

# RICE GROWING

Julie O'Keeffe

Life Cycles – rice plants  
Products – flow charts to  
show production processes

Contents:

- ◇ Who grows the most rice?
- ◇ Many ways of saying rice
- ◇ Rice farming



# HANDOUT 1 – RICE GROWING

## Who grows the most rice?

The following countries produce millions of tonnes of rice each year:

Bangladesh – 30 million tonnes

China – 199 million tonnes

India – 127 million tonnes

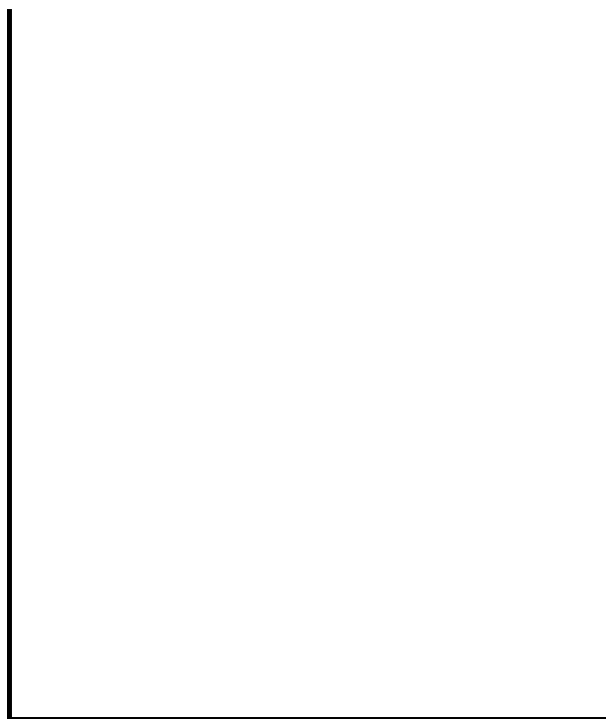
Indonesia – 51 million tonnes

Myanmar – 16 million tonnes

Thailand – 23 million tonnes

Vietnam – 30 million tonnes

Record the quantities of rice produced in each country as a bar or column graph



Number these countries from 1 to 7 in order of smallest amount of rice produced to the largest amount of rice produced:

..... Vietnam, ..... Bangladesh,  
..... China, ..... India,  
..... Myanmar, ..... Thailand,  
..... Indonesia

Write six questions to ask a friend about the graph.

Remember to use comparative language in some of your questions

1. ....  
.....
2. ....  
.....
3. ....  
.....
4. ....  
.....
5. ....  
.....
6. ....  
.....

# HANDOUT 2 – WAYS TO SAY RICE

There are many different ways to say the word 'rice'.

Copy the table onto card, cut out, mix up. Correctly match the language and the word for rice with each country.

LANGUAGE	WORD FOR RICE	COUNTRY
Filipino	arroz	Phillipines
Korean	bap	Korea
Japanese	gohan	Japan
Vietnamese	com (cooked) gao (uncooked)	Vietnam
Thai	kao	Thailand
Bahasa Indonesia	nasi (cooked) beras (uncooked)	Indonesia
Mandarin	fan (cooked) mi (uncooked)	China
Malay	nasi (cooked) beras (uncooked)	Malaysia
Hindi	chawal	India
Nepali	kanah	Nepal
Cambodian (Khmer)	baay	Cambodia
Lao	khao neow	Laos

# HANDOUT 3 – RICE FARMING

Match the tasks needed to grow rice to the most suitable season.

Enlarge the table onto card, cut out and organise the tasks under the correct season

RAINY SEASON	HOT SEASON	DRY SEASON
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Drying the rice grains.

Digging in the rice stubble.

Sowing the rice.

Breaking up the soil in the paddy.

Selling the rice grain at the local market.

Weeding the rice plants.

Ploughing with the buffalo.

Making new terraces on hillsides.

Winnowing the rice.



Planting the young rice shoots.

Scaring the birds away.

Harvesting the rice with knives.

Opening irrigation canals to flood the paddy fields with water.

# HANDOUT 4 – RICE FARMING

Sequence the steps in the rice growing process.

Copy the steps onto card, cut out and mix together.

Ask students to place the strips in the correct sequence.

The soil in the paddy field is broken up and levelled.

Rice seeds are sown in small areas of the paddies.

After 30 days young rice plants are ready to be planted in the paddy.

The paddy field is flooded with water.

The rice plants are pressed into the mud in neat rows.

When most of the rice is a golden-yellow colour it is ready to be harvested. Most harvesting is done by hand using a knife.

The grain is separated from the straw. (THRESHING)

The husk and the bran are cleaned off. (WINNOWING)

The rice grains are dried and stored.

When the rice grains are MILLED, the outer husk and the inner layers of bran are removed from the edible rice grains.

# STORIES WITH RICE LINKS

## CHINA

*The Old Woman and the Tiger* – <http://home.arcor.de/marcmarti/yugur/folktale/tale07c.htm>

*Folktales Germantown Academy* (Fifth Grade):  
*Talk Does Not Cook Rice*

*The Rich Man's Rice* – [www.germantownacademy.org/academics/l5/5th/chinfolk/stinde98.htm](http://www.germantownacademy.org/academics/l5/5th/chinfolk/stinde98.htm)

*The Rice Dinner* – [www.germantownacademy.org/academics/l5/5th/chinfolk/stinde01.htm](http://www.germantownacademy.org/academics/l5/5th/chinfolk/stinde01.htm)

*The Greedy Fly* – [www.araratcc.vic.edu.au/accweb/gumsan/page6.htm](http://www.araratcc.vic.edu.au/accweb/gumsan/page6.htm)

*Wormwood Rice Cake* – <http://2210.145.168.243/pk/111th-issue/99090804.htm>

## INDIA

*The Joy of Giving* by Manpreet Malik – [www.4to40.com/folktales/index.asp?article=folktales\\_joyofgiving](http://www.4to40.com/folktales/index.asp?article=folktales_joyofgiving)

*The Magic bowls* – [www.chennaionline.com/children/bowls.asp](http://www.chennaionline.com/children/bowls.asp)

## INDONESIA

*Too-too-moo and the Giant* – [www.aaronsherp.com/stories/022.html](http://www.aaronsherp.com/stories/022.html)

*The Legend of the Rice Paddy* – [www.dover.k12.nh.us/ESOL/DHS/folktales/2002-2003/legend\\_of\\_the\\_rice\\_paddy.htm](http://www.dover.k12.nh.us/ESOL/DHS/folktales/2002-2003/legend_of_the_rice_paddy.htm)

## JAPAN

*The God of Poverty and the God of Happiness* – [www.12.ocn.ne.jp/~sr.sanae/eng.poverty2](http://www.12.ocn.ne.jp/~sr.sanae/eng.poverty2)

*The Old Man Who Made the Trees Blossom* – [www.spiritoftrees.org/folktalesichung/old\\_man\\_who\\_made\\_trees\\_blossom.html](http://www.spiritoftrees.org/folktalesichung/old_man_who_made_trees_blossom.html)

*Do Nothing Taro* – [www.12.ocn.ne.jp/~sr.sanae/eng4.htm](http://www.12.ocn.ne.jp/~sr.sanae/eng4.htm)

*Monogusa Taro* – [www.mofa.go.jp/j\\_info/nagano/altas/a-1-2.html](http://www.mofa.go.jp/j_info/nagano/altas/a-1-2.html)

## KOREA

*The Girl and the Toad* – <http://hazel.forest.net/whootie/stories/gtoad.html>

## LAOS

*The Four Marvellous Brothers* – [www.seasite.niu.edu/lao/multimedia/four\\_brothers.htm](http://www.seasite.niu.edu/lao/multimedia/four_brothers.htm)

*If It Belongs To Us, It Will Come To Us* – [www.seasite.niu.edu/lao/multimedia/belong\\_to\\_us.htm](http://www.seasite.niu.edu/lao/multimedia/belong_to_us.htm)

## VIETNAM

*A Devoted Son* – [www.boatpeople.com/un\\_folktales/Banh-Trung.html](http://www.boatpeople.com/un_folktales/Banh-Trung.html)

*The Buffalo* – [www.thingsasian.com/article/legend/legend03.htm](http://www.thingsasian.com/article/legend/legend03.htm)

*The Buffalo Boy and the Banyan Tree* – [www.thingsasian.com/article/legend/legend01.htm](http://www.thingsasian.com/article/legend/legend01.htm)





# RICE – An Introduction

Di Dunlop

- ◇ Construct and interpret food chains and food webs
- ◇ Describe how scientific knowledge has influenced the development of practices in agriculture, eg. animal husbandry or crop cultivation to improve yields and sustainability.

## RICE AROUND THE WORLD

World rice production in 2011 – 2012 was approximately 721 million tonnes. At least 114 countries grow rice and more than fifty have an annual production of 100 000 tonnes or more. Asian farmers produce about 90% of the total, with two countries, China and India growing more than half the total crop.



Rice, being a semi-aquatic plant, needs a lot of water — particularly over its reproductive stage, from panicle to early grain development.

Most field crops usually grow best when at least 50% of the usable soil moisture is available to the plant. With rice, this figure is closer to 75%. especially during the reproductive phase.

Continuous ponding of water in rice fields is one way of meeting these high moisture demands. Ponding also reduces the risk plant stress, with subsequent loss of yield, and ponding helps suppress weed growth, improves the efficiency of the use of nitrogen, and in some environments helps to protect the crop from extreme temperature fluctuations.



### Water usage

Factors that determine the total water requirements of a crop are:

- evapo-transpiration,
- permeability of the soil,
- drainage,
- length of the growing season, and
- a level soil surface.

## RICE – AN INTRODUCTION

### What are the effects of a tsunami on rice production?

The tsunami of 26 December 2004 tragically affected many rice-producing areas in Asia

Country	Dead*	Missing*	Rice Consumption (kilogram per capita) #
Indonesia	166,320	6,245	230.9
Sri Lanka	29,854	6,007	148.8
India	10,749	5,640	111.2
Thailand	5,313	3,396	151.2
Malaysia	68	6	132.5
Myanmar	59		315.7

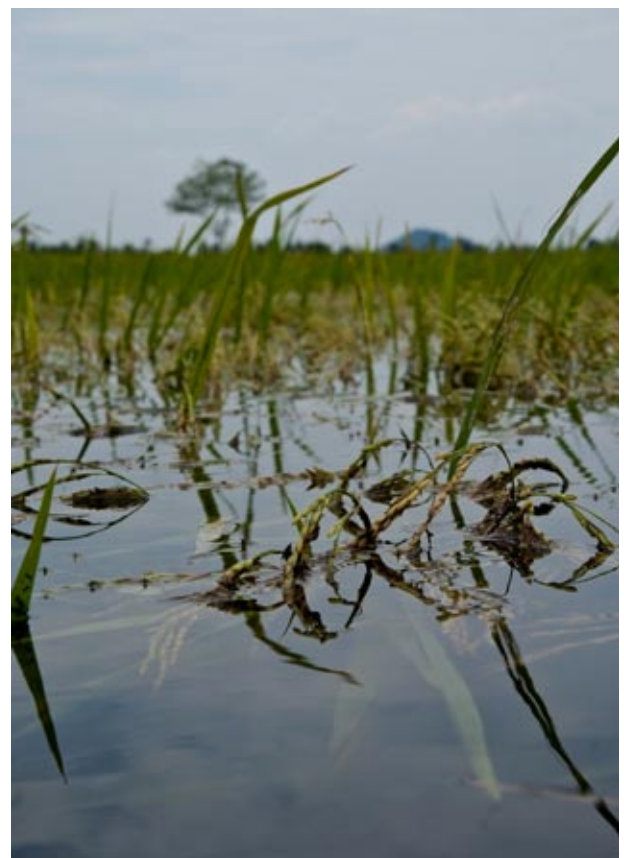
Sources: (\*) CNN.com, 20 January 2005 and (#) FAO

The exact extent of the damage to rice-lands is still to be evaluated. However, feedback from field officers puts the damage to rice fields at around 50 000 – 60 000 hectares—with damage primarily in Indonesia, Sri Lanka and India.

While the area of rice-land affected is not large in terms of the world's total rice area (approximately 150 metres /hectare), it is estimated that the tsunami affected the lives of more than 200 000 people who rely on rice crops for a significant part of their livelihoods.

A tsunami, or invasion of salt water, can affect rice production in terms of:

- Direct crop losses, food shortages, storage losses of donated food.
- Loss of seed stocks.
- Salinisation, soil loss, and soil deposits,
- Shortages of labour and equipment.
- Shortage of information on rice stocks and other production practices.



Devastated rice crop due to salt water inundation. Source: Wikimedia Commons



# DIGGING UP THE PAST OF SOUTH-EAST ASIA

Nic Stevenson

## IN SEARCH OF THE RICE AGE

- In the Neolithic period, did people move from China through Taiwan to the Philippines then out across the islands of the Pacific, or did they come from Indonesia?
- One way to tell is by figuring out when the Chinese technique of farming rice was first used. In their search for rice pollen, scientists drilled cores of sediment from Lake Paoay in Luzon.
- Back in the lab, Dr Janelle Stevenson cut the cores into sections. Pollen was extracted from each piece for dating and to see if any of it is from rice.
- Distinguishing rice pollen from other grasses takes a trained eye.
- Shown at right is an electron micrograph of rice pollen. One grain is about 4/100ths of a millimetre across.



Modern archeological expeditions are team efforts involving all manner of disciplines, from botany and geology to genetics and linguistics.

Dr Janelle Stevenson, from the Department of Archeology and Natural History at the Australian National University, specialises in finding and identifying the remains of plants. She's part of a large group investigating the controversial issue of how mainland Asian cultures spread through the islands of South-East Asia during the so-called Neolithic revolution, between 6000 and 3500 years ago.

'There are two theories', she said. 'One is that people moved from China through Taiwan, the Philippines, Indonesia, then out across the islands of the Pacific. Others say the expansion started in the south, out of Indonesia and into the Philippines.'

Evidence of how languages relate to each other favours the first scenario but to build up a complete picture of life in the Neolithic period, the team is tracing technologies thought to have originated in China. These include stone sinkers used to weight fishing nets, a particular kind of pottery and jewellery made from shells and rice.

Stevenson is also figuring out what the hunter-gatherers who already lived on the islands ate, and what impact the mainland technique of farming rice had on them.

One focus of her research is the Batanes, a group of islands halfway between Taiwan and the Philippine island of Luzon. Dating material from all three regions should indicate in which direction people migrated.

'Traditionally the diet of the people in the Batanes relied on taro and yam as the remote Pacific Islanders do', she said 'It now has a large rice component because they import cheap rice from the Philippines.'

Stevenson is looking for telltale signs of rice, such as its pollen, in sediment taken from the bottom of a lake in northern Luzon. Pollen grains' don't survive long out in the open, but waterlogged soil is a great preservative. As soon as they're brought to the surface, the long, cylindrical samples are wrapped in plastic and shipped to the team's quarantine lab in Australia. Here the cores are sliced up and pollen is extracted for identification and dating.

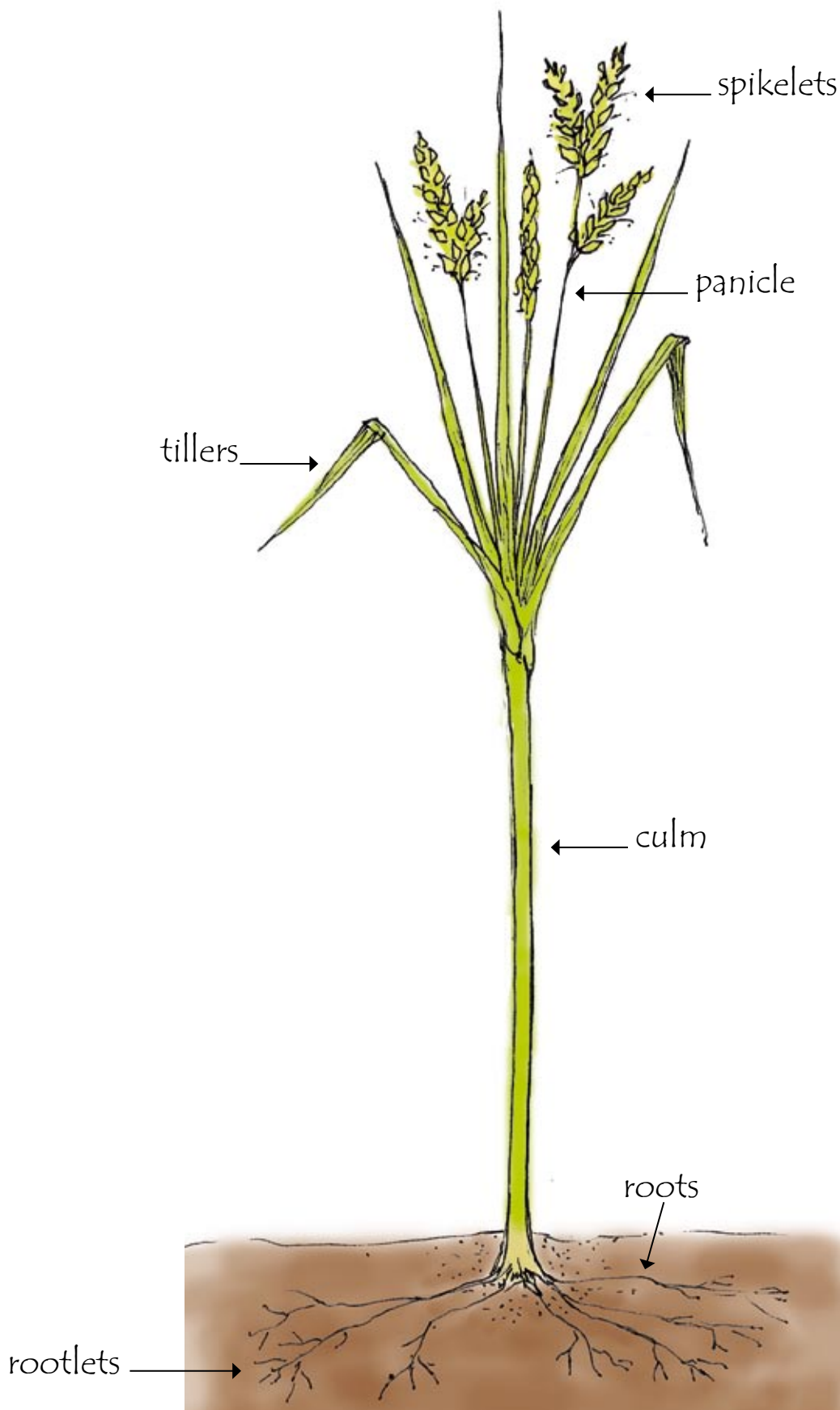
Stevenson said: 'So far, the oldest Neolithic sites in the Butanes are 2600 years old. slightly younger than similar sites on mainland Luzon, but we've only just started sampling. 'It's important to recognise that no one technique is going to resolve the argument.'

The Sun-Herald, 24 November 2002

## Miscellaneous facts

- Rice grows on every continent except Antarctica, from as far north as Russia (52°N) to as far south as Argentina (40°S).
- All modern cultivated rices belong to only two species:
- *Oryza sativa* from Asia, and *Oryza glaberrima*, a red rice from West Africa. There are now more than 140,000 varieties of rice flowering around the world.
- English gets the word 'rice' from the Greek *oryza*, via Latin *risium* and Italian *riso*.

# PARTS OF THE RICE PLANT





# RELIGION AND THE RICE-GROWING CYCLE IN BALI

Compiled and developed by Jennifer Curtis

*Rice terraces in Jatiluwih, Tabanan Regency Bali. Source: Wikimedia Commons*

In Bali, the cultivation of rice is accompanied by a sequence of rituals which are aimed at enlisting the protection of the rice goddess and other deities. Through ceremonies and offerings, the farmers ask that the developing grain is kept free of pests and that the plants produce a heavy harvest.

The first offering is made in the *sawah*, the irrigation field, immediately before hoeing begins to break up the soil before flooding. The offering is of plaited coconut leaves, the ingredients of betel nut chew, and a Chinese coin. The ceremony is organised by the *subak*, with many members attending.

In the past, a pilgrimage would be made to one of the holy lakes such as Lake Bratan to pray for a good supply of water, and to bring back some of the lake's holy water to sprinkle on the *sawah*. This practice is no longer common.

After flooding, the *sawah* is ploughed by one or two cows pulling a special plough, the *tenggala*. A seedbed is prepared by walling off part of the *sawah* and the seeds are broadcast by hand onto the already flooded bed.

A ceremony is held on a favourable day at this time and offerings are made in the fields. The seedlings are allowed to grow for 20–25 days before being transplanted. Trisodium phosphate (TSP) and urea are used to fertilise the fields before a team of hired planters start to transplant the seedlings into the muddy soil. Offerings are placed in each corner of the *sawah*, and nine seedlings are planted offering: eight for the cardinal and intermediate points of the compass and one for the central direction.

Ceremonies which are held as the rice grows vary from place to place, but a common sequence is:

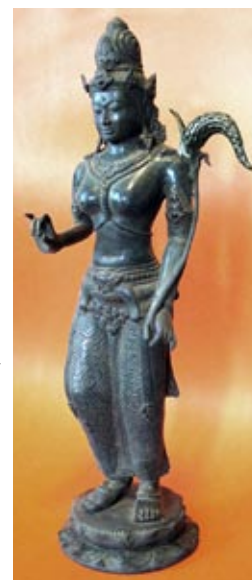
- 17–20 days: *bubuh tabah* – small offerings made for strong growth
- 35 days: *nasi warna* – major ceremony held in water temple, the offering consisting of 'four colours of rice' for a good crop
- 42 days: *esan* – woven coconut-leaf offerings in field
- 70 days: *sayat nagasari* – a major ceremony in the water temple, where offerings of cooked rice plus flowers, rice wine and holy water are made for a quick-maturing crop.

The rice begins to form heads of grain and start to ripen. This is the time when birds, mice or insects may attack the grain and the farmers erect bird-scaring devices such as clattering bamboo windmills. Plastic bags may be strung across the fields, and people walk through the fields shouting to frighten the birds. Small offerings of rice and lime on banana leaves may be placed at the corners of the *sawah*'s irrigation bays.

Two weeks before harvest, irrigation is stopped and the field is allowed to dry out.

The ceremonies continue:

- 105 days (3 Balinese months): *miseh* – small ceremony held for successful harvest
- About 120 days, immediately before harvest: *mabiukukung* – the biggest ceremony yet, held to ensure all goes well for harvest
- After harvest: *ngusaba ninia* – a thanksgiving ceremony is held in honour of Dewi Sri, the rice goddess.



*Dewi Sri, goddess of rice. Source: Wikimedia Commons*

This latter ceremony is sometimes planned as a major village festival even though it is held at the *subak* temple, and on these occasions the offerings will include roast ducklings and suckling pigs, along with towers of rice 1m high.

As with many temple offerings, the food is eaten by those attending the ceremony after the gods have partaken of the essence of the offerings.

## ACTIVITY

Prepare a table which graphically illustrates the Balinese rice-growing cycle and the religious ceremonies associated with it.



*Balinese alter at rice terraces, Gunung Batukaru. Source: Wikimedia Commons*

# ECOLOGY OF BALINESE RICE TERRACES

The rice plant *Oryza sativa*, which provides food for over half the world's population, is believed to have originated in the swamps of river deltas in South-East Asia, .

It is a member of the grass family, and is an unusual plant in that it can tolerate waterlogged soils which are anaerobic, ie. they have little or no oxygen because the air spaces in the soil have been filled with water.

The most important influence of landform upon rice growing in Bali is in the small chain of volcanoes and crater lakes that spread across the island from east to west. Here the water collects and is fed into springs and watercourses from which it is gathered for irrigation. The irrigation waters follow the fall of the land from the volcanoes to the sea.

Usually, the water is not left to lie still and stagnate in the *sawahs*, but is kept gently moving along. When one farm has been irrigated, the water flows down to the next farmers fields. When the whole *subak* has the water it needs, the water flows out to another feeder canal and the process continues.

Controlling, the flow of water into each bay of the *sawah* is simple. An inlet hole the size of a small melon is dug in the side of the feeder canal which is about 14 cm wide. Waterflow through this inlet is controlled by a coconut shell, or some weeds and clay matted together.

The terraces also follow the contours of the land, creating an agricultural setting that is proof against erosion. The building of contour banks on farming and grazing lands, along with contour ploughing, has long been advocated as an effective method of controlling soil erosion. However, Western habits of thought prefer straight lines and right angles to curves and odd shapes in their landscape planning. Consequently, contouring is not a common feature of agricultural landscapes based on European traditions. Although the Balinese farmers had little

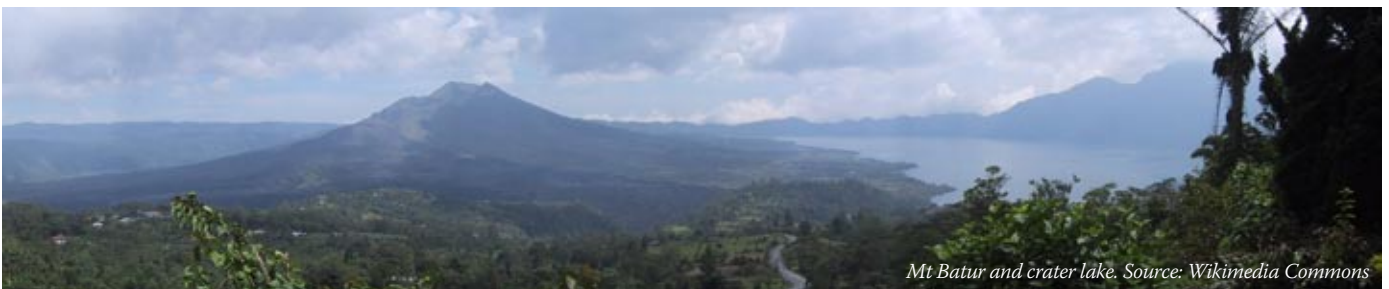


Contoured rice terraces, Bali. Source: Wikimedia Commons

other choice than to build the terrace walls so that they followed the contours of the hillsides (consider the need for level water surfaces), their construction is a visible reminder that the Balinese farmers work with nature and not against it.

Rice requires relatively high temperatures for the whole of its growing period and the optimum range between 20°C and 35°C. This temperature range is found in tropical, subtropical and warm temperate zones. Bali's location fits in well with the rice plant's optimum temperature requirements. An optimum temperature allows a plant's metabolism to function with greatest efficiency.

Besides a warm climate, rice needs plentiful sunlight, especially in the period when the grain is ripening. The tropical regions closest to the Equator



Mt Batur and crater lake. Source: Wikimedia Commons



# ECOLOGY OF BALINESE RICE TERRACES

are not ideal for rice growing because conditions are often cloudy, reducing the available light needed for photosynthesis. Generally, dry sunny seasons produce higher yields than constantly wet conditions, and the monsoonal climate of Bali provides just such a rain-free period of strong, direct sunlight, the so-called dry season.

Crops of rice can be grown in the wet season, resulting in slightly slower growth, but this is one of the industry's strengths, the ability to produce two or possibly three crops a year.

Even in the wet season, breaks in the monsoons provide many sunny periods, and the downpours come and go rapidly. There are periods when a tropical low weather system sets in and there is continuous rain for a few days, but these are not frequent and are part of the overall climatic pattern which is part of the rice field's ecology.



*Planting rice in the sawah. Source: P. Sheppard*

Rice demands a plentiful supply of water for its successful cultivation. It is estimated that the optimum amount of water needed for one crop during its life cycle is the equivalent of from 1300mm to 1800mm of rainfall.

The *sawahs* are flooded at the time of planting and the depth of water is increased as the seedlings grow until it reaches a depth of 150mm to 250mm, when the plant flowers (ie. Produces pollen-laden stamens).

The water is gradually drawn off until the field is dry just before harvest.

The initial clearing of Bali's forests to accommodate a rice-farming industry began well over 1000 years ago, and after the human impact on the island's natural ecosystem, changes and modifications have



*Preparing the sawah for planting. Source: P. Sheppard*

been gradual and aimed at complementing natural processes, not dominating them.

The irrigation systems have flooded no valleys, nor produced any notable evidence of pollution, erosion, or habitat degradation. Consequently it could be argued that for over several hundred years the cultivation of irrigated rice has become ecologically sustainable.

The soil is part of Bali's volcanic legacy and is rich in potassium and phosphorus; it also has enough clay content to stop water from draining away too rapidly. The nutrients in the soil are slowly released as water floods into the fields, bringing its own supply of dissolved nutrients.

After burning the rice stubble at the end of each harvest, the ashes return to the soil to recycle some of the essential elements. Fertiliser is sometime applied during growth: at 3 days, 35 days, and 55–60 days after transplanting.



*Threshing the rice. Source: Wikimedia Commons*



*Pest exterminators – Ducks in rice paddies at Ubud, Bali. Source: Wikimedia Commons*

The fallow *sawahs* provide a habitat for aquatic insects, frogs and fish. Eels are also plentiful, and it is customary for the village children to go fishing for them on the nights of a full moon. The Balinese swamp eels grow up to 1m long, have only one gill, and are capable of burrowing into the damp soil and aestivating until the field is flooded again.

Ducks swim on the flooded fields or search for food amongst the stalks of the growing plants. They are not only a source of food for the farmers, but are effective mobile pest exterminators.



*A Balinese Swamp eel, *monopterus albus*. Source Wikimedia Commons*

These ducks are trained to stay with their flocks by being guided in their wanderings through the fields by a duck herder wielding a long cane to which is a long cane to which is attached a piece of rag on a string. The herder, often a child, can control the movement of the ducks by dangling the piece of rag to one side or the other of the flock.

There are many insects that can attack the growing crop, but their effects are not usually serious. The main insect pest that is serious, because of its sheer weight of numbers, is the brown plant-hopper, *Nilaparvans lugens* (right). It can cause damage to the leaves because it is a small sap-sucking species of bug, but it also causes damage by carrying a virus that attacks the rice plant.



Spraying will kill one generation of the insects, but they bounce back with renewed vigour because their natural predators have also been killed by the first spraying. In the wake of increased infestations, the intensive use of pesticides (which were introduced at the time of the Green Revolution) was finally banned.



# PESTS OF THE BALINESE RICE FARMERS

In 1989 a new system of integrated pest management, which combines quarantine measures with controlled fallow periods, was introduced throughout Indonesia.

In many parts of Bali, however, the farmers had already stopped using the pesticides and allowed the infested area to lie fallow until the appropriate ceremonies had been held in the *subak* temple to appease the anger of the gods. During this period, most of the infestation had gone.

Larger animal pests include mice and rats of different species, and flocks of finch-like birds such as the *chestnut munia* and the *scaly-breasted munia*. The rice farmers loathe these small birds and spend much time and energy on protecting the crops from their massed raids.

Rice can also be affected by the fungus *rice blast* which attacks the ripening grain. The hot humid conditions of the ricefields offer such fungi a perfect habitat in which to grow and reproduce, and in the fight against fungus attacks one line of defence is the search for more resistant strains of rice.

In managing the cultivation of the rice crops, as well as in initiating control measures, the Balinese rice farmer is aided by the comparatively small size of each plot in the terraced fields. Breaking the cultivated land into various sized modules permits a great deal of flexibility of planning, which is not possible with larger sized units of land.

After a harvest in one terraced plot, the farmer (and the *subak*, indirectly) has the following options: to replant with rice, to grow a different type of crop (chilli pepper, eggplant, cassava) or to allow the ground to lie fallow. The same will apply to all the neighbouring terraced plots of the *sawah*. How many of the adjoining plots will be treated differently, and how many will be planted with the same crop?



Harvested rice. Source: P. Sheppard

The small size of the individual plots also helps with ploughing and similar tasks. Working on this scale, there is no need for tractors and the work can be done using cattle (not buffalo, which are too big and awkward for the hillside terraces).

At harvest time human labour, which is available and cheap, is used. The result is a system which in terms of energy output/input ratios is much more efficient than the mechanised systems of the developed world.

In any agricultural ecosystem there are varying combinations of human influences and natural processes.

The ecology of the irrigated ricefields of Bali has established a fine balance between the two, producing several tonne of rice per hectare year after year without damaging or degrading any part of the natural ecosystems of the region.



A Chestnut Munia. Source: Wikimedia Commons



A Scaly-Breasted Munia. Source: Wikimedia Commons

# IMPACT OF THE GREEN REVOLUTION ON BALINESE RICE FARMERS

Until the 1970s Balinese rice cultivation followed a cycle of planting two crops per year using the traditional *padi bali* variety of long-stemmed rice. Today, almost all the rice grown in Bali is one of the new high-yielding varieties of dwarf rice introduced as a result of the 'green revolution'.

It is possible to produce three crops per year, and because of the higher yields produced each harvest, Bali exports tens of thousands of tonnes of rice each year.

The transition from a traditional to a modern style of farming was not an easy one, and it was possibly made more difficult because the authorities did not recognise the importance of the *subaks*' role in Balinese agriculture.

The green revolution had its roots back in the 1940s and 1950s when new varieties of cereals were used in Europe and North America with amazing results. The new varieties (HYVs) depended heavily on fertilisers and pesticides: they were 'high response' as much as high-yielding. However, farmers of those regions were conditioned to regard the use of chemical products as a necessary part of agriculture and in any case were usually subsidised to allow them to purchase the fertilisers and other products.

When the new varieties of cereal were tried in India, production figures soared. Output from cereal and related crops rose from 50 million tonnes per year in the 1950s to 167 million tonnes in 1987. There were environmental and social costs but these were not fully recognised at the time.

Other developing countries became aware of the revolution and Indonesia was an eager convert. In the 1960s Indonesia imported one million tonnes of rice each year and the government regarded self-sufficiency of rice production as a major priority both to assist the economy and enhance national prestige.

An intensive program of rural education and extension serviced, *Bimas* (*bimbingan massal* or mass guidance) was initiated and the new varieties introduced throughout Indonesia. In the 1970s infestations of plant-hoppers convinced the authorities to introduce other strains of rice developed through its own breeding programs but in the 1980s other heavy attacks occurred and finally in 1986 the government banned 57 types of pesticide.

Since 1987 the government has discouraged the growing of three crops per year on the one piece of land to assist in the control of insect pests. It has also recognised that the new varieties (HYVs) of rice rested on a fine genetic base, and are continually seeking to broaden this base. The traditional *padi bali* is still grown in small plots, partly out of sentiment and partly as insurance. Some varieties of rice being used in Bali in 1995 were IR (International Rice) 36, IR 42 and IR 56. As an indication of the intensive research into rice varieties in South-East Asia, the latest strain of IR rice which has been developed by the International Rice Research Institute in the Philippines is IR 67683. There are also many other high yielding varieties of rice besides the IR strains.

During this time of transition, the role of the *subaks* had been overlooked, or at least not fully understood, by the government. Authoritarian central governments are not noted for their sensitivity or appreciation of local issues and in Bali there was also the added difficulty of Muslim officials from Jakarta coping with the beliefs and customs of the Hindu farmers.

There was a time of uncertainty while the various parties adjusted to the others' point of view, but because each had a degree of reason and logic (or perhaps faith) on its side, a workable compromise was reached. There was no arguing against the results of the new varieties.

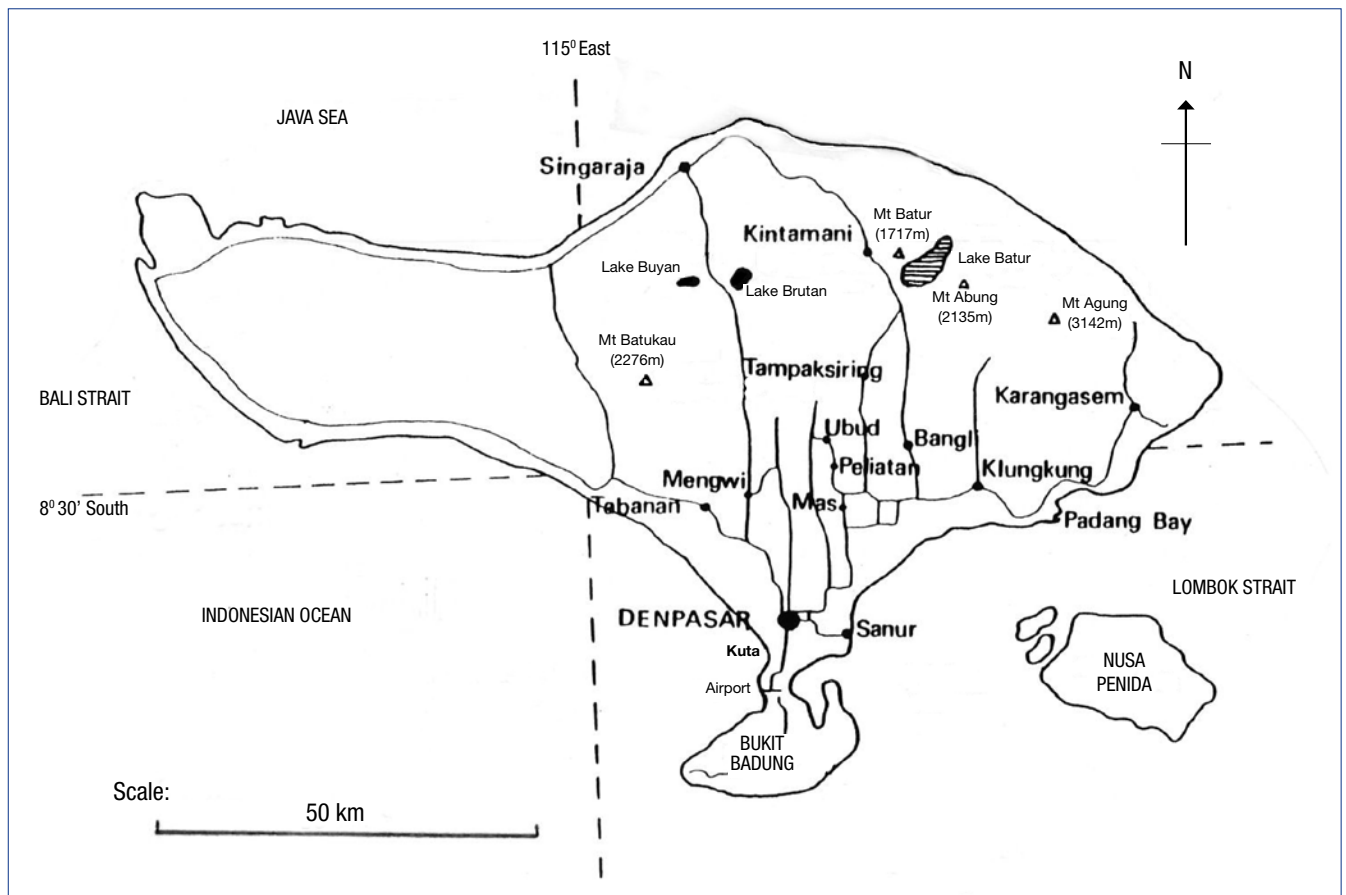
Once the excessive reliance on fertilisers and pesticides had been changed, the dwarf rice produced yields that were promised, and to the rice-conscious Balinese that was a powerful argument.

To the government-appointed officials, it became obvious that the tightly-knit organisation of the *subaks*, combined with their depth of knowledge in matters of rice growing, was something of inestimable value that could not be replaced by government directives.

Source: Michie, M. *Temples and Terraces – Rice, Religion and Society in Bali*. Pages 42–62. In *Nature and People in Indonesia*, Commonwealth of Australia, 1996. Funded by the Commonwealth Department of Employment, Education and Training. A joint production of the Asia Education Foundation and the Australian Association for Environmental Education.



# THE INDONESIA ISLANDS OF BALI



## INDONESIA AND THE REGION

