

Sam Phillips – Travel Scholarship Report

# The People and Plants of Bali, Indonesia

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When most people hear the name Bali, the first things that spring to mind are probably beaches, surfing and five-star hotels. In fact, when friends and colleagues first heard that I was applying for a scholarship to visit the Indonesian island that was usually their first reaction too! But while I can't say I too wasn't attracted by these things, my inspiration to visit Bali came from different sources.



*Strongylodon macrobotrys* flower at Ubud Botanic Garden

## Acknowledgements

But first, I'd like to say a few quick thank-yous. I'd particularly like to acknowledge the very generous financial support of The Merlin Trust, without whom this trip would never have happened. I would also like to thank all the staff at Threads of Life, Eka Karya Botanic Garden, and RBG Kew who were so generous in giving up their time and expertise in support of this trip.

## Introduction



[http://www.seacitymaps.com/indonesia/bali\\_map.htm](http://www.seacitymaps.com/indonesia/bali_map.htm)

Bali is an Indonesian island located at the westernmost end of the Lesser Sunda Islands. It lies between Java, the world's most populous island with a population of 135m, to the west, and the much smaller and less populated island of Lombok to the east.

East to west, the island is approximately 150 km wide, and spans roughly 100 km north to south at its widest point; its land area is 5,632 square kilometres. As a comparison, this is around the same size as the English county of Norfolk.

Though small, Bali is a very densely populated place. A 2010 census recorded a population of just under 4m. Getting around the island can be quite an adventure in itself; the road network is fairly archaic, traffic is terrible and there tends to be a somewhat relaxed attitude to traffic laws and road behaviour. In fact you tend to find quite a relaxed attitude to life in general in Bali. I had contemplated hiring a car during my trip to help me get around the island, but the two-hour drive from the airport to my first stop, Ubud, convinced me that this wasn't a good idea!

Over 90% of the population is Balinese Hindu, and this gives the island quite a different feel to the rest of Indonesia, which is predominantly Muslim. Religion is very important in Bali; the Balinese devote much of their time to making offerings, visiting temples and preparing for and carrying out religious ceremonies. It completely pervades everyday life on the island, and this includes the relationship the Balinese have with plants.

I flew into Denpasar, the regional capital of Bali, on 18th July and went immediately north to the town of Ubud.

I spent my first two weeks in Ubud, where I worked with the Threads of Life Foundation, an organisation that supports the traditional textile weaving industry in Indonesia.

After this, I travelled further north to the town of Bedugul, where holds Bali's Eka Karya Botanic Garden.

For the last few days of my trip, I stayed in Pemuteran in the north-west corner of Bali.



*Nepenthes ampullaria* pitcher growing at Ubud Botanic Garden

## Climate and topography of Bali



Bali's three main volcanoes at sunset

Visually, Bali is a very dramatic island. It is situated along the Pacific Ring of Fire, an area around the Pacific basin which is subject to volcanic activity and frequent earthquakes. There are three large volcanoes on Bali, two of which are currently quite active, as well as several smaller ones. The three major volcanoes are marked on the picture above – Gunung Batukau, Gunung Batur and Gunung Agung.

This central ridge of volcanoes reaches well over 2,000 metres in height. The tallest peak, Gunung Agung at the eastern end of the island, is 3,142m high. Gunung Agung really dominates Bali, it's clearly visible as you fly into the island. Spiritually it's also very significant. It's known locally as the "mother mountain", and the Balinese believe that it is a replica of Mount Meru, the central axis of the universe. One legend holds that the mountain is a fragment of Meru brought to Bali by the first Hindus. The most important temple on Bali, Pura Besakih, is located high on the slopes of Gunung Agung. Gunung Agung last erupted in 1963-64 and is still active.



Gunung Agung, Bali

The volcanic nature of Bali has contributed to its exceptional fertility; Bali is really a very lush island. The central mountains also influence the local climate. Clouds come over the island from the west, then as they hit the central mountains they get pushed higher and higher until rainfall is produced. The land south of the mountains receives the most rainfall.

Southern Bali is a broad, steadily descending area, and this is where most of Bali's rice crop is grown. The northern coastal strip is more steeply sloping and is the main coffee producing area of the island, along with other vegetable crops and cattle. The western mountainous region is much drier. Cultivation of the land here is difficult and it's consequently it is sparsely populated. This is where Bali's national park, Taman Nasional Bali Barat, is located.

## The Wallace Line

An interesting aspect of Bali's ecology is that it stands immediately to the west of The Wallace Line. This was a line imagined by Alfred Wallace in the mid-19<sup>th</sup> century, and it runs through what is now Indonesia. Wallace was working around the same time, and along similar lines, as Darwin.

During his extensive travels in south-east Asia, Wallace was struck by the sudden difference in bird families he encountered between Bali and Lombok. These islands are close; the stretch of water that runs between them is only 20 miles across. On Bali the birds were clearly related to those of the larger islands of Java and Sumatra and mainland Malaysia, to the west. On Lombok the birds were clearly related to those of New Guinea and Australia to the east. This feature occurs quite consistently all the way along the line.



<http://www.eoearth.org/articles/view/158664/?topic=49508>

The existence of The Wallace Line is explained by changes in ancient sea levels and continental shelf divisions. The Lombok trench is 5km deep, and runs along the Wallace Line. During previous ice ages when sea levels were much lower, the trench formed a constant barrier between the two

continental land masses. Island birds of the region do not cross even short stretches of water, so the trench has effectively separated the birds of Bali and Lombok for the last 50 million years.



The Lombok Trench, [www.earth.google.co.uk](http://www.earth.google.co.uk)

However, while the Wallace Line has served as a barrier to the movement of animals, many plant species were able to overcome this barrier to spread across the region.

## The Flora of Bali

Bali is almost entirely cultivated, and has been for thousands of years. There are only small pockets of native forest dotted about the island, except for in the national park region in the west.

The island is located in a biodiversity hotspot, called the Sundaland hotspot, which covers Malaysia and much of Indonesia. Biologically it is one of the richest hotspots on Earth, holding about 25,000 species of vascular plants, 60% of which are found nowhere else. There are at least 117 endemic plant genera in the hotspot.

Despite this location however, the native flora of Bali is actually quite impoverished. It has very low levels of endemism and quite a small native flora for a tropical island.

However, Bali is blessed with a fertile soil and a tropical climate, and the island can support a huge range of tropical plants. The Balinese are keen gardeners; they have a genuine love of beauty, and an abundance of cheap labour, and these two factors mean that wherever you go, outdoor space is carefully landscaped.

Many plants in Bali are considered sacred, or have some religious or spiritual significance. The Banyan tree (*Ficus benghalensis*) is one of the most sacred. Large specimens are often decorated with scarves and ribbons, and may have a small temple or shrine at their base.



Magnificent *Ficus bengalensis* specimen in Eka Karya Botanic Garden

*Ficus bengalensis* in the centre of Ubud's burial ground, with decoration and a small shrine at the base

## Aims and objectives of the trip

My trip had three main objectives. These were:

- To improve my knowledge of the flora of Bali and Indonesia
- To explore the relationship between people and plants in the region, and improve my understanding of the field of ethnobotany
- To learn more about conservation efforts in the region, in particular in relation to Balinese dye plants

I also hoped to gain some practical horticulture experience during my trip, while working with the Threads of Life organisation I was visiting.



*Phragmopedilum lemoinierianum* specimen in flower at Eka Karya Botanic Garden

## Threads of Life



Examining textiles in the Threads of Life office

For the first two weeks of my trip I worked with an organisation called Threads of Life. They work with weaving communities across Indonesia, supporting Indonesia's traditional crafts of textile weaving and natural dying. This is a craft that is in danger of dying out, and already a lot of the skills and plant knowledge have been lost.

The textiles that these communities produce are natural products, and the larger, more complex examples can take over a year to make from start to finish. Traditionally they were used as marriage gifts, heirlooms, as offerings to the ancestors, as trade goods for cash or barter or as everyday wear, and have played an integral part in the social, spiritual, and economic lives of the peoples of Indonesia for more than 2,000 years.

One aspect of the work of Threads of Life is visiting communities in the field, learning about and recording their weaving and dying techniques and commissioning works which they sell through their gallery in Ubud. The proceeds of these sales go towards helping their communities form independent cooperatives, and to preserve the weaving tradition. Sales of the textiles have become a really important source of income to these rural communities.

During the first few days of my stay with Threads of Life, I spent most of my time with the organisation's field staff. Threads of Life has four permanent field staff, Pung, Komang, Made and

Frog. As well as making visits to all the Threads of Life communities around Indonesia, they also lead the conservation programme for the plethora of plants used in the textile dying process.



The Threads of Life textile gallery, Ubud

The processes involved in traditional Indonesian textile dying are complex, and they vary between different communities. Each island has its own dye 'recipe', or several recipes in some cases. What makes things even more complicated is that there are over 700 living languages in Indonesia, so simply identifying the plants that are used by each community is a big task, and this is one part of the research of Threads of Life. Learning about these processes, which have been handed down for generations, was a fascinating experience for me.

I got the chance to try out the dying process with Threads of Life. The indigo recipe that I followed is one of the simplest recipes, and produces cotton with a deep indigo blue colour. There is only one stage to the dying, and only one plant, *Indigofera strobilifera*, is needed to achieve the dye effect. As you can see from the picture below the dye produced is extremely strong, it dyed my hands quite effectively and it took almost a week for them to go back to normal.



The effect of the *Indigofera strobilifera* dye

## Dye plants

The other colour commonly used in Indonesian textiles is red, and the process needed to obtain a lasting red dye is much more complicated than the indigo colour. First, the cotton thread needs to be oiled. An oily coating is deposited on the strands of cotton, which oxidises while it dries, and this oxidation damages the strands slightly and allows the red dye to be absorbed right through the material. In eastern Indonesia, oils are traditionally obtained from seeds of *Pangium edule*, *Sterculia foetida*, and *Schleichera oleosa*. In the islands of Flores and Sumba, use has shifted to *Aleurites moluccana* seed oil, the Candlenut, which is now widely cultivated in that region. On Kalimantan, the Indonesian part of Borneo, oil seeds from cultivated species in the *Cucumis* genus are used.

Small amounts of fat from ritually important animals may also be used on some islands in the oiling process, for example fat from monitor lizards, fresh-water turtles and snakes. All these ingredients are pounded together and added to water, in which the cotton is soaked.

After the cotton has been oiled and dried several times, the cotton is added to a new mixture containing the root bark of *Morinda citrifolia*, the Indian Mulberry or Noni tree. The roots and bark of this species contain high levels of a chemical called Morindin, and this is the substance that dyes the cotton and gives it its red colour.



*Eritrina variegata* bark; *Aleurites moluccana* nuts; *Calytropis gigantea* leaves; *Curcuma longa* root; *Morinda citrifolia* root and rootbark; some cotton thread

The dye effect obtained from Morindin is only semi-permanent however, so a mordant or fixative also needs to be added at this stage. A wide range of plants are used as mordants, all of which exhibit hyper-acumulation of aluminium in their bark and leaves, and it is this feature that creates the mordant effect. The most commonly used mordant in Indonesia is the dried leaves of *Symplocos* species, shown below.



Dried leaves of a *Symplocos* species, used in the dyeing process

I spent the first two weeks of my trip working with Threads of Life, learning about their organisation, the plants used by their cooperatives and the programmes they have to protect the forest and natural resources in Indonesia. I worked in their plant nursery, helping to propagate some of the dye plants used by their weavers, and visited their community gardens where they are attempting to cultivate dye plants specifically for their use as dyes. It was a fantastic experience, they were a great bunch and it was a fantastic introduction to Bali.



A small propagation experiment that I helped to carry out at the Threads of Life nursery, Ubud



The Threads of Life team on the 10<sup>th</sup> birthday of the organisation

## Rice cultivation

In the third week of my trip I left Ubud and moved north to Bedugul. This town is located on the slopes of the central mountains; the climate is cooler and wetter than the south of the island.

The land around Bedugul is steep, and this is where some of Bali's most famous rice terraces are located. This photo shows a set of fields in Tegallalan, a village in the Bedugu area. Close by is Jatiluwah, a small village surrounded by a group of terraces that have been awarded UNESCO world heritage status.



Balinese rice terraces at Tegallalan

As you can see, Bali's rice fields are exceptionally beautiful; in fact this picture really doesn't do them justice, they just can't convey how lush and green they actually are. It's no surprise that they have become a major tourist attraction.

A small but thriving unofficial tourist industry has emerged in Tegallalan based around these rice terraces. When you arrive in the village you're immediately accosted by hawkers selling souvenirs, and by unofficial guides offering to take you around the rice fields – for a fee. I wasn't sure how I felt about this at first; the atmosphere and beauty of the place was clearly affected by the hawkers, and it's quite likely that the large numbers of tourists trampling across the terraces is having a detrimental effect on the landscape. On the other hand, tourism provides farmers with an important

extra income, and increases the value of rice terraces. There is already a lot of pressure on land in Bali; there is an ever increasing demand for building and for animal grazing. Many rice paddies around the major towns have already been lost, but tourism can play a role in protecting what's left.



Tourists exploring the Tegallalan rice terraces

## Rice Field Irrigation

Komang, one of the Threads of Life field staff, kindly introduced me to Wayan, a rice farmer in Ubud. We went for a walk together through some very picturesque rice paddies around the edge of the town, and Wayan outlined some of the social and agricultural practices of rice cultivation in Bali. There was something of a language barrier, Wayan spoke barely any English but Komang's English is quite good and he was able to translate for me.

As an island, Bali manages to produce a very large rice crop year after year, made possible by a complex system of cooperation between farming communities. In particular, an elaborate irrigation system has been used for centuries to take maximum benefit of available water, and to make sure everyone gets their fair share. This system is all made possible by a cooperative known as the subak.

The subak is a community organization in which the farmers whose fields are fed by the same water source meet regularly to coordinate plantings, to control the distribution of irrigation water and to plan the construction and maintenance of channels and dams. There are around 1,300 subaks in Bali, each with up to 300 members. It's a very democratic system; each member has equal rights, regardless of status or wealth or the size of their farm. It is an ancient system, and has been referred to in texts as far back as the 11<sup>th</sup> century.

Subak communities are based around water temples, and overseen by a head elected by the members of the subak. This head also organises ritual offerings and subak temple festivals.



A rice field irrigation gate, Ubud

Water allocation is controlled by stone gates located at the top corner of each field, like the one shown above. These gates divide the water flow up into smaller units, multiples of around 1cm, depending on the size of the field. Each field has a very precise allocation of water.

The subak doesn't just control water allocation. It also dictates when each member must plough, sow and harvest their crop, so that the supply of rice remains constant throughout the year. This intricate organisation is a large factor in the strength of community life.

Traditionally rice is the main food component on Bali and the Balinese believe that rice is a gift of the gods. The first part of the harvest is offered back to the gods, and complex ceremonies accompany each stage of the growth of the rice plant – including sowing, transplanting and harvesting.

Each individual rice paddy has its own small shrine, like the one shown below, and offerings like the ones shown here are made daily. This type of offering is a very common sight in Bali; several are made in each household and business every day, and the streets and pavements are littered with them.



Typical Balinese rice field shrine



Rice seedling bed, Ubud

Rice crops are grown year round in Bali. Once harvested, the rice stalks are burnt and the paddy is soaked with water and repeatedly ploughed. A small corner of the paddy is cordoned off and sown with rice seed, shown above, and once this has germinated and established it is transplanted into the larger field. Sowing and planting the rice is strictly a male job, but when the rice has matured the whole subak community comes together for the harvest.

In the late 1960s, new high-yield rice varieties were introduced to Bali. These varieties can be harvested a month sooner than the traditional varieties, allowing farmers to squeeze three crops per year from their fields where they used to only manage two. However, they also have greater needs for fertiliser and irrigation, which places an extra strain on Bali's already stretched water resources. Today these new strains account for over 90% of rice production in Bali.

## The Organic Movement

Despite all this, the Balinese agree that older varieties definitely taste better, and in the last few years there has been a surge in interest in heritage rice varieties and traditional organic farming. A new heritage rice variety competition has been launched in Ubud, and a seed bank has been set up by a farming subak. Traditional rice varieties can be found on the menu of some of Ubud's most fashionable restaurants.

Heritage varieties are grown without chemicals and fertilisers. Instead, farmers keep flocks of ducks which help with weed and pest control. The ducks also recycle nutrients into the soil and provide the farmer with an additional income. Some farmers will also grow a fish crop in their paddies, which again control rice pests and add nutrients to the soil.

Improved cultural practices are also employed. Rice seedlings are given more space when they're transplanted, reducing competition and promoting strong root development. Fields are flooded just two days out of seven when the seedlings are young, to help encourage root growth.



A flock of ducks on a rice field in Ubud

## Bali's Mangroves

By now I only had a few short days left of my trip. For my last leg, I travelled north to Permuteran, a small town along the north west coast of Bali.

As I've already mentioned, this part of Bali is quite different to the south and central parts I had been staying in. The climate is drier, the land is much less cultivated, and population is less dense.

Bali's National Park, Taman Nasional Bali Barat, is located here. The park was established in 1941, with a primary aim of protecting Bali's most iconic conservation species, the Bali Starling. It covers just under 200 sq km, or around 5% of the total land surface of Bali.

There are several habitats in the park, including montane and mixed-monsoon forest, a savannah, and some small coral islands. There is also a substantial mangrove habitat, which I was very interested to see.

Indonesia is perhaps the number one country in the world for mangroves. It's thought that 25% of the world's mangroves exist there. They play an important role in stabilising coastlines, and create an important habitat for small fish and shrimps. However, like much of Indonesia's natural resources, it's under threat. It's estimated that 70% of Indonesia's mangroves have been cleared or are severely damaged.

Most of Bali's mangroves were located in the south of the island, close to Denpasar, but these were all cleared in the 1980s for shrimp farms. Now Bali's only remaining mangroves are found in the national park. The importance of mangroves has at last been recognised by the state, and restoration programs have been implemented.



A Mangrove restoration bed at Taman Nasional Bali Barat

## Conclusion

My horticultural visit to Bali was a fabulous, enriching experience, and one that I will remember for the rest of my life. It is an amazing island. I went with the aim of learning more about the plants of Indonesia, and this I achieved, but I also learnt a great deal about how these plants are used, managed and perceived by people in the region.

Almost every plant I came across had some practical use or cultural significance, and most of the people I met there seemed to have a deep knowledge of their native flora. There is a real connection between the Balinese and their environment, and this is the overriding impression of the island that I take with me.



Typical Balinese offerings