken needs about 2m x 2m of space, when they are small, 1m x 1m is enough.

Nests for layers and mother hens can be constructed from leafy or thatch materials and added to compost after use. Keep the feeder or water bowl near the entrance of the housing so that you do not disturb the birds when refilling.



GENERAL RECOMMENDATIONS ON SITE SELECTION

- Raised ground or elevated land that cannot be flooded by rain water
- Well-drained and separate house
- Protected from the sun (e.g. shade from trees) and ample fresh air
- Away from residences (around 10–15 ft. away)

GROWING PLANTS

1 NO TILLAGE

This technique does not disturb or damage the soil. Seeds are put into the soil with a no-tillage seeder and it is covered with mulch to help retain water.

Minimum tillage can also be used, that is, the soil is softened with a shovel only once before the seed or crop is planted. Since IFS is a system which requires maximum interactions among various components (crops, livestock) to obtain productivity, conservation agriculture methods that create minimum disturbance to the soil should be practiced.

2 MIXED CROPPING

Mixed cropping is the growing of two or more crops simultaneously on the same plot with or without distinct row arrangement (in the case of Babai, this could be on one terrace). Advantages include increased and more stable yield, soil conservation, greater nutritional value (from diversification of crops) and efficient labour use. Creating alternate row mixtures are recommended for easier management. It is important to note that mixed cropping requires a good selection of companion crops and correct spacing among crops to avoid overcrowding.

3 COMPOST

Compost is a locally-created source of nutrients for crops. A good, balanced compost consist of 3 main components: coconut husks/shells, rotten wood and green or brown leaves. These will give NPK — 3 main plant nutrients. Leaves, especially those of leguminous plants, give N (nitrogen), husks give P (Phosphorous) and coconut logs give K (potassium). Rusty tins, ground pumice and animal manure are other ingredients that can be added. These provide additional nutrients and micronutrients to create a balanced compost.

IMPORTANT TIPS

- If the compost shrinks low and smells bad, this means there is too much manure, fish waste or other nitrogen material. Add more dry, brown materials and wait a couple of days.
- The soil from tethered pigs is great to add into compost for potassium and nitrogen.

HOW TO CREATE A BALANCED COMPOST

STEP 1
Choose an area of ground to make your compost, say 3m x 3m area.

STEP 2
Mark out this area.

STEP 3
Spread the first layer of coconut husks on your compost area. The layer should be roughly 50cm thick. Cover with a thin layer of good soil and animal manure.

STEP 4
Spread the second layer of rotted coconut logs on top of the first layer, also 50cm high, cover with a thin layer of soil and animal manure.

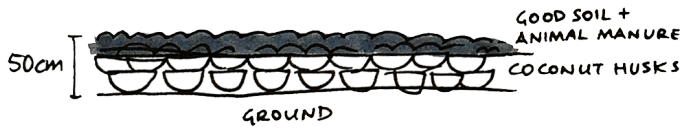
STEP 5
Place the third layer of dry leaves on top of the second layer, 50cm high, and cover with coconut fronds or old mats. Add a layer of soil and then animal manure. Seaweed (*Acanthophora spicifera*) can also be added to speed up the decomposition process.

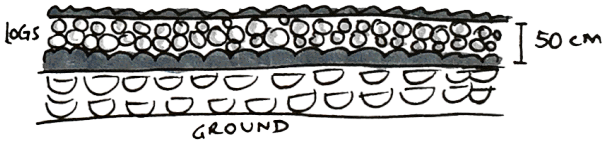
STEP 6
Cover with coconut fronds or old mats

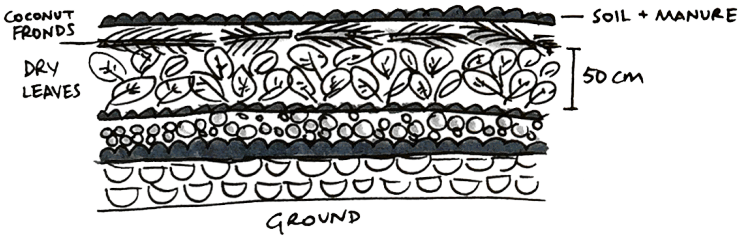
STEP 7
Water and turn/mix the compost layers every 3-4 days with a shovel.

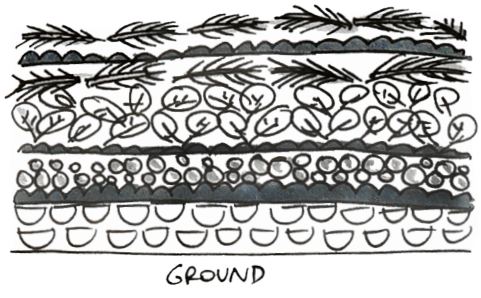
STEP 8
The compost will release heat as it decomposes. When there is no more heat, the compost is ready for use. You can check this by inserting a knife into the compost for heat.

STEP 9
Use the compost in planting holes for trees and other crops, or put it around crops in your terraces or plots.









7 GUIDANCE

on specific crops and planting methods

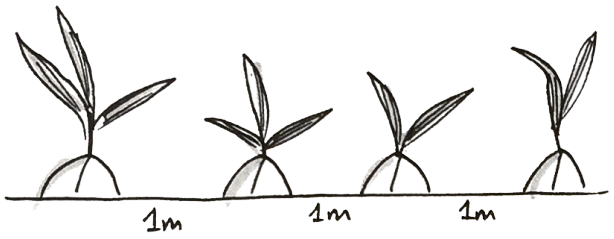
COCONUT HUSBANDRY

COCONUT SELECTION

It is important to select the best coconut seed nuts for the nursery. These should have high yield, good shape and water should slosh in the nut.

Nuts should be put in a nursery — inter-row spacing should be 1m and intra-row spacing should be 50cm. Rows should be raised in heavy rainfall areas and dug as furrows in dry areas. Nuts should be planted along the rows with appropriate spacing between the nuts.

When six months old or at the 5-leaf stage, nuts can be transferred to holes planted 50 cm deep. Holes should be filled with rotted coconut husks at the bottom, coconut logs in the middle and leaves at the top. Soil should be at the top to hold the coconut seedling as it grows.

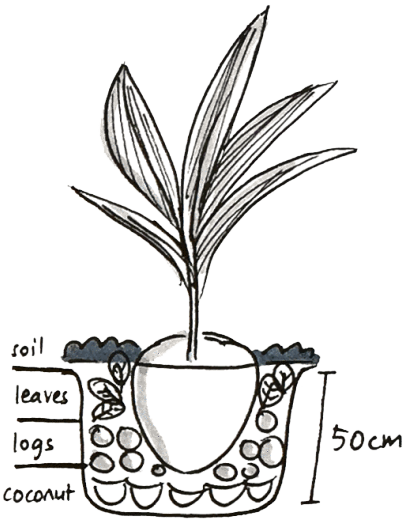


COCONUT REPLANTING

Coconut can tolerate saline conditions because of their root structure, physiology and structure of the palm. In Kiribati they have been known to grow very close to, if not in, the sea.

For planting, clear the area of husks and other vegetation. Mark the area in a triangle with sides of 9m in length for coconut spacing. Dig holes that are $1m^2$ at the site of planting and 50cm deep, and fill in with compost as for coconut husbandry. Plant good seedlings in prepared holes and water regularly.

The Kiribati way can also be used. This is where nuts are planted in small holes, composted and not depending on soil type.

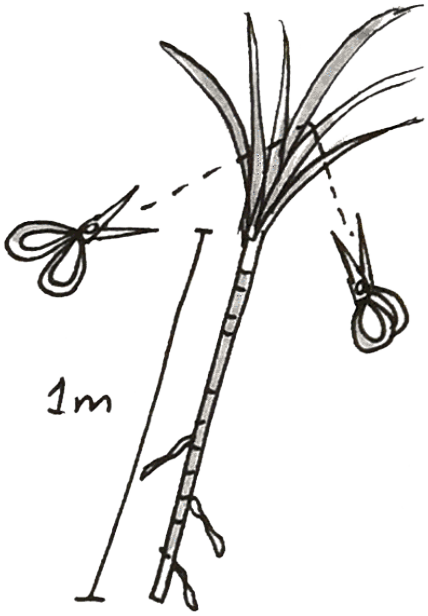


HOME GARDENING WITH IFS PRINCIPLES

This is the practice of growing crops near or around homesteads. The following crops are important in Kiribati.

1 PANDANUS

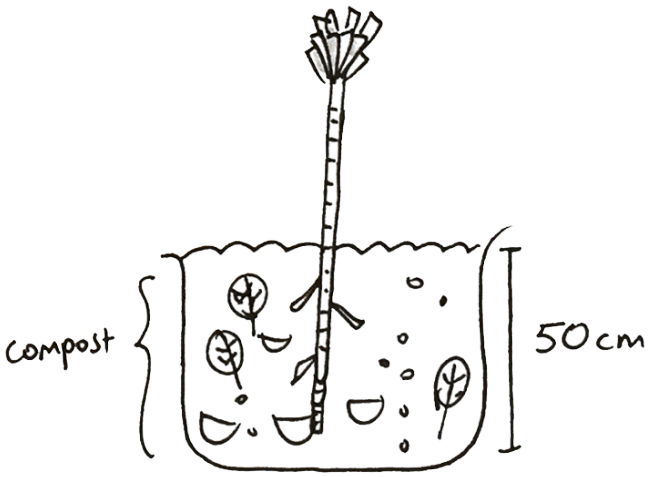
The pandanus is an important crop in Kiribati (second to coconut) which produces food, building materials, mat, medicine and many more uses, including handicraft making.



PROPAGATION

Pandanus can be propagated in a vegetative manner using cuttings of about one metre in length trimmed of its leaves. These are planted in holes of 50cm deep squares filled with a balanced compost (coconut husks, coconut stems and plant leaves). The planting material is placed in the middle and covered with soil.

Pandanus can also be planted from seed but plants will be variable in phenotype and genotype, and therefore is not recommended except in plant breeding work.



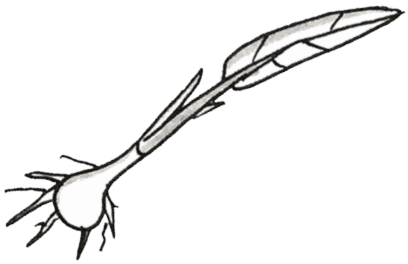
2 BANANAS

Bananas are also important and popular food items in Kiribati, whether cooked or eaten fresh when ripe. They also generate income when sold in markets.

PROPAGATION

Bullheads are the "corms" of old banana plants which have produced fruits. A cut is made 10cm above the corm to make a bullhead. This material produces uniform plants. The corm must have "buttons or swellings on them". It can be cut in half to make 2 planting materials, which can be cut in half again, length-wise, to make 4 planting materials (provided that they have "buttons or swellings" on them to grow into plants when planted in the field).

- **MAIDENHEAD**
  This is a mature plant which has not produced a bunch of bananas so it will produce a bunch quickly. It may suffer from transplanting shock and evapotranspiration.
- **BROADLEAF SUCKER**
  As the name suggest, the sucker has broad leaves. This sucker originates on the upper portion of the corm. It produces a bunch later than a sword sucker.



- **SWORD SUCKER**
  As the name also suggests, this sucker has sword-like leaves or narrow leaves. It originates on the lower portion of the corm. It matures earlier than the broadleaf sucker and a preferred material since it suffers less from water evaporation.

TREATMENT OF PLANTING MATERIAL

It is essential treat planting material in order to ensure healthy plants and prevent and reduce pest and disease attacks such as from taro beetles.

The following method has been used and found effective.

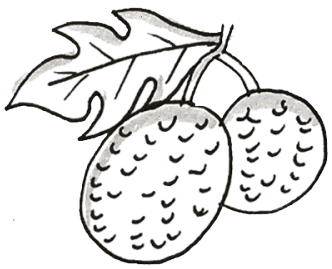
1. Clean the corm by trimming it to get rid of rot, pests and diseases present in the corm. Trim about ¼ to ½ inches of the corm.
2. Mix 1 part of household bleach with 5 parts of water to make enough mixture to "dip" the untreated corm in for 3 seconds. Dry briefly and then it is ready for planting.
3. **Planting:** dig a hole 1m x 1m square that is 50cm deep. Add compost to 25cm and cover with soil until ground level. Place the planting material in one corner of the hole and cover with soil. Water frequently until the plant is well established. The Kiribati way of planting in composted pits can also be used.

3 BREADFRUIT

Breadfruit is perhaps the most preferred fruit in Kiribati and is planted around homesteads.

PLANTING

- Choose a good variety to grow based on preference, vigour, pest and diseases tolerance and high yield. Consult the Agriculture Department in Tanaea and KOIFAWP. There are both seedless and seed varieties in Kiribati, example, *Bukiraro* (seedless) and *Maikeang* (seed variety)
- Prepare a hole that is 60cm^2 and 50cm deep. Fill 20cm of the hole with a balanced compost and fill the rest if the hole with good soil until the top. Plant the breadfruit material in the middle.
- Select a good planting material since it is a long-term crop. Some breadfruits produce young plants from their roots. These can be taken as planting material. Planting material can also be obtained by “marcotting”.



4 PAPAYA

Papaya needs full care and consideration before planting (e.g. a female plant turning into a male or a male-producing fruit). However, it is a popular crop in Kiribati for local consumption and sale.

PLANTING

- Select a good variety to grow and buy the seeds from certified seed sellers. *Hawaiian solo* is a preferred variety worldwide. Seeds from good local varieties can also be used.
- Prepare a composted hole of 50cm x 50cm size, spaced at 2m along the rows and 3m apart between the rows. Fill with compost 20cm deep and then good soil (*te bon*) until the top of the hole (ground level).
- Sow 3 to 4 seeds in the middle of the hole, thin these to 2 per hole, one male and one female, when old enough to recognize. However, 1 male plant for every 10 females is common practice.
- If seedlings are hermaphrodites (both male and female on the same flower) then leave 1 healthy seedling to grow per hole. Marcotts can also be planted, and is becoming popular in Kiribati.

5 SWAMP TARO

Swamp taro was the main staple in Ikiribati diets before rice took over. The length of time to cook it and grow it are the main problems. A variety called te *kaatutu* should be encouraged more since it takes less time to mature (6 months or less). These are grown in pits dug into the water table in many islands.

A typical method of growing called *Te Wakaa Baurua* is described here. This method is practiced at the bottom of the Babai pits in rather muddy conditions. A hole, about 50cm deep dug into the soil/mud should be large enough to hold the planting material—*te baku*—consisting of parts of the corm and trimmed leaves.

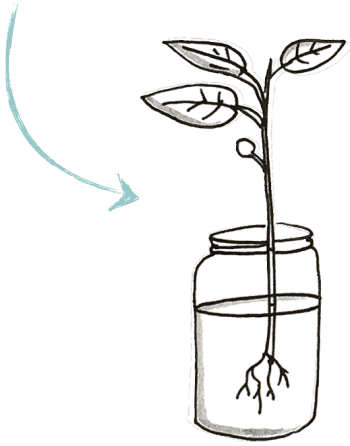
The bottom 10cm is filled with chopped green leaves of *te ren*. The top 20cm is filled with chopped rotten leaves of various plants and *te kaura* (*Abutilon indicum*) leaves. The hole is then filled with soil to the top. The planting material is planted in the middle of the hole and at various growth stages, "baskets" of woven leaves are put around the plant and composted with brown leaves.

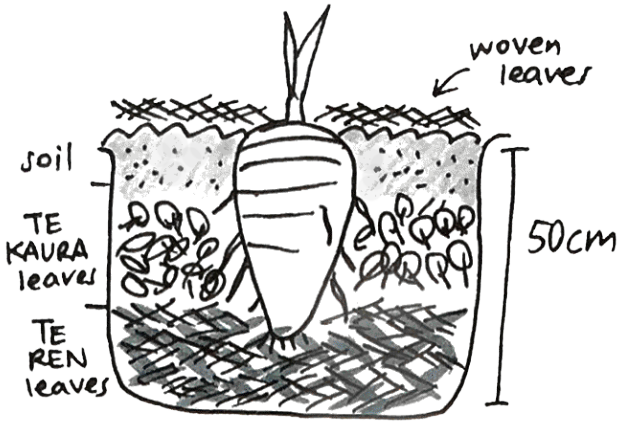
More baskets are put around the plants as they grow and compost is added. This is carried out till maturity and harvest.

6 NATIVE FIG

Native fig or *te bero* gives fruits which can be made into various very popular dishes, such as *Te bekei ni bero* — a favourite in Kiribati. The fig can grow wild in the bush in some islands and does not need much attention.

It is propagated with rooted cuttings. Branches can also be marcotted and used. The cuttings are grown in 30cm x 30cm holes filled with compost and soil or with soil alone.





7 PUMPKIN

Pumpkin grows well in Kiribati and does not need much attention. Holes of 40cm x 40cm filled with compost can be used in Kiribati to grow pumpkin.

There are a few methods to grow pumpkin. In one method, a large bottle (such as an empty soy sauce bottle) is filled with water and a 50cm-long cutting of pumpkin is put in the water. The bottle is put in the middle of the hole. The plants grow well with this method.

In the second method, 50cm-long cutting is planted in the middle of the hole, about 10cm deep. Part of the aboveground part of the cutting is also covered with soil.

Watering is essential for good growth. The plant should be left to produce sufficient biomass or growth before hand pollination is made otherwise too much biomass channeled to the fruit will leave little energy for growth and the plant may die.

8 PISONIA

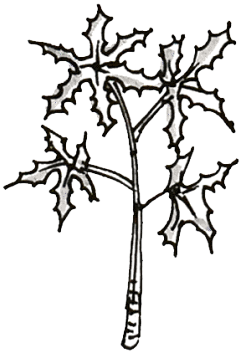
Te buka (pisonia) is not common in Kiribati, but important enough to be included in an IFS system. It can be grown in holes sized by 50cm x 50cm and 50cm deep filled with compost and soil.

9 CHAYA

This is a hardy plant which grows well in Kiribati and does not need much attention. It is a good source of vitamin and protein. It also adds nitrogen (N) to the soil, improving soil fertility.

For better growth, it is grown by using seeds or cuttings. Beds of appropriate size should be made, with about 10cm thickness of compost added onto the bed. This is then ploughed into the bed using a shovel. Seeds are planted in rows with a spacing of 50cm between rows and 20cm intra-row.

Three seeds should be planted per hole and thinned to one per hole 3 weeks after sowing. Frequent watering will ensure good growth.



Chaya

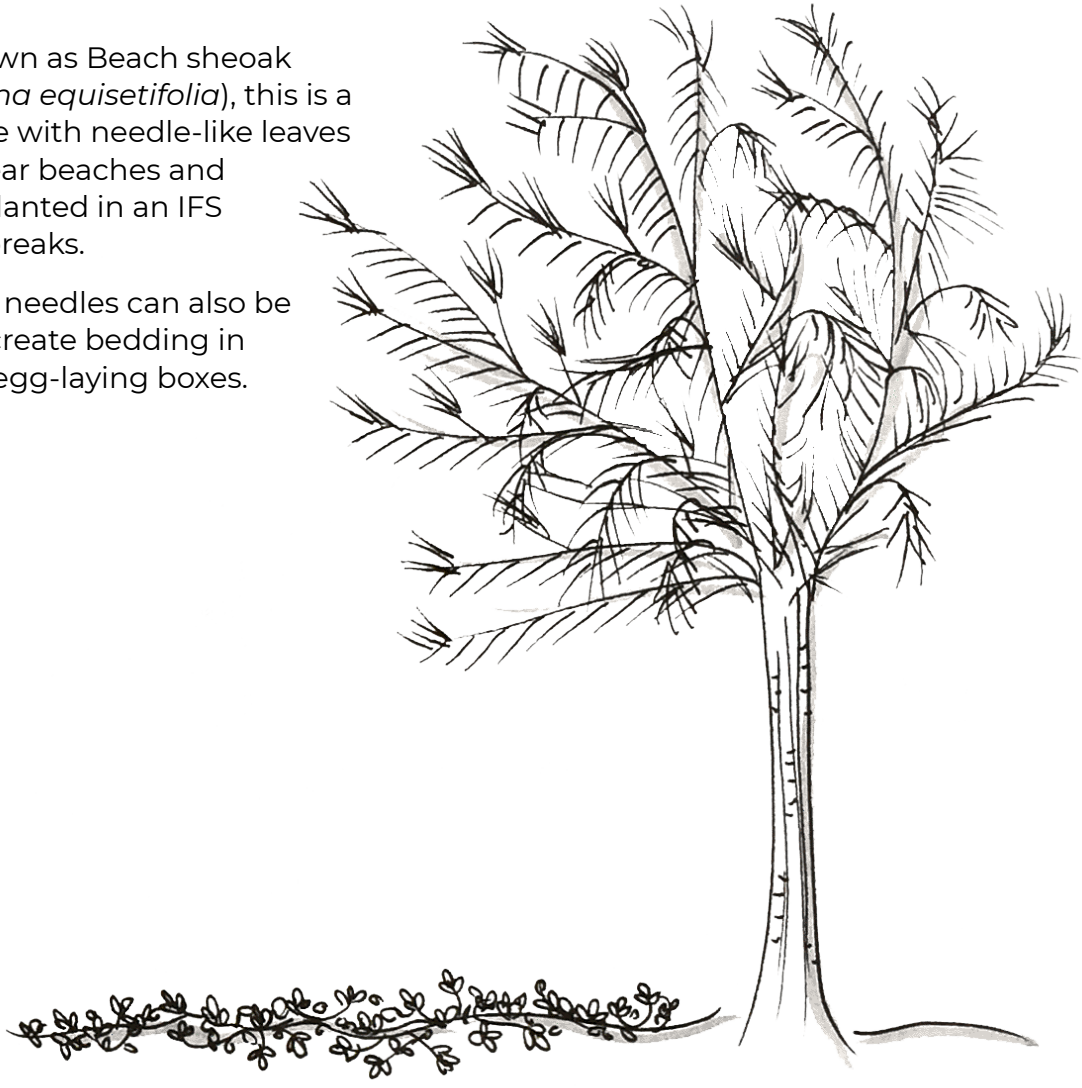
10 BEACH COWPEA

Te baa tenibaa (Vigna marina) belongs to the bean family and is found growing near beaches in Kiribati. It is a legume and produces edible trifoliate leaves, pods and yellow flowers. It can be used as a main crop or as a cover crop and planted into the soil before other crops are grown (for example *Vigna marina* followed by Chinese cabbage).

11 PINE NEEDLE TREE

Also known as Beach sheoak (*Casuarina equisetifolia*), this is a large tree with needle-like leaves found near beaches and can be planted in an IFS as windbreaks.

The pine needles can also be used to create bedding in chicken egg-laying boxes.



8 KEY CRITERIA

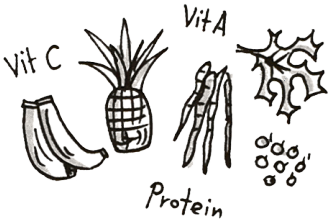
for selecting crops

Different crops should be selected depending on the specific Outer Island, the available supply and the preferences of households and communities.

However, generally speaking, below are some key criteria to support Agricultural Assistants in selecting crops suitable in an IFS model.

KEY CRITERIA

- Ability to provide improved yield when mix-cropped
- Climate resistant
- Pest and disease resistant
- Nutritional value of foods produced
- Potential income value of food or product produced
- Salinity resistant
- Drought/flood resistant



It is also important to consider that the land size recommendations presented in this document may need to be adapted based on available land size and the average land holding or access to land that smallholders farmers have.

Ministry of Agriculture,
Food and Rural Affairs

Investing in rural people

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