The World - Our Home

DISCOVERING OUR GEOGRAPHICAL ENVIRONMENT

BOOK 1

EDWARD GILSON

Translated into English by Anton Quintano

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Discovering our Geographical Environment
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A geography textbook for the third year of secondary schools

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http://sustainablesisters.blogspot.com/2012/10/paths-traps-and-produce.htm (p. 23 bottom); http://www.daleysfruit.com.au/forum/fruit-fly-exclusion-bags/ (p. 22 third from top); (p. 66) Gibraltar - Fedra bulk carrier accident 2008 by Roy McGrail(krm qib); http://futurepredictions.com/2011/02/; Animals Time © Animals. Time 2012, http://animalstime.com/cute-endangered-animals-top-10-cute-endangered-animals (p. 73 bottom); Shell p. 77 (oil well); http://www.geograph.org.uk/photo/3056187 (p. 91 top); Union Print (p. 110 top); Union Print (p. 110 bottom)

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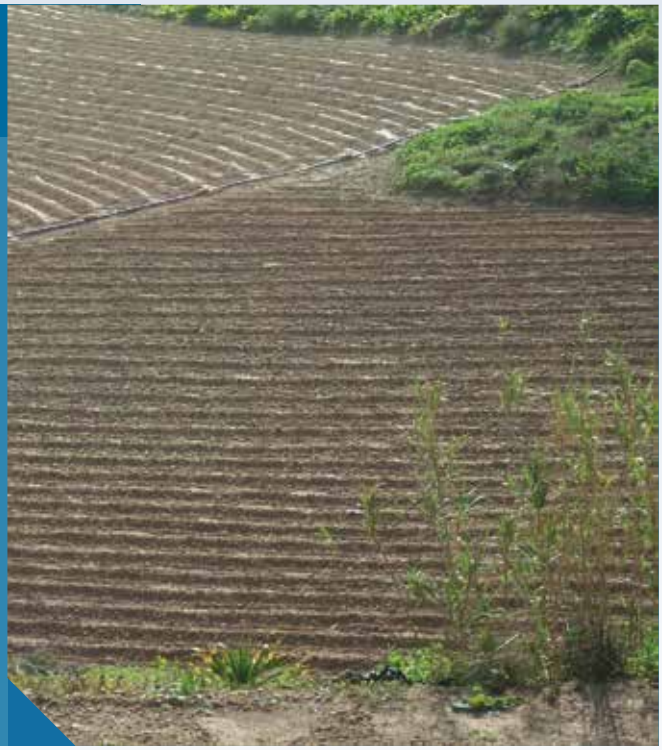


Maltese farmers produce large quantities of fruit and vegetables in different seasons for the Maltese consumer as well as for export. They cultivate these crops with great toil in small fields that are surrounded by rubble walls.

Farming

1

Farming is one of the oldest trades performed by man. This industry produces fresh and wholesome food by means of a large number of farmers who work the fields and raise animals.

Among the 14,000 full-time and part-time farmers in Malta there are those who cultivate many products such as potatoes, tomatoes, vegetables and fruit. There are also farmers who grow vines both for wine and for grapes. There are others who grow olive trees for the production of oil. Other farmers cultivate clover, wheat and hay as fodder for the animals. These crops are grown both on the irrigated fields which have water also in summer, as well as in dry fields which depend on rain for water.

On the other hand one finds farmers who only raise animals such as pigs, cows, sheep and goats, as well as rabbits and fowl. These animals are not only slaughtered for their fresh and wholesome meat but also for other products such as eggs, milk and cheeselets.

Cows are kept in modern farms under sheds which shelter them from the weather. Cows are raised both for their milk and for their meat. Their dung is collected, dried and sold to the farmers as manure which is dispersed in the fields to make the soil more fertile.

The Farmer's Work

In olden times, farming was Malta's major economic activity. The majority of the Maltese people used to work in the fields. They used to grow a large quantity of fruit and vegetables in different seasons in their small fields bounded by rubble walls or prickly pear trees. Among other crops they grew potatoes, onions, globe artichokes, tomatoes, peas and cabages. They also grew fruit trees such as oranges, lemons, peaches, small pears, plums and apricots. In the farms by their fields, they used to raise a cow or two, some sheep and goats, rabbits and hens, as well as a mule or donkey. The farmer used to work from early morning till late in the evening. All the family used to give a helping hand, even the children. They used to milk the cows, pick the potatoes, clean the animals and what not. All work was done by hand, or at most, with the help of a beast. Apart from this hardship, the Maltese farmer had to face many physical and human problems. Probably the worst problem was the summer heat and drought, when no rain falls for more than four months. Therefore

the soil dries up completely and the harvests wither and die. Moreover the high summer temperatures dry up and evaporate whatever moisture that remains in the soil. On the other hand, in September and October we ususlly get sudden and heavy downpours of rain. Therefore much soil is carried to sea and lost. The excessive water can result in plant disease and mould. The wind too can cause much damage. It can increase the drought, fell the blossoms and wither the crops grown by the farmer.

Malta's soil, upon which the farmer depends for his livelihood, is not fertile enough since it is calcareous and somewhat stony. Moreover the soil lacks organic matter and humus. The farmer needs to disperse fertilisers and maure in order to keep the soil in a healthy state and to produce abundunt crops. However, maybe the greatest problem which the Maltese farmer faces is the small size of the holding on which to grows his produce. Unfortunately the holding keeps decreasing in size because of inheritance, since when the owner dies, it is divided among his heirs. The small size of Malta precludes any common pastures of green where the farmer can herd his flocks in the open as happens abroad. Therefore the animals are fed costly dry hay and fodder.

During the past few years, especially after Malta's accession to the European Union, Maltese farmers have been granted financial aid so that they might reduce these problems and compete profitably with foreign farmers.

In the past, farming was done by hand or with the help of some beasts. The soil would be tilled with a wooden plough pulled by a mule, horse or donkey. With the plough, the farmer tilled the soil, pulled the wild grass and cut out the furrows in preparation for the sowing and planting of crops.

The Farmer, then and now

The farmer and his family used to live on a farmhouse typically made up of two storeys. The farmer and his family used to live in the upper storey, while the animals were housed and fed in the lower rooms called animal sties. In these sties one could find sheep, goats, a cow and a mule or donkey which used to help the farmer with the plough. Upstairs there also used to be the upper store room where the harvests and seeds were stored. The fowl and the dogs used to roam all about the farm especially in the central yard. The food products which the farmer got from the fields and from his animals were enough to feed his family and the same animals.

Many of these farms are nowadays abandoned and suffering much damage. Some of them which still preserve some typically Maltese characteristics, such as the one in the picture, are being restored and then sold for luxury residences to Maltese or foreign people.

The farmer has built special structures called greenhouses in order to reduce the impact of weather elements upon which he has no control such as torrential rain, heat, strong wind or hailstorms. These structures are usually made up of steel or wooden arcs covered in transparent materials such as plastic or glass, which allow the rays of the sun to penetrate but keep the heat from escaping. The farmer controls the internal temperature by opening or closing a number of windows as needed. In this way the plants that grow inside, such as tomatoes, cucumbers, vegetable marrows, eggplants, strawberries and flowers, are protected from any damage that can be caused if grown outside. These greenhouses allow the farmer to grow crops out of season and throughout the year.

One of the problems faced by farmers was water storage in winter so that it would be available in summer. So they would dig wells or deep reservoirs, and also build surface reservoirs and cisterns in order to store water for the dry months. They also built stone water channels which brought the water to the nearby fields. Later the farmer started to pump the water up by means of wind-pumps. By means of these wind-pumps the farmers used to bring water from underground into the reservoirs which they built in their fields.

Developments in Farming

The major task of farmers and herdsmen is to produce food. In order to do this farmers use traditional methods that were well tested in time. They also use modern methods to increase production and to offer wholesome food at a reasonable price. In fact many farmers are nowadays availing themselves of the experience gained from their fathers in time, as well as adopting modern methods which lessen their toil and increase produce.

Nowadays many farmers have invested in modern machines, such as tractors which quickly plough the fields, modern apparatus which spray and distribute the fertilisers and pesticides, and other machines that can harvest the fields in a short time. Other farmers have received financial help from the European Union and have built reservoirs in order to bring the water to their fields and irrigate them by the modern drip method. Farmers are also using healthier seeds that have been developed and genetically modified in laboratories and are more resistant to disease. They are also growing crops all the year round in the controlled environment of greenhouses.

Farmers are nowadays using small tents or greenhouses called tunnels under which they grow some types of vegetables and fruit in a protected and ideal environment. Under plastic the seeedling crops are protected from heavy rain, the birds and other things that may weaken them.

There were important developments in animal husbandry too. Contrary to what happened in the past, each farmer grows one kind of animal only on his farm. One may find animal farms specialised in pig breeding for pork or cows for milk and beef as well as chicken, turkey, duck or rabbit farms. Animal husbandry has gone through great changes and nowadays animals are bred in modern and clean farms under the supervision of the Department of Veterinary Services. These officers inspect farms regularly and they also take samples of the animals' blood so that the minds of both farmers the consumers might be at rest about the goodness of the animals and the products.

Today many farmers invest in modern machinery. Such machines increase production and reduce toil at the same time.

In the past few years farms have been built which avoid stress on animals through better ventilation, refuse collection and automatic feeding. These all help the farmer to have healthier animals and the consumer in having more wholesome and nutricious products.

New farming methods

Many farmers have benefitted directly from helping schemes such as funds so that their practices may conform to the directives and regulations of the European Union, and also to modernise their farms and to increase their production. In a farming complex at San Ġwann one finds some that have invested strongly in modern machinery. One finds very large farms having hundreds of cattle under large sheds which offer shelter from the weather elements to these cows, as well as ample storage space for hay. The rooftops of these sheds channel the rainwater into reservoirs which provide water for the use of the same cows and of the farm in general.

The cows sleep on soft and comfortable rubber mattresses and in summer large fans are switched on so that the temperature remains cool. Moreover the cows are milked whenever they feel like by means of automatic milking robots which provide a hygenic process all the while. Waste of fodder is avoided by means of a computerised feeding system. The robot detects disease in cows or rotten milk at an early stage so that the farmer might remedy in time.

Some farms have invested in alternative source of energy by installing photovoltaic pannels on their rooftops and thus have saved on the electricity bill. All this helps farmers in having more spare time and less toil, as well as increase the quantity and quality of their products.

Nowadays many cows are raised under sheds that provide shelter. These animals sleep on rubber mattresses that are soft and more comfortable than the hard concrete.

Many farmers are nowadays growing vines by modern methods for the production of wine. Among the vines that are planted one finds varieties such as Chardonney and Merlot which are very adapted to local climate. The vines are grown in rows, all at a distance from one another, entwined on thick sticks and steel wire.

They are irrigated by the drip method, and the soil is given a variety of nutrients so that the vines may grow strong. Furthermore the farmer sprays pesticides so that insects might not infect them with disease.

The bunches of grapes are only harvested when the farmer is assured, by the use of special apparatus, that they contain enough sugar. Often these grapes are sold by contract to local wine producers for a pre-determined price.

Malta possesses all the requisites for the growing of vines that give grapes of good quality. As can be seen in the picture the vines are made to creep along high props so that the fruit may be kept aloof of the ground keeping i tin a very good state. The vines are also covered by nets so that they would not be eaten by birds and insects.

Farming and the Environment

Farmers are increasingly using artificial fertilisers and natural manure in order to increase production and to keep the soil in a fertile state. These fertilisers are necessary to render to the soil the nutrients that would have been lost. In order to be fertile, soil needs minerals, especially nitrogen, phosphorus and potassium. Thanks to these nutrients, the soil can give whoelsome and abandunt crops. During the growing season, even rain can diminish the nutrients in the soil. This happens since rainwater dissolves the nutrients that are needed by the crops and carries them down into the rocks. This may lead to pollution of the groundwater by means of the manure and the fertilisers that are applied by the farmer from time to time. Infact recently it has been scientifically proved that groundwater and watercourses contain high amounts of nitrates. This is the result of the overuse of manure and artificial fertilisers by the local farmers.This escessive use can bring about an increase in nutrients in the water which cause a rapid growth of algae leading to eutrophication, that is the decrease of oxygen available for all other organisms in the water. In order to avoid contamination, the farmers are now prohibited from using animal manure in the rainy season. They are also being obliged to keep a record of all the purchases, transportation and use of mineral and organic fertiliser or manure of their own animals. Moreover the fertiliser must be stored in a closed place out of the way of running water. Such practices will help avoid any poisonous traces reaching groundwater.

Soil needs a lot of nutrients in order to give good and abandunt products. Although fertilisers are costly, they are needed in order to render back in quick time the nutrients that were taken by the crops. It is feared that these fertilisers and animal manure might pollute groundwater.

Nowadays, farmers are using more sprays like insecticides and pesticides in order to control parasites, insects and worms which occasionally destroy crops. This medicine is used systematically both as deterrent and also as remedy for the diseases which occur during the growth of crops. Today farmers are well geared to apply these sprays in order to eradicate disease quickly. It is thought that without the use of sprays, many products such as tomatoes, potatoes, green pepper and many other fruit and vegetables will be lost and the farmers will have great financial loss.

Although insecticides and pesticides are effective and capable of eliminating insects and disease, unfortunately they also damage the environment. The spray is poisonous and kills indiscriminately; it also kills species which do not harm, or even are beneficial, to the environment. Moreover the accumulation of pesticides affects all creatures in nature since they are inter-related like a chain. Finally such poisons may accumulate in predators like man, causing serious damage to health. Traces of this spary may also find their way to the groundwater, fresh water-courses and the sea. Some insects are becoming immune to spray and it does not kill them any more. The farmers are being asked to use smaller doses of chemical poisons since insects are becoming more resistant to them. Some farmers like the owners of greenhouses, are using biological control by introducing insects which eat the ones which cause disease.

One way for the farmer to save on pesticides and fertilisers is by adopting crop rotation. In fact farmers are being encouraged to use this method which had been practised by our fore-fathers in order to keep the soil fertile. By this system a plot of land is planted with different crops every season in rotation. In this way a balance is held between those crops which weaken the soil and those which render back the lost nutrients. For example, cereals like wheat and barley weaken the soil since their roots absorb a lot of nutrients. However, these same cereals can purify the soil from some poisonous substances which are left over by other products.

On the other hand, other crops like potatos and carrots, as well as legumes (eg. clover, beans and chick-peas) restore many nutrients to the soil and strengthen it. Not only does this system save the farmer the use fertilisers but it also prevents disease since worms and insects cannot proliferate.

Lately in Malta some farmers are growing crops in frames filled with water and nutrients rather than in soil. This type of cultivation, called hydroponic, is beneficial both to the farmer and to the environment. The water which is used for this cultivation is not wasted but recycled. Moreover since this water is held in frames, it is never dispersed in the environment and therefore there is no fear that it may pollute groundwater. Disease is better controlled by the farmer using this system. In case of disease the relative frames are taken away and the others are not infected.

Water is essential both for the prodction of crops and for animal husbandry. As we all know rainfall in Malta occurs mostly from September to March. Because of this, it is very difficult for crops to grow in the rainless months from April to August unless irrigation takes place. Farmers are more than ever very dependent on water for growing crops. In the past, farmers used to harness water in deep wells dug up in their fields. They used to pull up the water by means of chain pumps with the help of a blind-folded donkey. Wind-pumps too helped the farmers, especially of the North of Malta, to pump up water for their farm. Lately many farmers have dug up deep boreholes in order to have water for irrigation especially in the summer months. Due to these boreholes the cultivable area in Malta has increased considerably and now farmers can grow crops all the year round. However these boreholes, many of which have been dug illegally, are causing irreparable damage to the quality and quantity of groundwater.

In order to reduce loss of water by evaporation, many farmers are now using modern irrigation techniques by means of sprinkler or drip irrigation. These are sustainable techniques since the amount of water used by the farmers is very limited. These systems also help in avoiding salinisation of the soil which in many areas of Malta already contains alot of sodium (salt).

Damage to the Environment

The farmer is the foremost keeper of the rural areas and the natural landscape. He not only embellishes the countryside by the colours of the crops he grows in his fields, but he also keeps the country lanes and the rural buildings in a good state. One can mention the restoration and protection of the rubble walls which are a characteristic feature of Malta's countryside. Rubble walls dominate the Maltese rural landscape and they were primarily built to separate the fields from the country lanes.They were also built to separate one field from another and to terrace the hillside with one wall at a lower level than the other. One finds walls of different sizes with stones that are placed on top of each other without the use of mortar. These walls were built with great skill and they are not easily damaged though they are very exposed to the weather elements.

Water filters through the holes in between the stones of the rubble walls though the soil is kept in place. This is why it is very important that these walls be continuously maintained since without them the soil would be eroded and carried by the water into the sea.

Throughout the years, farmers have built terraced rubble walls on the slopes in order to be able to use the land for agriculture. Without these walls soil would be carried down and lost due to the gradient of the slope. Rubble walls hold the soil in place and protect it from heavy rainfall. After some torrential rain, which is common in Malta, the water may pass through the holes in between the stones though the soil keeps behind it. Moreover on these walls live a number of wild plants and creatures such as the lizards, geckos, vipers, ocellated skinks and weasels. The birds too find refuge in the rubble walls and they build their nests there.

Thanks to developments in biotechnology, production in farms has increased during the past years. As a result of experiments that were held in laboratories and after intense research and study, stronger animals have been bred which can withstand disease and give a greater quantity of products that are of better quality too. Also in laboratories seeds have been produced that are capable of withstanding disease and can give a greater number of harvests. Due to these developments, agricultural production has increased.

Organic Farming

Nowadays, consumers are well informed about the foodstuffs that they buy and consume. Some developments in agriculture among which methods for the increase in crop yield have left a negative impact on the environment, crops, fruit and other farm products which we consume.

This is why an increasing number of farmers are turning to agricultural systems in which the growing of crops and animal husbandry are done according to methods which respect both the environment and the animals themselves. These farmers are using natural or organic methods. This is done by using traditional and biological practces which keep the soil fertile and in good condition without the use of symthetic materials like chemical pesticides and fertilsers. Organic farming is a productive method which keeps the soil fertile ideally by using biological means such as crop rotation where different crops are grown on the same plot in different seasons. In this rotation, legumes like beans, peas and pod vegetables render to the soil the nutrients which were taken by other crops. Another method for fertilising soil is by growing clover or alfalfa which are then ploughed up into the same soil. This method helps in keeping the soil fertile without the need for synthetic fertilisers.

As we all know animal manure helps in keeping a high amount of nutrients in the soil. For this to take place the manure must come from animals that are fed natural food, not synthetic fodder. The farmer can also produce his own compost from the left-overs of crops like foliage, leaves and other plants that are left after harvesting.

Synthetic pesticides are prohibited by organic farming. However, farmers may use natural pesticides derived from substances taken from plants or trees. Traps containing chemicals that attract insects are also used, as well as other control methods such as the raising of 'good' insects which eat others that damage crops.

By the use of natural methods without any trace of sprays, the agricultural product will be of the best quality, even though it means harder work for the farmer. Because of this consumers are willing to pay a high price for organic products since they know these were grown without damaging the environment. Many farmers and producers of organically grown crops sell their products directly from their fields, in boxes at the farmers' market or in established commercial outlets. All organically grown products in the European Union are officially labelled so that the consumers' minds are at rest that the products have been grown or raised naturally at all stages, from the farm to the table.

The Mediterranean fruit fly is a destuctive insect. It is a colourful and beautiful insect with red eyes and transparent wings. The fruit that is infected by this fly falls off the tree before ripening and on it will be clear signs of rotting. This insect is controlled by diferent methods in organic farming. Each fruit, or the whole tree, may be covered by a net which hinders the approach of the fly. Another method is by trapping. The flies go down the containers filled with honey and vinegar that are hung by the branches. Then the insects will no longer be able to fly back. There are other organic methods like the breeding of ants and beatles which eat the eggs and the larvae of the flies as soon as they hatch. Some wasps and birds do the same since they eat both the fly and its larvae.

1

In Malta farming is divided into two types, arable farming and pastoral farming or animal husbandry. Fill in the two tables with the given information.

a. In the first column insert the inputs or things which are necessary for the two types of farmers.

Choose from: water for irrigation, tractors, sheds for the animals, fertile soil, seeds, fodder, water for the animals, medicine for the fowl and animals, sprays and insecticides, electricity, manure, clover.

b. In the second column write down the activities which the arable and pastoral farmers practise on their work from time to time.

Choose from: sowing and planting, cleaning and disinfecting the farm, ploughing with the tractor, laying the drip pipes, inoculating the animals, spraying against parasites, milking the cows, harvesting, dispersing the manure, feeding the animals, taking blood samples for tests, picking hens' eggs.

c. In the last column list some examples of products grown or raised by the farmers.

Choose from: milk, potatoes, tomatoes, pigs, carrots, clover, strawberries, hens, fruit, manure, eggs, rabbits.

Arable Farming		
Inputs	Processes	Outputs

Pastoral farming		
Inputs	Processes	Outputs

2

Look carefully at these two graphs. Graph A shows the average temperature while graph B shows the monthly rainfall in Malta.

a. In which months the Maltese farmer needs not bother to irrigate his fields?

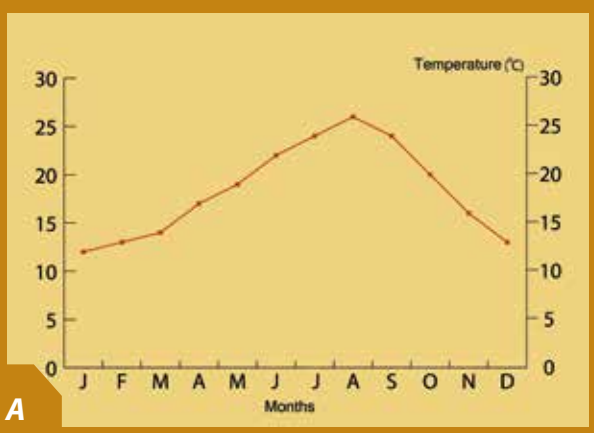
b. Explain why.

c. In which months does the soil need to be irrigated?

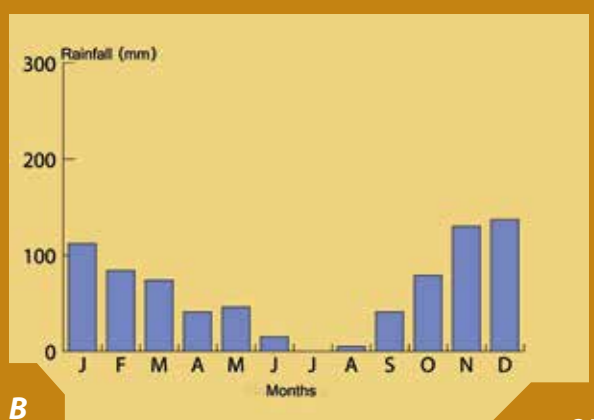
d. Explain why

e. What do you think can the Maltese farmer do in order to lessen the use of water in summer while still having a healthy product?

f. What is the difference between irrigated fields and dry cultivation?



A



B

3

Below here are some newspaper headlines about problems sometimes faced by Maltese arable and pastoral farmers.

a. Choose five of these headlines as reported in the newspapers and briefly explain how they can cause serious problems to arable and pastoral farmers.

b. In the table below you can find a list of problems which arable and pastoral farmers meet in their daily work. Write a solution near to each problem as shown in the example.

Problem	solution
Animal disease	Regular inoculations against disease by doctors and vets.
Strong wind	
Soil loss	
Drought	
Poor soil	
Harmful insects	
Birds eating grapes	
High electricity bill	

4

Read carefully the following article written by the European Union and published in a Maltese newspaper.

Malta with highest amounts of nitrates in water

Among the 28 countries of the European Union, Malta has got the highest levels of nitrates in the waters of watercourses and groundwater. More than 70% of groundwater has been found to contain more than the accepted level of 50mg per litre by the EU. The same can be said of water in watercourses and that stored in reservoirs. Most nitrate pollution is caused by the large amount of fertilisers, manure and pesticides used in agriculture. Although the Maltese Government is doing its utmost to improve the situation, many farmers are still abusing and do not observe the directives issued. Other countries having the same problems are France, Italy and Cyprus, though the situation there is improving.

a. Why are artificial fertilisers and natural manure useful in farming?

b. What is the difference between artificial fertilisers and natural manure?

c. Where do the high levels of nitrates in the waters as mentioned in the report coming from?

d. Explain how groundwater is being polluted by nitrates.

e. Why do you think farmers use pesticides in the cultivation of their crops?

f. Mention and explain how sprays can damage:
- creatures that live in watercourses and ponds;
- beneficial birds, insects and worms;
- human beings.

g. After the publication of the EU report which confirmed that groundwater resources are contaminated by nitrates, a meeting for all arable and pastoral farmers was called to see what can be done.

After the publication of the EU report which confirmed that groundwater resources are contaminated by nitrates, a meeting for all arable and pastoral farmers was called to see what can be done.

- Animal manure should not be used in the rainy season.
- Manure should be stored in closed places away from water.
- Farms should dig cess-pits for the storage of animal waste.

- Manure and chemical fertilisers should not be used in waterlogged places or those prone to flooding.
- The use of untreated sewage is prohibited in fields.
- Farmers should keep an account of the purchase of fertilisers and transport of manure.
- No natural or artificial fertilser may be used to within 5 metres distance of watercourses or 100 metres from the coast.
- All types of fertilisers must be distributed evenly across the fields and must also be ploughed into the soil immediately after.
- Crop rotation should be practised.

You have been commissioned by the Malta Government to write two short leaflets, one for arable farmers and the other for pastoral farmers, explaining to them what they can do to lessen the pollution of water by nitrates. You can mention the following points:

- Sources of nitrate pollution
- Explanation of the causes of water pollution on its way into the ground
- What measures they may take
- Reasons why these measures are needed.

5

Look carefully at the picture.

a. What can the farmer do to stop what is happening in the picture?

b Mention some creatures which can do the same damage as that in the picture.

c. What do we mean when we say, 'Some insects are becoming immune to spraying?'

d. In order to control what is happening in the picture, what can the farmer use other than spray?

e. Name some creatures which the farmer can use to control disease biologically.

f. What are the advantages of biological control on chemical control?

g. Mention two ways by which sprays can be harmful to the natural environment.

6

a. Complete the table below by writing the advantages and disadvantages of common farming and organic farming.

	Common farming	Organic farming
Advantages		
Disadvantages		

b. In a few words explain how a farmer who practises organic farming can:

- keep the soil fertile;
- keep insects and disease away from his crops;
- safeguard the natural environment.

c. 'Farmers who grow their products organically and without any treatment have to hope that Divine Providence protect their products.' Do you agree with this opinion? Explain why.

Organically grown products are certified by a label so that the consumer may be rest assured that he is buying genuine products grown in a natural way.

d. Go around in a supermarket and make a list of organically grown products that have this label.

e Try to find out any such products grown by Maltese farmers or companies.

f. While you are at the supermarket try to find out whether the customers:
- know what organically grown products are;
- whether they prefer buying commonly grown or organically grown products;
- whether they are willing to spend some more money for organically grown products.

g. Draw a poster titled 'Why should we choose organically grown products?' so that it be hung at the supermarket you visited. In this poster mention the advantages of organic farming for people's health and for the environment.

Over the years the Maltese farmer has successfully grown a number of agricultural products on fertile soil, notwithstanding limitations such as dry climate, shallow and stony soil with low levels of organic material. In order to solve these problems the farmer saw to maintain the soil in good state so that he could produce more foodstuff.

Soil

2

Soil is able to perform vital functions in order to sustain life on earth. Soil sustains trees, plants and other creatures which live in the country.

Soil can filter and store water before it reaches the bedrock. Soil is vital for agriculture since plants take nutrients from it so that they may grow and produce food both for people and for farm animals.

Unfortunately soil has become increasingly vulnerable to erosion by means of water, wind and salinity due to the increase in population and certain agricultural practices. Therefore soil, which is such an essential resource, has to be well managed in order to serve indefinitely.

Formation of Soil

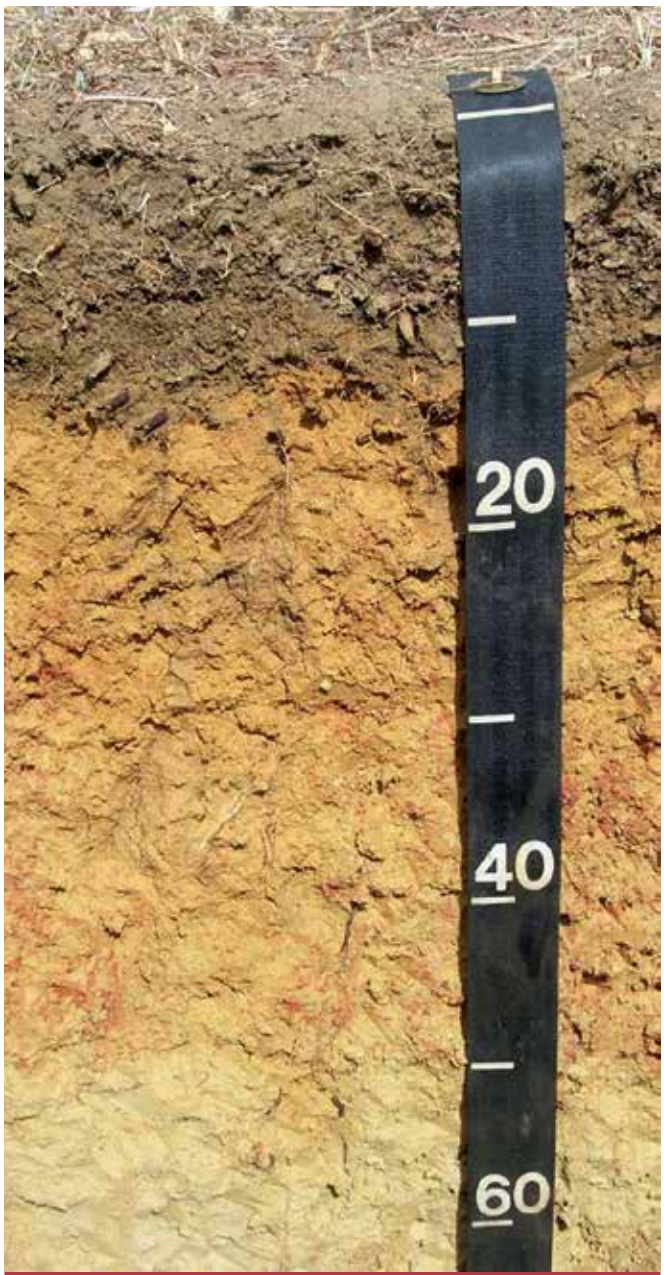
Soil is made up of pieces of rock and minerals as well as a mixture of organic material which forms out of plants and roots of trees. Moreover there are also living organisms, humidity and some gases in the soil.

The particles of rock and minerals vary in size from small stones to fine mineral particles that are dissolved by water in the soil. These minerals or nutrients are absorbed by the plants in order to grow, flower and produce fruit. All the plants and creatures that die decompose slowly into a substance called humus. This is done by means of microscopic organisms like bacteria and fungi. Humus is essential for plants and it makes the soil fertile. All creatures living in soil are vital not only in breaking up organic material but also to aerate the soil.

The creatures which live in the soil, like earthworms, insects and snails, help it remain open to the circulation of air.

In Malta there are three main types of soil – red soil (also called terra rossa), white soil (also called carbonate raw soil) and brown soil (also called xerorendzina). Red soil lies in areas of coralline limestone while brown soil and white soil are derived from blue clay and globigerina limestone respectively.

Maltese soil seriously lacks organic material. Almost half of it contains less than 2%. Moreover the majorityof soil in Malta is mostly shallow and stony. It is also loaded with calcium carbonate and is calcareous.



After thousands of years, soil forms a profile with different layers as can be seen in the picture above. Soil is mainly made up of three layers; the topsoil, the subsoil and the regolith which is material which is not easily reached. The topsoil or active soil is made up of fine dark material. It is a fertile layer where one finds most living organisms and organic material. The regolith is not as fine as the topsoil since it is very stony. This layer is much less fertile than the layer on top since it has little organic material. At the bottom one finds the bedrock which weathers into soil by time.

One may say that new soil is being formed each day. It is formed by the breaking up and weathering of rocks. Rocks are cracked and broken up also due to rain, dew, sunshine and changes in temperature. Even plants help in weathering rocks into soil. This can be noticed in the garigue areas. Here plants grow in cracks and potholes for shelter. They use their roots which enter the narrowest crack in order to find water. After a period of time the plants' roots grow wider, expanding the cracks in the rocks which break up further. During this process, the plants deposit remains of leaves and roots which mix with the dust of the broken rocks by the action of micro-organisms, worms and fungi.

This process takes thousands of years to complete and this is the reason why in most countries soil is protected by law.

Creatures found in the soil perform important functions. It is calculated that 600 million bacteria are present in every gram of soil. Good soils also host many earthworms which carry the leaves and other organic matter to the subsoil, eat them and later deposit them as waste in the topsoil. Organic matter includes the remains of once living plants and creatures which died and rotted, like leaves, branches, roots, animal waste and remains of creatures themselves. Soil cannot remain fertile unless this process of humus formation from organic matter keeps going on. Humus fills the soil with nutrients and hence plants and trees may live and thrive there.

Different types of soil

Throughout the world there are many types of soil. Each type of soil is much the result of the climate and vegetation of the place where it is formed. For example temperature and rainfall affect the rate of weathering of the rock and at the same time the type of vegetation found in the place. The quality and organic material of the soil are influenced by the flora and fauna of the place and the rate at which the latter decompose.

Soil can be of different types. It may be clayey or sandy, fine or stony. Soil varies in colour too. In fact one can find dark, reddish, yellowish or brownish soils. The colour is the result of the parent material of the soil and the amount of organic matter in it. The amount of organic matter or humus varies too. Since humus is dark in colour, it keeps the soil warm. It also keeps the soil light by helping the circulation of air and it also hosts many small creatures and organisms. In some areas one finds well-developed and deep soil consisting of two main layers. Young soil which has formed not long ago is usually shallow and has one layer.

In many areas around Malta, farmers have transported soil resulting in a mixed type. In fact such transportation of soil has been done for farming especially when fields were built up. In that case the soil is carried to other areas and is mixed with other types of soil. For this reason, in some areas of the Maltese Islands, one finds a mixture of the three main types of soil. In the picture above one can see different types of soil in the limits of Siġġiewi.

In the Maltese Islands, soils resemble their parent rock. One finds red soil (terra rossa) formed out of upper and lower coralline limestone, white soil (carbonate raw soil) made up of blue clay, and brown soil (xerorendzina) developed from globigerina limestone. These types of soils can be generally found in the places of origin upon their parent rock, but throughout the years, people have moved and transported loads of soil from one locality to another so that in certain places one finds different types of soil in a single place. Due to the dry climate and since it is quite young, Maltese soil is mostly made up of a single layer.

Maltese soil has a high water retention capacity since it contains a high percetage of calcium carbonate. Although it may be humid, it still allows water to percolate and so it does not become waterlogged. All types of soil in Malta suffer from deficiency of organic material.

The hard upper and lower coralline limestone gave us the soils that are found in the areas around Mellieħa, Ħad-Dingli and Ħaż-Żabbar. The farmers refer to it as tal-ħamri (the reddish soil). Its red colour comes from chemicals replete with iron oxides. This is a rather stony soil and its organic content is 4.5%. This is the largest amount of organic material found among all soils in Malta. This soil is mostly used by farmers to grow potatoes, green pepper, tomatoes and egg-plants.

Brown soil, also known as xerorendzina, is made up of particles of globigerina limestone mixed with a little organic matter. One finds it mostly in valleys and where the rock outcrop is globigerina. In order to make up for its lack of organic material, farmers mix it up with alot of manure. This is mixed with the soil so that it can have enough nutrients for the growing of fruit and vegetables.

White soil is derived from the soft blue clay layer and it is made up of light yellow particles (see the picture below). It contains alot of calcium carbonate but only small quantities of organic matter. In this type of soil parsley, onion, cauliflower and cabbages are mostly grown. In summer white soil does not warm as much as the other types of soil do, due to its light colour. Moreover while the other types of soil will be dry in summer this type will still be a little humid due to its moist lower soil horizon. However, after heavy rainfall this type of soil is easily waterlogged and the farmer may not cultivate it at will. Crops may be diseased when they are rooted in very wet soil. After a long drought, white soil dries up completely and will solidify like stony dry soil.

Soil Loss

It has been lately estimated that every year about 75 million tons of soil are lost around the world. It may be said that soil loss is a serious problem faced by all the countries of the world. Soil is being lost by the action of the wind and rain, as well as through human activities such as urban spread and development, as also by farming that is become more intensive.

Malta is quite wind-swept. High wind occurs on a day in five on average. This causes the loss of fine soil from the surface especially during dry periods or after that the farmer has ploughed his fields. Soil tends to be carried away by rainfall, especially after heavy storms with sudden downpours. Sometimes these waters pass at great speed and strength due to the large volume of rainfall. Rain water digs, plucks up, and carries away the soil from the fields into the valleys where it is eventually deposited. Rain water can knock down rubble walls and if these are not quickly repaired, precious soil may end up into the sea and thus be lost forever.

Apart from separating one field from another, rubble walls help in avoiding soil loss through running water. When rain falls abundantly, the soil quickly becomes heavy and exerts pressure on rubble walls. There may be instances when the walls fall and they will be breached. This will cause the soil to be carried away and lost since there will be nothing to retain it.

Soil is increasingly being threatened through people's activities. Soil erosion results as soon as farmers uproot the natural vegetation and trees. Natural vegetation is taken away in order to turn the land for cultivation or for pasture. In order to increase yields, farmers started to use machinery and a lot of pesticides and fertilisers. Nowadays farmers are cultivating the soil intensively such that it is not being given time to restore its nutrients. This leads to the weakening of the soil and its loss. In Malta soil quality is being lessened due to high concentrations of lead, zinc, copper and other heavy metals. This high level of lead is the result of overuse or animal manure, compost made out of mixed domestic waste, chemicals used in agriculture, treated sewerage, as well as from dust and smoke coming from industrial plants. Apart from polluting and weakening the soil, these high levels of substances enter the food chain and may even adversely affect people's health.

The above pictures show us what happened in the central areas of the United States about 1936. High winds blew off the soil from the fields and many farmers had to leave the area and all their property since the land became useless. This happened because the farmers had uprooted all trees and plants and ploughed up the soil into fine dust for cultivation. As a result the wind found it easy to carry away millions of tons of soil especially in the dry summer months.

Soil erosion by rain and wind is higher up on the hills than in the plains. Heavy rain can carry soil from high areas into the valleys and the sea. The steeper the gradient of the slope, the easier it is for soil to be lost. Soil loss is also heavy where there are abandoned fields, where rubble walls have collapsed and where the surface has been uncovered without vegetation and dry.

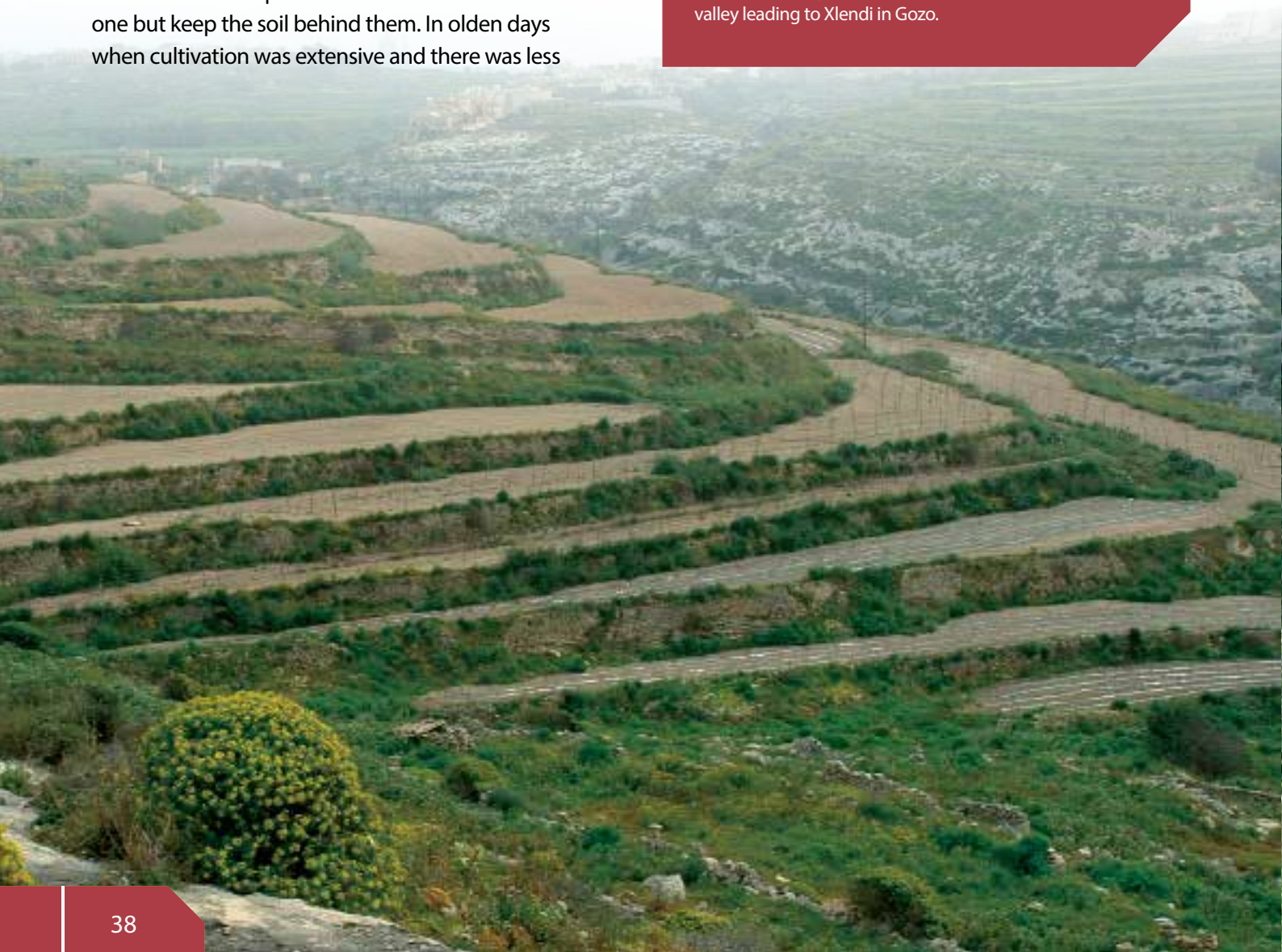
Concreted country lanes, especially those on hill- and valley-slopes, are increasing both the quantity and the speed of water run-off. So water gathers greater strength to pluck and carry the soil with it towards the sea.

Caring for the Soil

Soil is a renewable resource if it is cared for and properly worked. Without proper management soil, which has taken thousands of years to form, may be rapidly lost.

Since ancient times, people have endeavoured to save the soil from loss. Maltese farmers realised that they should care for the soil and should not allow it to be carried by rainwater into the sea. Therefore with great skill they cut out the slopes of the hills and valleys into great steps, one underneath the other. On the outer side of each step they built retaining walls and filled the spaces in between with soil that was available in the area. The hill slopes could thus be cultivated. These retaining walls, called rubble walls, were built without the use of mortar or cement so that they allow rainwater to pass on from one field into a lower one but keep the soil behind them. In olden days when cultivation was extensive and there was less pressure on the land to produce more foodstuff, animal manure was enough to render to the soil the nutrients that had been taken by the crops. There was no pressure on the land to be worked intensively and

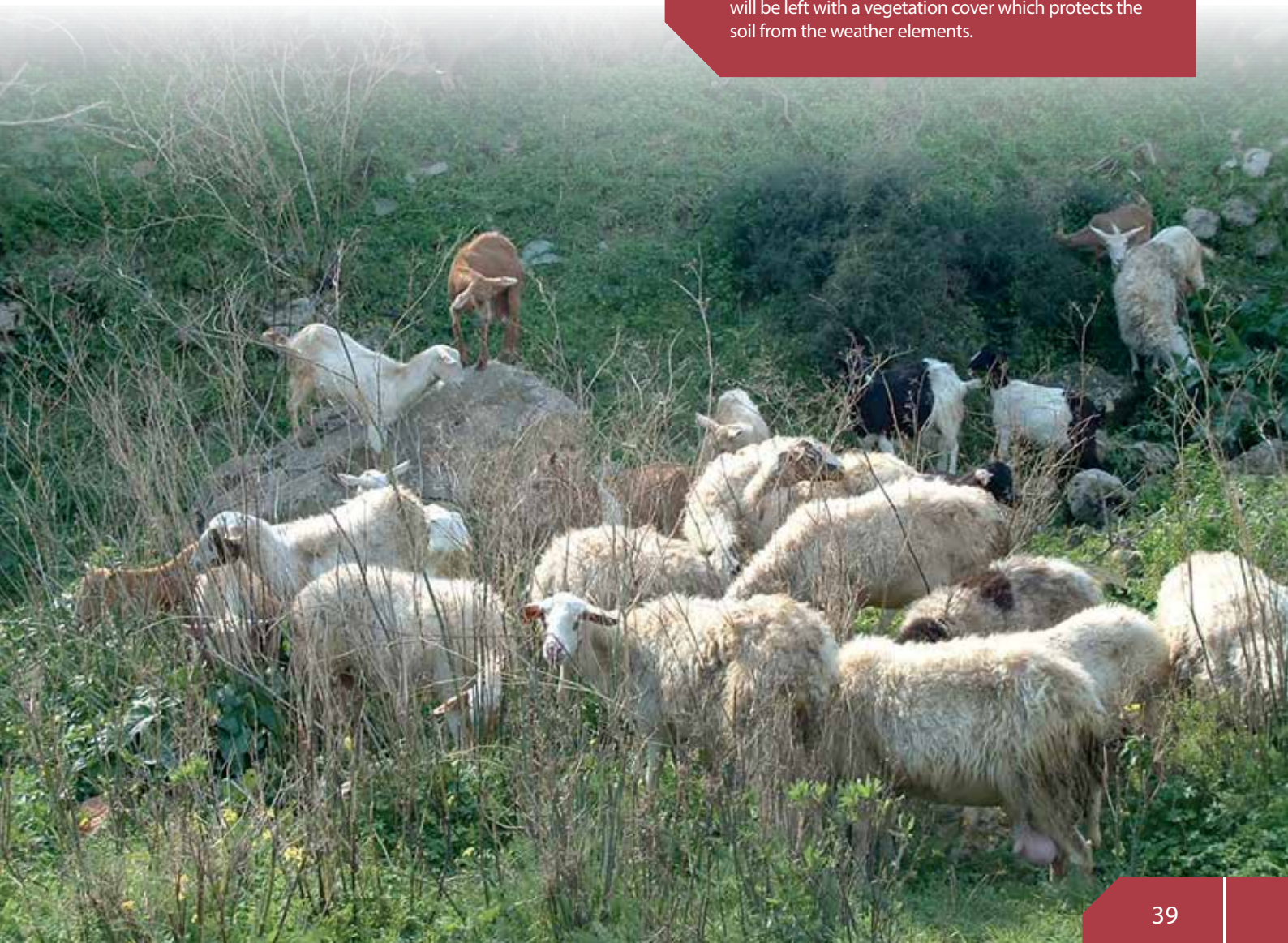
Framers should never plough the fields up and down the hill-sides, especially in valleys and slopes. Rainwater passes quickly through the furrows dug by the farmer and it plucks and carries soil downhill. In such places farmers have built terraced fields and they plough the fields horizontally and perpendicularly to the slope so that water will not be able to carry the soil downhill. This can be easily seen in the picture below showing the valley leading to Xlendi in Gozo.



it used to be left fallow for a time. This is no longer possible today with the current intensive cultivation systems. Due to the overuse of artificial fertilisers and animal manure, soil is being damaged, so much that it is becoming weaker and poorer leading to lesser, rather than greater production. The solution lies in a more moderate and careful use of these fertilisers. Crop rotation is being re-introduced by which farmers cultivate different crops on the same plot of land according to the season. This system reduces the need for fertilisers since some crops render to the soil the nutrients which were used by other types of crops.

Other practices such as the planting of trees, restoration and rebuilding of rubble walls, controlled pasture, careful ploughing and the enforcement of laws that safeguard soil fertility all help in mitigating the problem of soil loss.

If the farmer holds a large number of pasturing animals in a small area, the plant cover will soon be depleted and the soil will remain uncovered. Such uncovered soil without vegetation will be easily blown away by the wind and carried quickly by running water. On the other hand if pasture is controlled, having a moderate number of animals according to the size of the fields, the land will be left with a vegetation cover which protects the soil from the weather elements.



Nowadays, due to the high levels of production, soil is becoming weak and has no chance to recover. Finally the soil loses all its nutrients and will become vulnerable to erosion by running water and the wind. One solution is crop rotation, by which the farmer plants different types of crops on the same plot of land according to the season. In this way the soil remains fertile without the need for fertilisers and with lesser costs to the farmer.

Farming starts with the uprooting of the natural vegetation and trees. By deforestation, there will no longer be roots to keep the soil in place, so slowly the soil will be carried away and lost. The branches of trees help intercept the soil that is blown by the wind and slows down the drought. The leaves lessen the effect of heavy rain and the soil will not be moved by the waters. Afforestation projects, like the ones in the picture above, are very beneficial, especially in places that suffer from soil erosion. The planting of indigenous trees such as the cypress, shelter and protect soil from the wind. Wind breakers, made up of curtains of reeds, also protect from the wind in exposed areas.

1

a. Give one reason and explain why:
   - life on earth depends on soil;
   - soil is a renewable resource.

b. Join these sentences about the formation of soil.

Soil is made up of stone particles	that were broken and pulverised in time.
In soil one finds pieces and particles of rock	organic matter, air and water.
Organic matter consists of	consists of water and air.
Organic material is also known as	humus, which is essential for soil fertility.
	more than half the volume of soil.
	the remains of vegetation and other creatures that died and rotted.

c. Look carefully at the picture above.
   i. What is the soil in the picture made of?
   ii. Explain how the soil in the picture was formed.
   iii. What is humus and why is it so important?

2

The picture on the right shows a cross-section of a parcel of soil from the surface to the bottom.

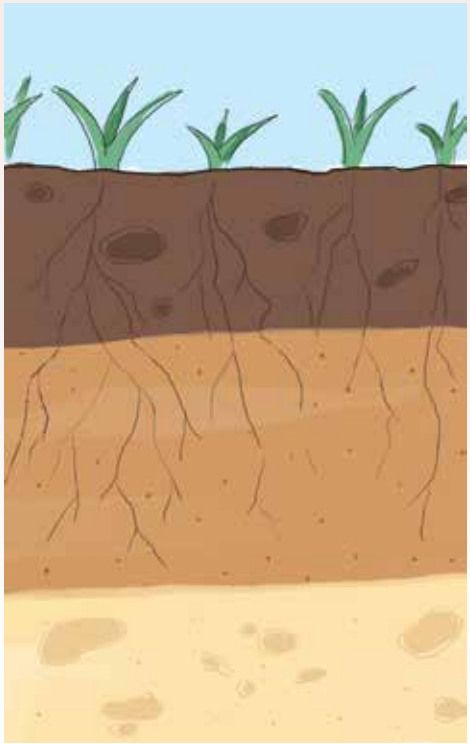
a. What is such a cross-section called?

b. Mark the three main layers, that is the active or surface layer, the subsoil and the lower layer.

c. Also add the following: bedrock, dark and fine particle, living organisms, pieces of stone, much organic matter (humus), little organic matter.

d. What is the function of earthworms in the soil?

e. Name and explain three characteristics by which one type of soil may be different from another.

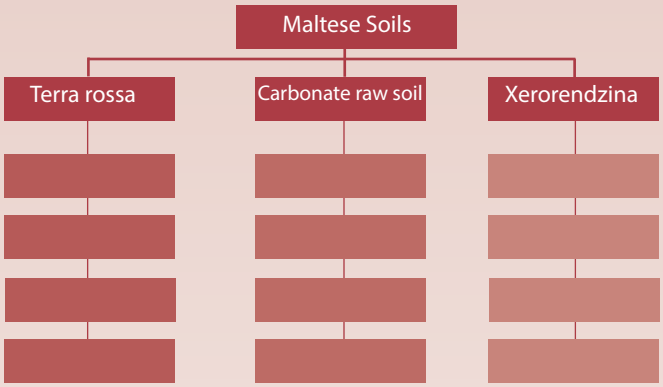


3

In the Maltese Islands one finds three main types of soil, known as red soil, white soil and brown soil. Below you may find some general characteristics of each type of soil.

a. In the table place these characteristics under the correct type of soil.

stony soil, from the soft blue clay rock, is easily waterlogged, high concentration of calcium carbonate, keeps humid, iron oxide, made from hard coralline limestone, made from globigerina limestone, brownish colour, reddish colour, light yellowish colour.



b. Find pictures or take photographs of two different types of soil found in the Maltese Islands. Give some information about each type of soil you found.

c. Explain why:

- soils differ from each other very much in colour;
- there are places with soils of different colour;
- earthworms are useful for the soil.

4

Every year tons of soil are lost due to natural processes and people's activities.

a. State whether this information about soil loss or erosion is true or not.

The rate of soil loss is higher on hill-slopes than on the plains.

Much soil is lost where the land is covered by trees.

Vegetation cover on the surface protects the soil from the wind and waters.

Tree roots keep the soil in place.

Breaches in rubble walls lead to soil being lost to water runoff.

The more soil is lost the greater is the food production.

Uncovered soil without vegetation is well protected against the wind and rain.

After rainfall, wind causes a substantial loss of fine soil from the surface.

b. Re-write correctly the sentences which are wrong in the above exercise.

c. Look carefully at pictures A and B.

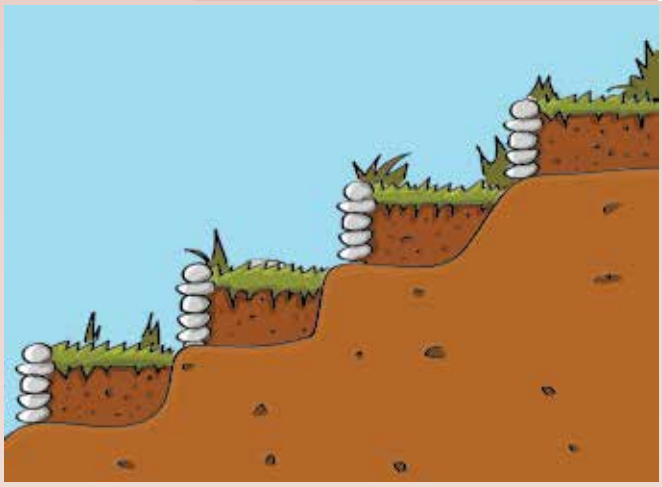
i. Mention and explain two features which clearly show that the soil in picture A is not in danger of being lost.

ii. Explain why the soil in picture B is in great danger of being carried and lost.

iii. What weather elements have caused the collapse of part of rubble wall in picture B?

iv. Why, do you think, should the collapsed rubble wall be rebuilt immediately?

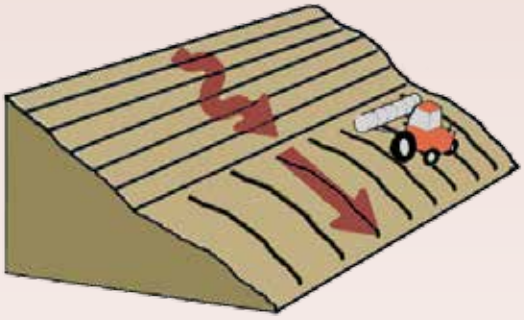
v. Mark properly the diagram on the right to show how these walls stop soil erosion especially in the hiil-slopes.



5

The diagram below shows land ready to be sowed after being ploughed by the farmer with the tractor.

a. Where do you think is it more probable that the soil be lost, in the upper part or the lower part? Give reasons.



b. Look carefully at the picture on the right.

i. What is the activity in the picture called?

ii. Explain how this activity leads to soil loss.

iii. Name and explain two other farming practices which can cause soil loss.

6

These are some activities which farmers can do in order to protect the soil in their fields.

a. Match the following.

Afforestation	*Furrows made by the plough perpendicularly to the slope of land.*
Terraced fields	*Cultivation of different products on the same plot of land in rotation.*
Crop rotation	*Planting a row of trees on the windward side.*
Contour ploughing	*Stone walls, one at a lower level than the other, in the shape of steps.*
Row of trees	*A limited number of animals according to the size of the land.*
Organic farming	*Planting of many trees.*
Controlled pasture	*Without the use of chemical fertilisers and pesticides.*

b. Explain in detail five of the activities mentioned in exercise (a) by which the farmer can lessen soil loss.

c. Posters will be placed in many country districts of the Maltese Islands in order to remind the farmers of the need to care for and work the soil in good manner. You have been assigned to draw two posters which will be placed in rural areas of Malta. With the help of some drawing or pictures, each poster must have a slogan with a clear message and some information about one measure of soil conservation for reducing the problem of soil loss.

Jobs related to the sea are nowadays more varied . They are no longer limited to traditional maritime sectors like transport, shipbuilding, port-activities, fishing and salt-panning, but there are now new sectors of great potential such as aquaculture, building of off-shore wind farms, the building of super yachts and yacht marina development. It is probable that in future new resources will be exploited from deeper seas, not only oil and gas, but also minerals, metals and biological resources. Added to this one may mention development in the tourist industry with the building of new cruise liner terminals and luxurious seaside apartments.

The Sea

3

The sea is one of our greatest resources. Many fishermen make a living by the sea and provide us with fresh and varied fish throughout the year. The sea is also sought for recreation. Many people go to sea especially in summer for bathing, to practise some sport like boarding, or to relax. Some sheltered inlets have been developed into ports and are now large transhipment centres. In certain ports there developed the shipbuilding and ship-repair industries that were very important for many years, employing thousands of skilled tradesmen.

Merchant ships carry millions of products like oils and fruit, books and computers, around the world. Sea voyages take longer than air voyages but they are much cheaper and ships can carry many more products. Moreover

the sea can maintain life on earth - it is able to control certain gases and absorb large amounts of CO_2 and it has great influence on climate.

Physical characteristics of the coast

The sea is continuously shaping and changing coastal features. During storms the sea weathers the rocks of the coast by means of erosion. Waves and sea currents transport material that would have been weathered by the waves and deposit it in other places. This process by which the sea can weather, erode and transport material results in the formation of different coastal features.

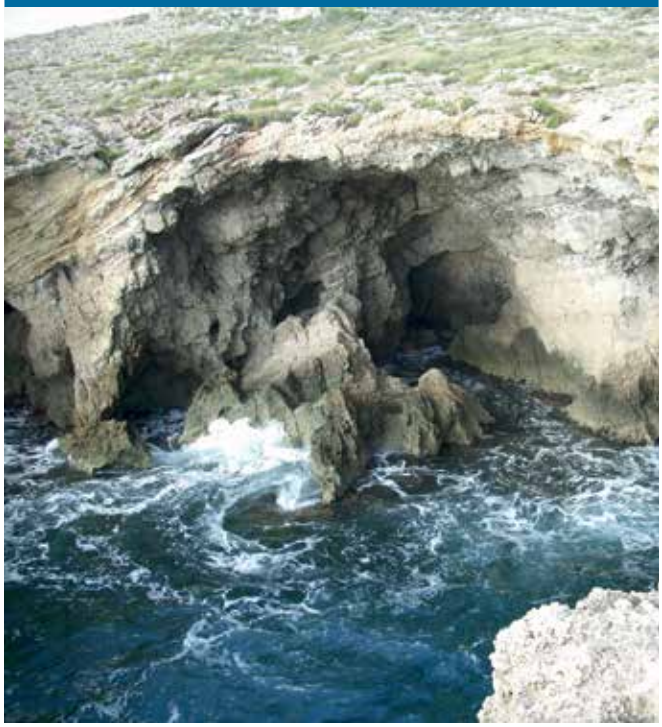
Coastal rocks are weathered, bored and eroded by different processes. The force of the waves, laden with sand, pebbles and small stones that continuously pound the rocks, erodes the base of the cliffs mostly. Meanwhile the same material breaks up into smaller pieces becoming rounded and smooth pebbles and also fine sand.

Rocks are weakened and broken under the continuous pounding of the waves.

Waves are strong enough to widen the cracks by hydraulic action. When sea water enters with force into these cracks the air inside them will be pressed against the rocks. During the backwash of the wave the trapped air will expand releasing pressure from the rocks. The continuous change in pressure will finally weaken the rocks which break down into the sea.

These physical processes work hand in hand with other chemical and biological ones to form typical forms and structures which one finds all around the coast. Along the years, the sea breaks against the cracks in the rock, slowly widening and eroding them until they form sea caves, of which one can see many along the coasts of the Maltese Islands. Two of the most famous are Il-Ħnejja ('the Arch', Blue Grotto, picture above) near Wied iż-Żurrieq and Għar Lapsi, limits of Siġġiewi.

The sea, laden with rock pieces, is capable of eroding and widening cracks in hard rock such as upper and lower coralline limestone. In the above picture we can see deep caves formed into the upper coralline limestone on the northern coast of Gozo.



Where there are protruding promontories or headlands, the cave sometimes erodes right through the headland and forms a small arch. A well-known arch like this, called the Azure Window, could be seen at Dwejra Point in Gozo until it totally collapsed into the sea on 8 March 2017. Another large arch like this can be seen at Wied il-Mielaħ, limits of Għarb in Gozo too. In Malta we may find other examples such as the arch at Ras il-Ħamrija near Għar Lapsi (photo above), Wied iż-Żurrieq arch (Blue Grotto) and the arch between Il-Ħofra l-Kbira (Island Bay) and Il-Ħofra ż-Żghira (Cyclops Bay) near Delimara.

The force of the sea continues to erode the headland until the ceiling of the arch collapses too and only a separate rock or a stack remains off the coast. One finds such stacks at Għar Qawqla in Marsalforn, Gozo and even in Comino. Slowly, even this separated rock will be eroded and what remains will be only a low reef at the level of the sea known as a stump.

Between Il-Ħofra l-Kbira (Island Bay) and Il-Ħofra ż-Żgħira (Cyclops Bay) there lies a headland called Ras il-Fenek. Throughout the years, the sea eroded a cave in a weak spot right through the headland. Thus a small arch called It-Toqba (the hole) was formed. In time the ceiling of this arch will collapse and the outer part will be a separate rock or stack.

The above picture shows the arch which stood in Għar Qawqla, limits of Marsalforn. In time the ceiling of the cave gave way and collapsed due to the physical processes explained here. Nowadays what is left is only a rock called a stack. Even this feature is being slowly eroded and there will come a time when nothing will be seen of this stack, except for a small reef under the sea level.

By hydraulic action, the sea can also open small cracks in the ceilings of caves. During storms, the sea enters with great force into these cracks and a rush of sea water will come out of the crack in the shape of a jet. Such a feature is called a blowhole. One can find such a blowhole at Irdum l-Aħmar in Mellieħa just past Daħlet ix-Xmajjar.

Waves erode the soft globigerina limestone cliffs quickly. At first the sea erodes a low piece under the cliff and in time the protruding part above this notch gives way and collapses too. By this process, which takes thousands of years, the cliff retreats slowly and leaves a wave-cut platform in front of it, slightly above sea-level, as can be seen in the picture below. Such wave-cut platforms can be seen in many places around the Maltese coast such as at Delimara and Sliema.

As can also be seen in the picture below, such flat platforms are usually full of large and small holes of different shapes. The potholes are formed through chemical processes which erode the soft globigerina rock.

Where there are globigerina limestone cliffs, the sea weathers and erodes the rock quickly. The cliff is eroded at its foot while the upper part will remain protruded like a shelf. In time, this shelf collapses to the bottom. In this way, on the wave-cut platform, one finds boulders that had broken and fallen from the same cliff.

The water and salt of the sea are able to dissolve the calcareous rock of the Maltese Islands and can change the shape of the coast with holes, cracks, points and edges. These potholes are frequently filled up with seawater which evaporates quickly. As can be seen in the above photo, some of these potholes are large are round in shape. When the sea is rough, it fills the hole forming an eddy which moves the pebbles around the pothole, further eroding and widening it.

The rock at the coast is usually covered in many different species of lichens which produce highly erosive acids. Even small animals such as small snails, limpets and shells are also able to dig holes in the coast and thus the rock is slowly eroded.

By time, all the material which falls when the waves hit the rock becomes pebbles and sand through erosion. The waves themselves as well as sea currents push this material on to the coast to form beaches such as the ones at Għajn Tuffieħa and Armier in Malta and ir-Ramla l-Ħamra in Gozo. (See the picture below). Soft rock like greensand and blue clay are quickly eroded by waves. On the other hand, where the rock is hard like coralline limestone, erosion takes much more time and therefore there may form a headland. A typical example is Ras il-Qarraba between Għajn Tuffieħa and Ġnejna Bay.

Traditional Fishing

Since early times, fishing was an important source of food for the peoples of the Mediterranean region. Nowadays the fishing industry around the Mediterranean employs almost 90,000 fishermen working on more than 40,000 fishing craft. In Malta this industry contributes towards the country's economy since it provides fresh fish for the local market and for the tourism sector.

In Malta fishing is a family concern. Generally the fisherman is owner of his boat and its gear. By fishing he provides for the livelihood of his family, although he often has another job. It is also in the family that the fisherman learns his trade which is normally inherited from one generation to another. Most fishermen use small wooden boats of less than 12 metres and go out at sea for a time which rarely exceeds12 hours. Half the Maltese fishing fleet berth at Marsaxlokk or St George's Bay, Birzebbuga. In the Maltese Islands there are about 1,400 fishing craft and this economic activity employs about 2,000 fishermen, although only 400 are full-timers.

Maltese fishermen catch about 1,500 tonnes of fish and other sea-food every year. Most species caught are the blue-fin tuna, dolphin fish, swordfish, pilot fish, and groupers. Dolphin fish and pilot fish are very popular among the Maltese which are caught by means of fishing floats. This type of fishing is peculiar to the Maltese Islands since it is only Maltese fishermen who throw palm branches and cork pieces on to the sea for the fish to shelter under while migrating near Malta. When a substantial number of fish settle under the floats, the fishermen throw in their nets to round them up.

The majority of Maltese fishermen use the traditional boat called luzzu, which has pointed bow and stern, as well as the kajjik which is flat-sterned. (see the picture above.) These traditional and locally built boats are rarely longer than 8 metres and make up 60% of the Maltese fishing craft. The rest of the fleet consist of larger vessels that can withstand rough seas and which have cabins where the fishermen may rest. Such vessels can sail for longer periods since they include refrigerators for keeping the fish fresh, strong winches for hauling heavy nets, as well as modern apparatus and instruments for safer navigation.

Large fish such as tuna and swordfish are caught by means of long-line fishing. The lines hold many pointed hooks as can be seen in the above picture. The fishermen attach small fish like sardines to the hooks so that the tuna and swordfish are attracted to them and thus be caught. This type of fishing is mostly done between April and June.

Fishing nearer to the coast is mostly done by means of trammel nets. This is a long net which hangs perpendicularly down to deep water by which many small fish are caught. The trammel nets are usually held straight by means of weights at their lower end. Some others are left floating by the current.

Fish such as bogue, horse mackerel, mackerel, sprat and sardines are caught by night through artificial light and nets called lampara. This is done by means of a vessel which tugs two kajjikki with lamps. (see picture below.) These two kajjikki will anchor at a distance from each other with the lights on. Fish like mackerel and sardines gather by the light of the lamps and when the fishermen notice that there are enough fish, they go round them with the nets for the catch.

Trawling can be done throughout the year by large trawlers which catch fish like hake, mullet, curled picarel, calamari, octopus, prawns and other demersal fish. These fish do not migrate but stay in the same place. The trawl net is in the shape of a large basket and is held to the bottom by means of weights made of lead. It is tugged along the sea bottom by the trawler and catches whatever fish there are in that place. For every catch the fishermen get a large mix of different fish which they have to separate according to kind on board. Trawling in the same places for a long time will deplete the bottom of most of the fish since there will not be enough time for the place to replace the fish that had been caught.

Traditional fishing as practised by Maltese fishermen is sustainable. The number of fish caught is not great and there is no danger for the different species. Nonetheless there is still need for young fish to be protected so that they may grow enough to be able to reproduce.

For this reason the EU is obliging the fishermen to widen the holes of the nets and to enlarge the hooks of the lines. Thus the sea bottom and the small fish which live there will be protected. Trawl nets cannot be used near to the coasts, on meadows of Neptune grass or on coral reefs. Moreover the EU imposed a size-limit on the catch of 28 species that are at risk of extinction. For example hake smaller than 20 cm cannot be caught. The same holds for groupers smaller than 45 cm and giant prawns smaller than 20 cm. In this way threatened species are being protected.

Dolphin Fish (lampuki)

Autumn is the dolphin fish season for Maltese and Gozitan fishermen. In fact the dolphin fish season is crucial for most full-time fishermen. Dolphin fish are migratory and for hundreds of years, Maltese fishermen have used floats in order to catch them. This is done between August and January, more especially in October and November, when this fish migrates through the surrounding sea.

Dolphin fish are found in the warmer seas around the world. It is a fast migratory fish that grows quickly since it is quite voracious. In fact it usually weighs 2 kilogrammes only six months after hatching. While migrating, the dolphin fish habitually shelters under floating objects such as anchored or slow-moving ships. This is why Maltese fishermen use the float method in order to catch this fish. Floats are made in the shape of a tent of palm branches held together on the surface by means of polystyrene or cork pieces and anchored to the bottom with large stones.

The fishermen anchor their floats to the bottom of the sea with large stones, and they mark their lines with flags and lights for the night. The fish which gather under the palm branches of the floats are encircled by nets and thus caught. Although in other countries such as Spain, Tunisia and the Balearic Islands fishing for dolphin fish is also carried out, in Malta such fishing is both organised and structured. This guarantees an adequate income for the fishermen and protects stocks from over-fishing of the species.

The Malta Government Department of Fisheries controls this activity by issuing yearly licences to a number of fishermen who have the necessary gear and crews for this work. The vessels concerned must be more than six metres long and equipped with trusted security and navigational instruments. Fishing by floats can only be done in certain areas and the Department assigns a zone to each fisherman. No one can trespass and throw his lines in a zone reserved to another fisherman. Each licensed fishermen is bound to throw 35 lines, all marked with the licence number of his vessel. At the start of the season, all lines are thrown on the same day under the supervision of Fisheries Department officials.

Fishing for dolphin fish and pilot fish is seasonal and is always carried out between the feast of St Mary (15 August) and the end of the year (31 December). Every year, about 1000 tonnes of dolphin fish are caught around the Mediterranean, 300 to 500 of which by Maltese fishermen. This represents about one-third of all the income from fishing in Malta.

When one visits Marsaxlokk in August, one may see many fishermen boarding a number of palm branches, masonry stones, as well as polystyrene and cork pieces. (see picture below.) This is some of the gear needed for the traditional fishing for dolphin fish. These palm branches are attached to a line with polystyrene and corks pieces, kept just under the level of the sea, that are also anchored to the bottom by means of masonry stones. These lines are thrown about 10 kilometres away from the coast in places indicated by Department of Fisheries officials. There are about 130 berths in place for fishing the dolphin fish and anyone who has a licence can fish starting from his assigned berth outward along his line. Every year, on 15 August the season is opened by the traditional blessing of the fishing craft at fishing village of Marsaxlokk.

The sale of dolphin and pilot fish is held at the fish market, the only fish market by auction in Malta. At about 4.00 a.m., the fishermen unload the fish in the official boxes and pass them on to their middleman who will lead the auction. The fish-vendors gather as soon as the auction starts. The middleman shouts out the price as he shows each lot. When the demand is high, the price increases. If the catch is large, then the price will fall. When agreement is reached, the fish-vendor takes the box, weighs it and pays the price. About 25% of fish caught in Malta is exported to Europe and this ensures that the price does not fall unduly.

Dolphin fish is an important resource and means of livelihood for Maltese fishermen. Dolphin fish live only up to 4 years and they grow quickly. Recent studies have found that they breed near to our coasts in the Sicilian Channel. It hatches in June and stays nearby until the beginning of winter. At this time Maltese fishermen fish for the young dolphin fish of about 6 months by means of the traditional floats. When the sea temperature cools down to less than 21°Celsius, the large shoals make their way to the Atlantic Ocean. During the past few years the numbers of dolphin fish have decreased. This may be caused by the increased number of foreign fishermen who are now turning to dolphin fish in the Mediterranean since other species are already depleted. In order that fishing for dolphin fish remains sustainable, it must be regulated internationally.

The Destruction of the Tuna Fish

Tuna are large fish that spend their lives swimming restlessly. Among many species of tuna, the blue-fin tuna migrates through the Mediterranean and is caught mostly between May and July. This is the largest species of tuna, sometimes reaching a length of over 4 metres and weighing 1000 kilogrammes, that is more than a horse. Tuna swims at a normal speed of three to seven kilometres per hour, however, when it is chasing a prey, it may reach a speed of 100 kilometres per hour! One can find tuna migrating all along the Atlantic coasts, from Brazil to Canada and from West Africa to Norway. Every year shoals of tuna enter the Gulf of Mexico and the Mediterranean in order to reproduce.

Tuna is much sought after for the nutritional value of its meat. It is also commercially profitable due to its size. Its meat contains fats and fish oil with quantities of Omega 3. This oil is indicated for protection against heart disease. Moreover, tuna also contains vitamins A and D, as well as many beneficial minerals such as sodium, calcium, iron and phosphate.

Each year about 45,000 tonnes of blue-fin tuna are being caught in the Mediterranean by means of vessels geared with long nets and modern instruments.

The greatest consumers of tuna fish are the peoples of the Far East, especially the Japanese who like to eat sushi. They buy about 40% of all the tuna catch.

There are various ways of catching the tuna. One method is by the long line drawn from large factory-ships which process the tuna on board, ready for delivery to the country of destination. Another method is by the use of enormous nets which are left floating in the migration routes of the tuna. These are harmful to the marine ecosystem since many species, including mammals, are being caught. These large nets have been called death nets and many countries have prohibited their use. One method is by the use of the purse seine net which catch the fish on their migration. Before being exported, the tuna is placed in a large pen for six months where they are fed to reach maximum weight. Small aircraft are used to identify the position of shoals of tuna.

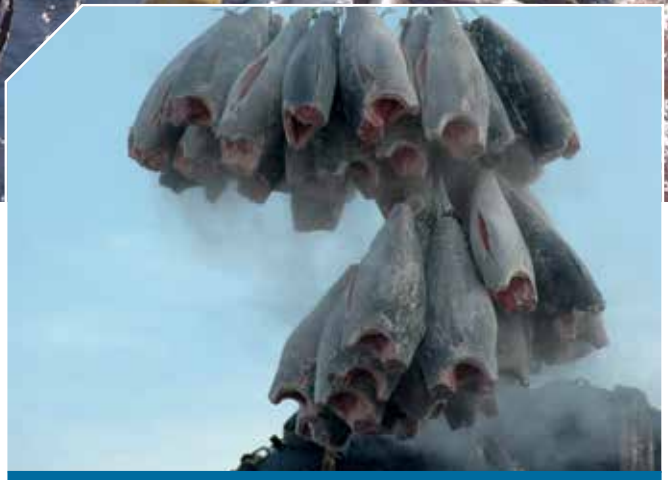
Recent studies have shown that the blue-fin tuna catch is diminishing both in quantity and in size of fish. This shows that there is over-fishing and that the tuna is not being allowed to grow enough to reproduce. This can have an

Tuna is also caught by means of the tunny-net, also called tunny fishing ground, which is made up of a very strong net in the shape of a labyrinth. While the tuna are migrating, many enter the labyrinth and cannot find their way back. The trapped tuna are hauled on to the boats by means of hooks. Here we can see Mellieħa fishermen catching tuna in the Mellieħa Bay tunny-net

adverse impact on the number of grown-up tuna and the total numbers. A report published by World Wildlife Fund states that blue-fin tuna can be considered as a species under threat of extinction.

Overfishing of tuna in the Mediterranean is placing their reserves under great threat. Therefore for reasons of sustainability, fishing for tuna has been put under the supervision of an international commission, the International Commission for the Conservation of Atlantic Tuna (ICCAT). In such a way the species will be protected and will recuperate after years of threat by uncontrolled over-fishing. Each country has been assigned a quota for its share of fishing and the total for 2013 amounted to 13,400 tonnes in the Mediterranean. These quotas will decrease yearly until safe levels are reached. The tuna fishing season has been shortened to six months and the minimum weight of fish that can be caught is 30 kg. The use of aircraft to spot shoals of fish is now prohibited. Moreover the captains of fishing vessels must report immediately the quantity and weight of the tuna caught and they are also obliged to inform the Commission about their exact position. ICCAT officials also have the right to board the fishing vessels in order to check the number and weight of the tuna caught, as well as to visit tuna farms.

Around the Maltese coast one finds a number of blue-fin tuna farms. This tuna shoal is firstly held by the purse-seine net until the mobile cage is brought to the place. The tuna is then led into this cage which is slowly tugged to the tuna farm. Sometimes this voyage takes weeks. When the tuna reach the fixed farm they are transferred inside and fed fish like Atlantic mackerel that are caught by Maltese fishermen. The tuna is kept for about six months when they are grown enough to be sold. Finally they are hauled up from the pen, killed, put into refrigeration and boarded on ships sailing for markets in Japan. Every year about 300 tonnes of blue-fin tuna are exported from Malta to Japan.



Tuna caught at sea are placed inside cages and tugged to the tuna farm. In these fixed cages tuna are well-fed with fresh fish until they put on enough weight to be sold.

Fish Farming

Developments in fishing by the use of modern technological means have increased efficiency in this industry. As a result the amount of fish caught has increased. Provision of fish has increased in the markets by means of the use of larger vessels which can brave stormy seas, advanced systems for detecting shoals and fishing with larger nets. Nevertheless the demand for fish and seafood is increasing both because of the expanding population and because people are eating more fish due to the higher standard of living.

This is causing pressure on the reserves at sea, so much so that fish reserves are drastically being reduced and some species are threatened with extinction. The EU and other agencies are doing thier utmost to reduce overfishing. But it is difficult to control fishing in the Mediterranean since the sea is surounded by many countries.

Aquaculture, or fish-farming, that is the raising of fish in farms, can help fishing satisfy the demand for more fish. In this way, aquaculture can provide the local market with fish, help reduce overfishing at sea and the protection of threatened species. This is what happened in Scotland, Canada and Norway. These countries produce so much salmon in their fishfarms that the need for catching salmon at sea has been reduced substantially. Nowadays, salmon in the wild are reproducing and fast increasing. Aquaculture is fast increasing worldwide so much so that every year 52 million tonnes of fish are raised. This represents almost half the fish and sea-food consumed worldwide.

In Malta too this industry is fast developing, producing about 1,100 tonnes of

seabream and seabass in large pens situated about one kilometre away from the coast. Here conditions are very good for fishfarming; sea temperature varies between 15 and 28°C, the water is less polluted and contains more oxygen; it is also continuously changed by currents which make the fish more active and less prone to disease. These factors contribute towards the raising of best quality fish in the Maltese waters throughout the year.

Hatching and raising of small seabram and seabass is made in apposite tanks at the Aquaculture Centre of St Lucian's Tower, Marsaxlokk. This process takes about 4 months until the fish gain a weight of about 2 grams. At this stage the fish are transferred to the pen sat at sea for their growth to continue in the fish-farms.

Great quantities of seabream and seabass are raised in large pens which are found in certain areas outside Malta's coast. In this way we may have a sufficient fish production all the year round.

The small seabass and seabream are kept for four months in the special tanks in Fort St Lucian. When they are of a certain size, they are transferred to pens situated off the coast until they reach the desired size and weight.

Fish-farms are made up of round pens of about 20 metres diameter and 10 metres depth. These pens need tobe large for the fish to be able to move and roam about. Everyday the fish are fed automatically on a balanced diet so that they gain the necessary fats. The fish stay inthe pen for about 15 months until they reach the weight of about 350-450 grams. The majority of the seabream and seabass raised in Malta are exported to Italy where they are sold in supermarkets.

In Malta one can also find larger fish-farms for the raising of tuna fish. In these fish-farms, the tuna which had been caught by the large nets in the open sea are raised and fed until they are exported to Japan. Studies are being conducted in many Mediterranean countires, including Malta for the hatching and raising of tuna same as is done with other species so that their farming will no longer be dependent on the initial catch in the wild.

Sometimes fish-farm operators disagree with other entrepreneurs of the fishing, tourist and entertainment industries. Moreover they may be environmental problems such as the phosphate and nitrate waste that comes from the natural waste and other wasted food. This may damage the environs of the pens, such as the destruction of algae in which fish hatch. Because of this fish-farmers are obliged to take samples of the sea and of the mud from the sea bottom to independent laboratories so that they may be tested. Others are of the opinion that these fish-farms are an eyesore since located close shore and should therefore be moved further out in deeper seas. In this way they would not be visible from the shore and any pollution will be cleaned naturally by the sea currents.

Pollution of the Mediterranean Sea

About 400 million people live around the Mediterranean Sea in 22 different countries. About 150 million of them live close to the coast. To these must be added the 200 million tourists who visit the region every year. The Mediterranean Sea must be kept clean in order to protect all these people's health. Moreover, the Mediterranean biome is most rich in living species, many of which are unique in the whole world. The sea's biodiversity must be protected against all types of pollution.

The Mediterranean is one of the most vulnerable seas in the world. Not only is the sea itself under pressure from man's activities, but it is also almost enclosed since it is only open at the Straits of Gibraltar, so that the waters of the Mediterranean take about 80 years to change.

About 80% of marine pollution originates from the land. Over 50% of urban areas with over 100,000 people do not possess sewage treatment plants and therefore the waste is thrown into the sea untreated. Sometimes very scenic bays have to be closed for swimming because of such pollution and the risk for people's health. Moreover, many landfills and rubbish dumps on the southern and eastern Mediterranean coasts are situated close to the shore and lead to sea pollution, especially those that are not properly managed. Mediterranean Sea environments are exposed to agricultural waste originating form pesticide use

and from fertilisers which are carried to sea by rivers. About 80 rivers carry heavy metals, toxic substances and industrial chemicals to the Mediterranean which are slowly polluting the sea and destroying marine ecosystems and various species.

Around the coasts of the Mediterranean, one finds about 200 petro-chemical plants which include large oil refineries. All of these release large amounts of CO_2 and other toxic gases which end up at sea. One also finds many power stations near the coasts. Many of them use fossil fuels while others produce nuclear energy.

One other activity which causes the Mediterranean to be polluted is shipping. There is a large increase both in number and size of ships and the Mediterranean route is one of the most frequented.

Beautiful bays must be closed for swimming since the sea and coasts are polluted and become a threat to people's health. The shore below is polluted by tar originating from a ship sailing nearby.

Sources and effects

On average about 10,000 commercial ships sail the Mediterranean every day, among which 300 oil tankers. Although the Mediterranean Sea is only 0.7% of the world's sea area, it hosts 30% of all commercial shipping. Since so many ships are constantly sailing, loading, carrying and unloading their cargoes, many accidents may happen. Disasters such as the one seen in p. 66 which happened in the Strait of Gibraltar can have a very adverse effect on the economy of the place.

All this pollution is causing the death of a large number of fish and sea-birds, as well as the poisoning of sea-food. There are more than 104 marine species threatened by pollution. The quality of life of 150 million people who live by the coasts of the Mediterranean Sea depends on the safety of the same sea.

Until a few years ago, all the sewerage generated in Malta found itself into the sea causing a detrimental effect on the environment, especially marine flora and fauna. 80% of it used to go out at Wied Għammieq into the sea at Xgħajra. Then currents used to carry this material to the touristic villages of Marsascala, Marsxlokk and Birżebbuġa. The same happened in other localities in Malta and Gozo. Sewerage contains nutrients such as phophates and nitrates which favour the increase of certain algae which destroy other species of the place. Nowadays all the sewerage of Malta is treated and filtered in four purposely built treatment plants. These plants filter the sewerage in three stages before it is thrown in the sea without the risk of damaging the marine environment or people's health. In the first phase the sewerage is filtered of its solid and fat content by mechanical means. Hence the water passes to the second phase in which it is naturally cleaned of its biological impurities. This is done in 18 to24 hours in purposely built large tanks. Finally the water is disinfected before being thrown into the sea.

During the past 40 years many initiatives and strategies have been developed and action taken in order to safeguard the Mediterranean from pollution. This was not an easy task. No single country can be blamed for the pollution in the Mediterranean and none can solve the problem on its own. Moreover pollution generated by one country can affect others since it can roam about the whole sea. Another difficulty is the cultural and economic diversity of the countries of Southern Europe, Northern Africa and the Middle East. Nonetheless in 1975, sixteen countries, among whom Malta, adopted a resolution (MAP) to tackle jointly matters of sea pollution. As of today, 22 countries are signatory to the Barcelona Convention by which an assessment of the environmental problems of the Mediterranean is made, control of risky activities is practised and action plans are jointly set up. These countries are striving to control pollution originating from land such as sewerage; address problems of pollution coming from transportation of oil, chemicals and other dangerous waste at sea; and to draft laws safeguarding the biodiversity of the Mediterranean Sea before it is too late.

Biodiversity of the Mediterranean Sea

Sea covers 70% of the Earth's surface. This salt-water forms the greater part of the hydrosphere and is a crucial environment for life on the planet. Living at sea and totally depending on it one finds a great number of animals and plants. The sea holds great biodiversity: microscopic organisms like plankton; flowering plants such as algae; corals; sponges; worms of different shapes; molluscs of different sizes like snails, shells, octopus, limpets and cuttlefish; crustaceans like lobsters, crabs and prawns; a large variety of fish of many sizes, shapes and colour, like the Maltese ray, morey eel and mullet; reptiles such as sea turtles; and mammals like whales.

Unfortunately people are exploiting the beautiful resources of the sea without control. Apart from illegal and uncontrolled fishing, the sea is also being used to cover up large quantities of poisonous and dangerous waste. Moreover there is also the negative impact of shipping and oil pollution both of which are destroying sea creatures and the natural balance of the sea.

The marine life cycle depends on plants such as algae that use the sun's energy to turn carbon dioxide and water into food. In this way they feed themselves and thrive. Algae and other marine plants are mostly found near coats, on reefs and on continentalshelves. Here the sea is not deeper than 200 metres and the rays of the sun penetrate to the bottom thus helping the process of photosythesis. Algae of many beautiful shapes and colour thrive in the Mediterranean Sea. One finds brown algae like the cystoseira, red, blue and also green algae such as green stokes (or sea lettuce).

The Mediterranean Sea holds a large biodiversity, starting from microscopic organisms to fish of different sizes, shapes and colour (like this morey eel), as well as reptiles and large mammals.

These algae attract large numbers of herbivores like the salema which is commonly found grazing in shoals on algae meadows. The herbivores are then eaten by larger fish which are usually faster as well. These carnivores swallow the smaller fish or tear them apart before eating them as the sharks do.

At sea one also finds large varieties of marine-worms which drag themselves along the rocks or among the grass and leaves of the algae. Some of them like the Barbary bug roam about scavenging on pieces of dead fish. Othe species of marine-worms pass all their lives in shells which they themselves develop. These put out their tentacles so that they may catch smaller creatures to feed on.

One may find a number of corals and sea anemones of different shapes and colours attached to the rocks at the bottom of the sea. Sea anemones are ususlly well attached to the green stokes or the rocks and they are able to catch their prey by using their long and narrow tentacles near to their mouth. On the other hand, corals are made of calcareous skeletons which slowly build up reefs of a few metres' height in the Mediterranean.

The environment on the sea bed

Under the sea, naptune's grass or posidonia meadows are a most natural and rich in biodevirsty. This is a flowering plant which spreads out in large meadows that provide both shelter and food for many creatures. In this environment many creatures reproduce and it provides the ideal habitat for many young members of various species to thrive. Above all these meadows give out oxygen for the sea and they also protect coasts and the sea bed from the rigours of strong waves. However, due to the people's greed, meadows of naptune's grass are sloely dying in many parts of the Mediterranean Sea. Posidonia is very sensitive to pollution. This plant can be destroyed by sewerage, hot water outflowing from thermal power stations, rapid coastal development, trawling, yacht anchors and aquaculture. All these are negatively impacting these meadows and in future this can affect all life forms of the sea bed.

Naptune's grass which deposit on the shore provide an important environment and also halt erosion of the sand. Therefore in winter months naptune's grass should not be removed from the beaches.

Trawling, the use of endless nets and ships geared with the most technologically advanced instruments are causing the destruction of many species and the natural balance of the sea-bed. Reliable information states that during the past years the stocks of different species of fish and other creatures such as blue-fin tuna, grouper, sea turtles, dolphins, monk seals and many others are depleted because of pollution and uncontrolled fishing. Although many species are protected by law, some like sea turtles and monk seals (picture below) and dolphins are caught by the long lines and fishermen's nets. These are trapped by the hooks or suffocate in the nets. Moreover due to human activity along the beaches, it has become very difficult for sea turtles to find quiet bays where to lay their eggs. Such sea turtles used to hatch regularly even at Ramla l-Ħamra in Gozo. The same can be said of the monk seal. Only about 350 are left living near Greece. Not only are their breeding areas disturbed by tourism, but they are also suffocating when they are trapped in fishermen's nets since they would not be able to rise to the surface to breathe. The detruction of so many species in the Mediterranean Sea is altering the ecological balance and while some species are dwindling, others are proliferating. The increase in jelly-fish may be attributed to the decrease in the population of sea turtles.

Human activities are seriously threateneing the seas around the Mediterranean. There is a need for designating more protected maritime zones so that large areas of sea and coasts be specifically dedicated to the protection and maintenance of biodiversity by the use of law. In this way future generations will be able to enjoy this environment. Zones like these offer protection for the sea environment and the creatures living therein. Human activity will not be excluded from these zones, however, natural resources will be used sparingly so that the natural environment and all species at sea will be protected.

1

Study carefully the pictures on the right.

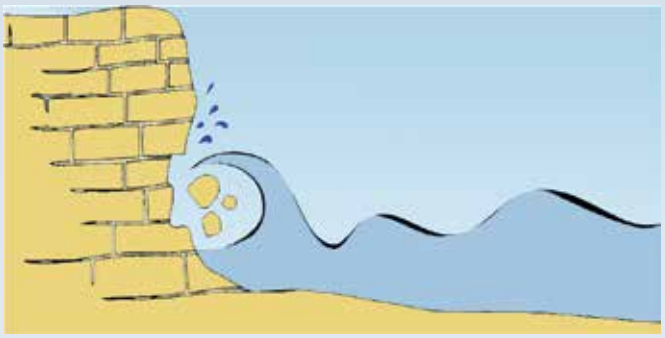
- Why do you think is the sea regarded as an important natural resource?
- Explain also how the sea has been used by people for the necessities listed below.

food | transport | recreation | economic activities

2

a. The picture on the right shows waves breaking on the foot of a cliff.

i. Explain how the sea can weather and erode the rocks along a coast.
ii. Label the diagram well to show how the force of the wave can weaken and break the rocks of the coast.



b. Look carefully at the diagram below which shows the process of headland erosion.

Label the diagram with the words written hereunder:

arch | stump | stack | headland | sea-cave | cracks in the rock

c. Fill in the blanks with the same words given in the exercise (b) to complete this paragraph about erosion of rocks by the coast.

The sea attacks weak places such as _____ and slowly erodes and widens them. In this way _____ are formed such as those that can be seen at Għar Lapsi and in many other areas around the coast. Where there is a _____ the cave may penetrate right through and an _____ is formed like the one at the mouth of Wied il-Mielaħ in Għarb. As years goes by the ceiling of this cave collapses into the sea and only a _____ is left similar to a pillar standing alone out at sea. By time this too will be eroded and only a _____ is left behind.

d. Look carefully at pictures A, B, C and D. Compare them to the features shown in the diagram of exercise 2 (b).


A


B


C


D

i. Identify the natural features shown in each photo.
ii. Mention the natural features according to how they formed in order of time.
iii. Draw each picture in the form of a labelled diagram according to the same order.
iv. Explain how each of these coastal features was formed.

3

a. The Tourism Authority has charged you with preparing a brochure for tourists who visit Dwejra Bay in Gozo. Describe some physical features which can be seen in this area and explain how these features were formed. Include diagrams and photos so that one can identify these features during the visit.

b. These are some headline news published on 8 and 9 March 2017.

Azure Window collapses totally into the sea

Malta's Azure Window is no more

i. Draw a diagram to show how the Azure Window at Dwejra looked like until that date.

ii. Draw a diagram to show how the cliff looks like today.

iii. Draw a diagram to show what usually happens when only the ceiling of the arch collapses.

iv. Why do you think did the Azure Window collapse totally in such an unusual way?

4

The diagram below shows characteristic features found along the Maltese coast.

a. Write the missing names or numbers of the features marked 1 to 9 in the blank boxes on the right.

6	
	wave-cut platform
3	
	cliff
	blowhole
8	
	boulder-scree
9	
2	

b. Choose four of the above features and explain how they were formed.

5

Study carefully the diagram on the right.

a. What is the physical feature shown in the picture called?

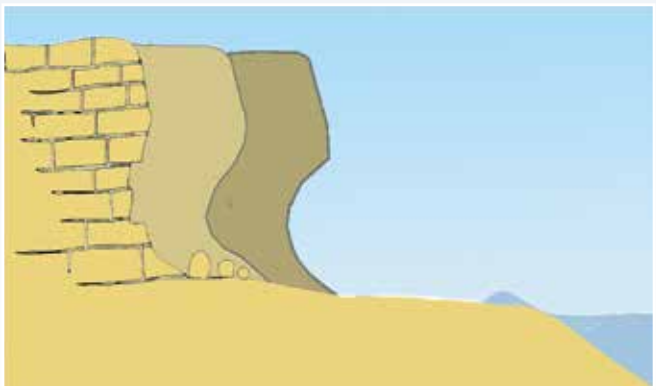
b. Label the diagram on the right with the following phrases.

cliff retreat

present position of cliff

waves cut a low notch at the foot of the cliff

wave-cut platform



c. Use the given words to explain how a cliff like the one in the diagram is eroded leaving a smooth coastal plain.

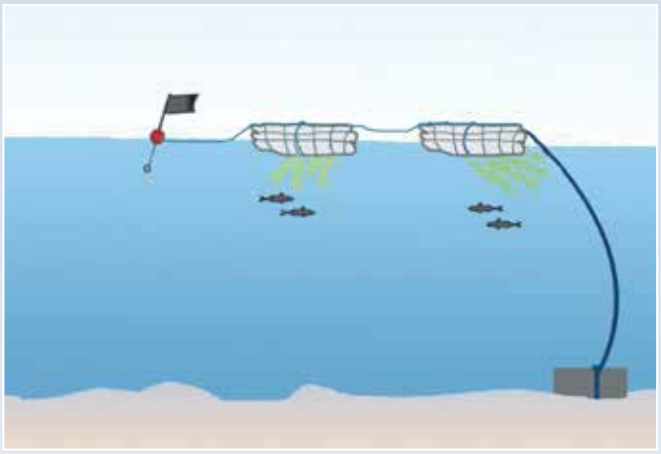
d. On the diagram draw the original position of the cliff.

e. Often wave-cut platforms are full of potholes and pointed rocks. Explain how the latter features are formed.

6

Read carefully the following article carried in a Maltese newspaper.

a. Why do you think is the blessing of fishing vessels ceremony held in Marsaxlokk?
b. Why is this ceremony held in August?
c. Use the diagram below to explain how dolphin-fish are caught.
d. What other fish is also caught in the same way?
e. Why can we consider the fishing of dolphin-fish by Maltese fishermen as a sustainable form of fishing?



Dolphin-fish Season Opens

13 August

The dolphin-fish fishing season has opened. The Fisheries Minister attended the traditional Blessing of Luzzus ceremony at the fishing village of Marsaxlokk. The parish-priest blessed the vessels from ashore. Later he boarded a luzzu to continue the blessing around the harbour. In a short speech the parish-priest wished the fisherman good fortune and a safe return during their work.

Usually 130 lines are laid around Malta and Gozo, however, this year there will be about 110. Along these lines, the fishermen cast pieces of cork and palm branches and other objects, together called fishing floats.

Last year the dolphin-fish season was a good one for Maltese fishermen.

According to official statistics by the Fisheries Department Maltese fishermen caught 430,000 kilograms of dolphin-fish in 2010, earning them more than €1,049,000. Moreover they also caught a large amount of pilot-fish which added to their earnings. This volume is measured according to the catch which was registered at the Fish-Market throughout last season.

Meanwhile a similar Blessing ceremony is also held in Gozo to mark the opening of the dolphin-fish season.

7

Read what these people are saying about fishing for blue-fin tuna which migrates in the Mediterranean.

Tuna fish grows up to 4 metres and can weigh more than 1,000 kilograms. Its flesh is full of nutrients, proteins and vitamins. Sushi made from raw tuna flesh mixed with rice is much in demand by my clients, and they pay handsomely for it.
owner of a Japanese restaurant

We throw very long nets in places known as migratory routes of tuna so that we may catch them. We spot shoals of fish by means of small aircraft and none will get away. Our vessels are fully equipped and we can also process all the catch at sea
a Spanish tuna fisherman

Due to over-fishing of tuna, there is the possibility of the fish becoming rare or even extinct. We need to adopt drastic measures immediately. This measure should be a three year moratorium on the catch of tuna.
Greenpeace activist

Large vessels use purse-seine nets to catch tuna and they tug them over by means of mobile cages. In our large pens we feed the tuna with Atlantic mackerel and other food until they gain enough weight. After some months we haul them up from the pen, kill, refrigerate and export them to Japan. Profit from tuna raised in Malta is high.
owner of aquaculture pens in Maltese waters

We are no longer catching large tuna as we used to with the long line. The tuna we are catching now are very small due to the large fishermen vessels that are equipped with high technology and endless nets.
Maltese long-line fisherman

Answer the following questions.

a. Explain why the Japanese restaurant owner wishes that there be more tuna catch.
b. Why is the Greenpeace activist worried? What is she proposing? Do you agree with her?
c. By the use of diagrams explain fishing methods for blue-fin tuna that are endangering the sustainability of the fish.
d. Do you agree with the system by which tuna are caught in the wild and then raised in pens? Do you think that this is a sustainable way of protecting this fish species?
e. Mention some regulations that were recently introduced to save tuna from extinction.

8

Recent estimates show that half the fish and sea-food consumed world-wide comes from aquaculture.

a. What do you mean by 'aquaculture'?
b. Why do you think that aquaculture is needed environmentally?
c. In the table below, list the advantages and disadvantages of aquaculture.

Aquaculture	
Advantages	
Disadvantages	

d. Explain how seabass and seabream are raised in fish-farms around the Maltese coast, from the hatchery to the plate.

e. St Paul's Bay Local Council has received several applications from fish-farm owners in order to expand their operations and to lay down new ones off the coast. Associations representing divers, local residents, hoteliers and environmentalists are against this development.

i. Why do you think is there such large opposition to new fish-farms from:
- divers
- environmentalists
- hoteliers and
- local residents ?

ii. If you were the mayor, what stand would you take?

iii. Is there a way of allowing fish-farms to expand while protecting the sea and limiting the visual impact?

9

Look carefully at a map of the Mediterranean Sea.

a. List six large cities situated on the coasts of the Mediterranean Sea.

b. What harm can these cities do to the living organisms of the sea?

c. Why do you think the Mediterranean Sea is more vulnerable to pollution than other seas?

d. Look carefully at the features in the pictures which can harm or pollute the Mediterranean Sea.
   i. Describe ways in which the activities shown in the pictures can cause serious environmental problems.
   ii. Continue the table below by writing all the sources which, in one way or another, are polluting the Mediterranean.
   iii. In the second column write down the impact which these sources have on the environment, people and the economy.

Pollution of the Mediterranean Sea	
Sources of Pollution	***Negative Impacts***

e Mention some sea creatures that are threatened by different sources of pollution.

f A recent study shows that algae and posidonia meadows are decreasing around the Maltese coasts.

i. Why do you think these are decreasing?
ii. Why are they being destroyed?
iii. What do you think can be done in order to protect such a rich environment?

g. During the past years efforts have been made to clean up the Mediterranean. Many meetings and conferences have been held for countries which touch on the Mediterranean Sea.

i. Why do you think this is not an easy task?
ii. Mention some measures that can be taken so that the Mediterranean be protected from pollution.
iii. Imagine that you will be participating in a protest march against the pollution of the Mediterranean Sea.

- Prepare a poster to take with you with a slogan written on.
- In the poster give your proposals of how we should reduce pollution.
- Draw pictures to make the poster attractive.

Rainwater

4

Rainwater is essential for our everyday life. In fact 70% of our body is water. It is essential for people to have a fresh and clean water supply. Moreover many primary and secondary activities such as farming and manufacturing industry depend on water.

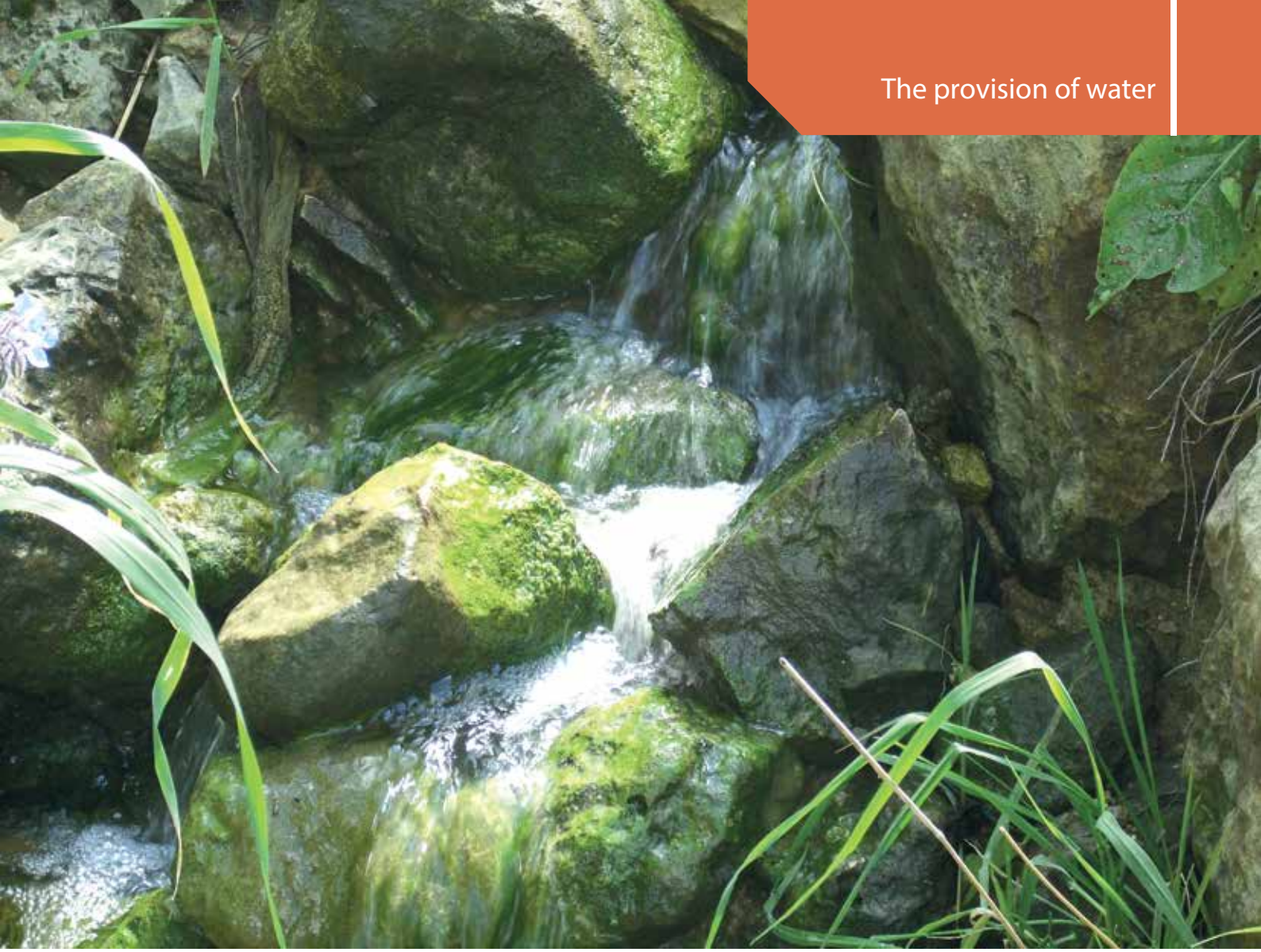
Water is found at sea, in the atmosphere, in ice-caps in rivers and lakes. Only 1% of this water is potable. Fresh water forms as part of the hydrological cycle when it is evaporated from the land and sea surface into the atmosphere later to be returned as rain or snow. The world reserve of fresh water is enough to maintain a population far greater than the present. Problems arise due to the large cost of harnessing and conducting water and because of irregular rainfall – since it may be heavy in one place but scarce in another.

Recent estimates reported that only about 15% of the total world population have tap-water. About one billion people do not have access to clean and safe water. Every year millions die due to lack of water or due to contaminated water. Women and children pass many hours collecting and fetching water from natural springs or rivers. The little water they can carry must serve them for a whole day. This water is not always clean and sometimes it infects and kills people when it is polluted.

The Hydrological Cycle

Water is an important, precious and essential resource and therefore it has a great social and economic value. Consumption of water has been on the increase throughout the world, doubling in the last 50 years. Much water is used for energy production, agriculture, domestic and industrial use. In many countries the ever increasing demand for water is causing great scarcities. Excessive exploitation of water is compromising the quantity and quality of the remaining water in many countries, including Malta. We must therefore lessen the demand and use water more efficiently.

The total world capacity of water is 1,384 million cubic kilometres. Large amounts are found in the clouds, lakes, rivers and oceans. The largest share (97%) lies in the oceans. The rest is found in large masses such as in Antarctica and Greenland, as well as on high mountains. Other reservoirs of water are found underground in the pores of permeable rocks. Only a small part of the water stored underground, at sea or in the air actually passes through the hydrological cycle. The hot sun evaporates water from the oceans and the land to become water vapour. The sun also evaporates water from plants by a process called transpiration. This water-vapour is carried in the air by wind until changes its state into small water droplets by condensation. Rain water and other precipitation such as snow and ice fall into the sea and onto the land. Water goes into the soil and slowly percolates the rock which stores water



like a sponge. Occasionally rain-water emerges from the rocks thus forming natural springs and rivers. This run-off water moves down the slopes into the valleys and on to the sea.

One can say that in most countries, much of the potable water depends on the water filtered by the rocks and stored underground. This water is usually pumped up by people using electric water pumps. Water coming out of natural springs and moving down the valley sides is also harnessed and used. Throughout the year, large lakes and rivers such as the Nile, Mississippi and Po also provide large quantities of water. Unfortunately the water of these rivers is polluted and therefore it must be well treated and filtered before being used for domestic purposes.

For many years, dams have been constructed across many rivers so that their water might be stalled and harnessed behind them.

The climate of the Maltese Islands is dry, typically Mediterranean, with an annual average rainfall of 530 mm. Much of this rainwater falls in sudden torrential storms resulting in the rapid loss to sea of about 15% of the water. Moreover, about 65% of the water quickly evaporates due to the high temperatures. Only 25% of the water is able to percolate into the rock whence it can be pumped up for everyday use. This water source is not enough for the demand in the Maltese Islands, recourse has been taken for desalinisation systems. In fact more than half of the potable water produced in the Maltese Islands comes from reverse osmosis plants (See pictures in page 83) which consume one quarter of the electrical energy generated in Malta. Therefore all Maltese residents must feel obliged to use water responsibly and reduce waste. For example one must repair leaking water taps or report any waste. We must use tap water properly or rather use water from the well. According to law every house should have a well. If this were so, each household would save 25% on water consumption.

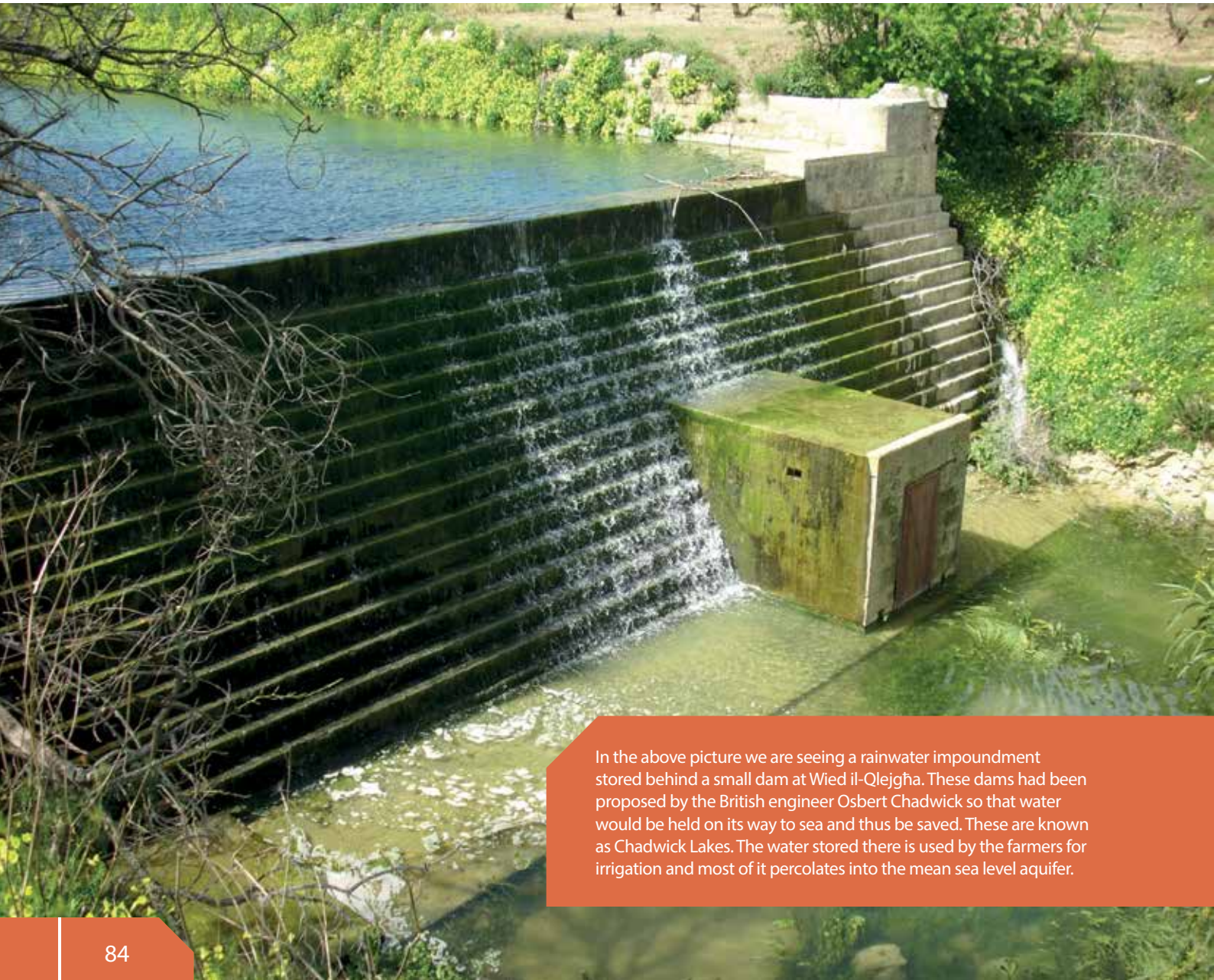
In the past, aqueducts were built in order to bring water to towns. In 1615 Wignacourt Aqueduct was built (see picture above) to bring water from its source behind Mtarfa to Valletta, seven kilometres away. Nowadays, wide underground pipes are used to bring water from remote areas to densely populated places. Often water that is pumped or brought from different sources is stored in large reservoirs before being distributed into homes. After being used water is thrown away into the sewerage system. This polluted water must be treated before being thrown into the sea or any river.

Nowadays 55% of potable water consumed in Malta is produced in the reverse osmosis plants (See picture at left). These are desalination plants which are able to change sea water into potable water. Presently there are three reverse osmosis plants in Malta: at Pembroke, at il-Ħaġra s-Sewda near Għar Lapsi and at Ċirkewwa. At these plants sea water is pumped up from holes dug down to sea level and it is changed into excellent potable water after passing through membranes and fine filters (See picture below). However, this process uses a lot of electrical energy and therefore it is very costly. Moreover the large amounts of very salty water that is thrown back into the nearby sea causes much damage to marine ecosystems. Mediterranean countries which suffer from a large scarcity of water are building reverse osmosis plants. There are more than 700 reverse osmosis plants in Spain providing water for 8 million people daily.

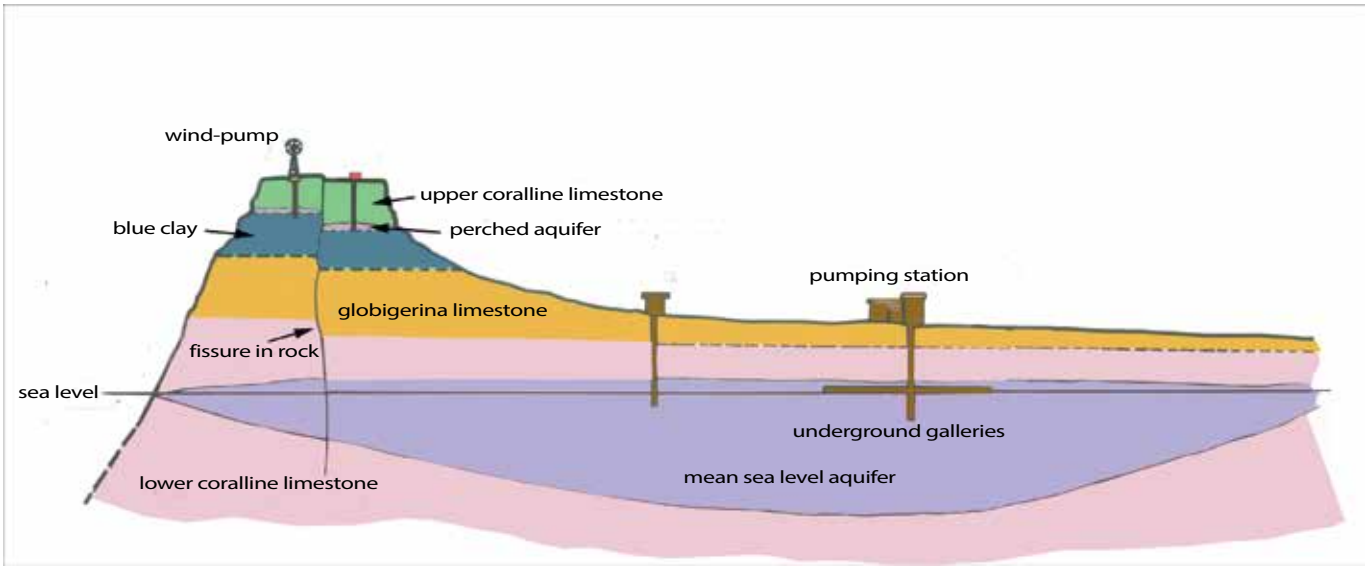
Natural water storage in the rocks

Malta's natural water reserves totally depend on rainwater which percolates into the rock and is stored underground. Rainwater which succeeds in percolating through the fissures and deposits in the pores of the rock is stored in two natural aquifers called perched aquifer and mean sea level aquifer.

The perched aquifer lies in Maltese and Gozitan localities where the rock outcrop is upper coralline limestone. Rainwater percolates easily through the fissures of the upper coralline limestone and greensand which lies below it and settles on the blue clay layer. Blue clay is the only impermeable layer of rock present in the Maltese Islands and it keeps the water from percolating further down. Rainwater will therefore settle on the blue clay layer and the greater the rainfall the higher the percolation and the thicker will the perched aquifer be. This type of aquifer is found where there exist the three layers of rock on top of each other, namely in the west of Malta at Dingli and Rabat and on the flat-topped hills of Gozo. When the rocks are saturated in winter, water will move sideways until



In the above picture we are seeing a rainwater impoundment stored behind a small dam at Wied il-Qlejgħa. These dams had been proposed by the British engineer Osbert Chadwick so that water would be held on its way to sea and thus be saved. These are known as Chadwick Lakes. The water stored there is used by the farmers for irrigation and most of it percolates into the mean sea level aquifer.



Natural water stores in the rocks

it emerges by the slopes. This is how natural springs are formed.

In olden times such springs were the only source of potable water for the Maltese to drink, to give to their animals and for irrigation. In time farmers learned how to pump up water from the perched aquifer by means of the animal drawn watermill and later the wind-pump. Unfortunately one cannot see natural springs any more since farmers are pumping up water in large amounts for irrigation from this source.

The other source of fresh water is at a much lower level. It is called the mean sea level aquifer. It lies in the fissures and pores of the globigerina and lower coralline limestone. This fresh water reserve lies at the same level of the sea. While the water on the perched aquifer rests on the blue clay, the water in the mean sea level aquifer rests on the salty water which percolates through the rocks. Fresh water which is stored in the globigerina and lower coralline limestone does not mix readily with the salty water which comes from the sea since the latter is denser, therefore heavier. Thanks to this, fresh water stays on top.

As can be seen in the diagram, this store of water in the rocks is in the shape of a lens, thick at the centre, but thin by the sides. In winter months the water therein increases, but in summer it decreases.

Water stored above the blue clay layer used to be pumped up by means of the water pump (the remains of the machinery are visible in the picture above) or with a wind-pump (See picture below). Water was used to irrigate the fields especially during the dry summer months.

Presently slightly less than half the water consumed in Malta is brought up from the aquifers. Water is extracted using boreholes dug in the rocks as well as from galleries dug horizontally in the lower coralline limestone with the use of large pumps. (See picture below). These galleries were dug by hand in the hard lower coralline limestone at the level of the sea. Water drips and trickles down from the ceiling and sides on to the ground of these galleries and moves along to a central place whence it is pumped up. In the Maltese Islands there are about 42 kilometres of such galleries which produce most of the potable water coming from the aquifers. The picture below shows one of these galleries dug at about 100 metres underground which channels potable water to the pumping station at Ta' Kandja. Water that is extracted is tested, added with chlorine and stored in one of the covered reservoirs that are located across the Island.

Until recently all the potable water which Malta needed was pumped up from these two natural aquifers. Water from the rocks was enough to satisfy all that was needed in Malta. Along the years a large number of boreholes like the one in the picture above were dug, as well as 42 kilometres of galleries to pump up the water stored in the rocks. In the past decades the standard of living, factories and tourists increased. Water from the rocks was no longer enough for the demand. Malta had to turn to reverse osmosis plants that change seawater into potable water. These are costing Malta much money since they consume one quarter of the electrical energy generated.

Saving the water reserves

Rainfall is scarce in the Maltese Islands. The demand for water is increasing and this is leading to large quantities being extracted from the aquifers. The water in the aquifer is seriously threatened by over-extraction and by pollution and this otherwise renewable resource is at risk of being permanently lost.

Water in the aquifers must be kept in equilibrium. One should not pump more water than the amount that percolates through the rocks. If this is not the case and pumped water exceeds the replenishment of the aquifer, the water reserve will drop and sea water will make its way into the aquifer instead. This is precisely what happened in the last decades, so much so that in the last 50 years, the water stored in the aquifer diminished by 25%.

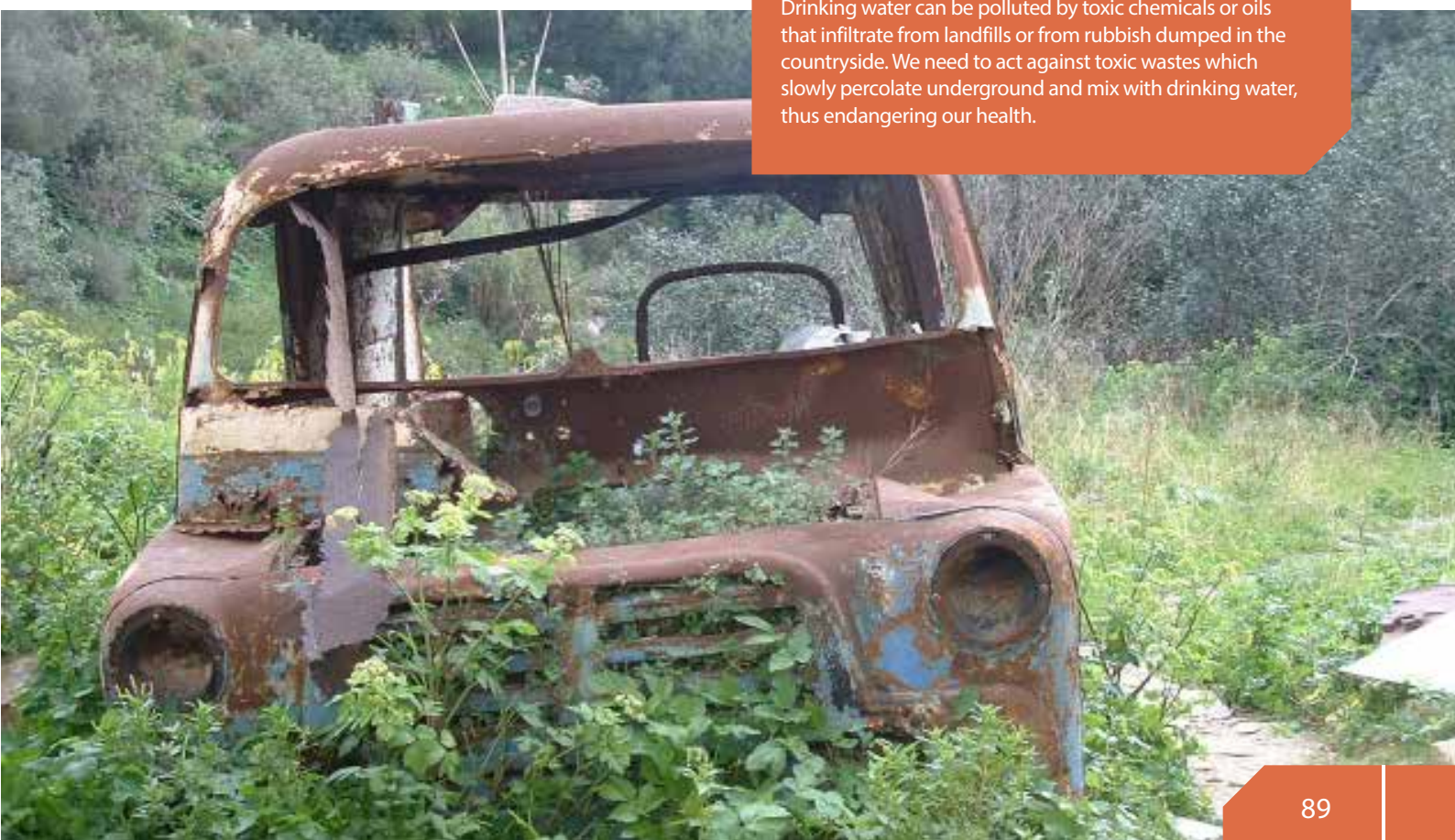
In the past years the percolation of water into the rock has decreased substantially. Large areas have been built up and the urban zones have spread. Because of this, rainwater finds its way into sea rapidly, as happens to 80% of the rainwater which falls upon the urban areas. On the other hand more than 95% of the rainwater which falls on the rural areas infiltrates into the ground. Recent studies have shown that the Maltese are extracting from the aquifer double the amount of water which percolates into the rocks after rainfall. Because of this the water reserve of the aquifer is being irreparably damaged both in quantity and quality. We can sustainably extract 25 million cubic metres of per annum but we are actually pumping up 40 million cubic metres. This is 17 million cubic metres more than we ought to. Due to this over-extraction, seawater is finding its way into the aquifer and ruining the fresh water by turning it into quite salty water. Much of this water is being illegally pumped up through boreholes dug into the rock. These have been dug in the fields for irrigation and on farms for raising animals. Other illegal boreholes are found in private homes for watering the gardens, and in commercial and industrial places such as in quarries, abattoirs, factories, car-wash stations and hotels. Due to this over-extraction, freshwater in the aquifers may be totally depleted with 20 years' time. Steps should be taken to control illegal pumping of groundwater since there may come a time when all the necessary fresh water will have to be produced from sea water at a much greater cost than today.

Water brought up from the aquifers now contains a lot of nitrates. This happens because farmers use large quantities of fertilisers for their products to look better for the consumer. Even the animal manure that is dispersed in the soil can also increase the level of nitrates in the water stored in the rocks. Another

threat to the quality of water in the aquifers may come from damage incurred by the sewerage system since infected water may flow. Rainwater which percolates into the rocks carries all these poisons, mixing them with the water in the rocks. In fact the water pumped up from the perched aquifer is so much polluted with nitrates that it is only used for irrigation.

The Mediterranean region will suffer drought due to climatic change. Rain will fall in short torrential downpours. This will lead to greater loss of rainwater since there will not be enough time for it to percolate into the land and most of it will soon find its way to sea. Moreover the level of the sea is expected to rise by 90 cm by 2100 due to global warming. Therefore much sea water will infiltrate into the mean sea level aquifer and the level of fresh water will rise. The water in the aquifer will become saltier and probably unsuitable for drinking.

Drinking water can be polluted by toxic chemicals or oils that infiltrate from landfills or from rubbish dumped in the countryside. We need to act against toxic wastes which slowly percolate underground and mix with drinking water, thus endangering our health.



Due to over-extraction, freshwater in the aquifer has decreased and salty water has increasingly infiltrated from the sea, so much so that in many places, water has become brackish and it is now unsuitable both for drinking and for irrigation. We need to reduce the consumption of groundwater and find alternative sources of water to be used in farming and industry. This can be done by the use of sewerage waste treatment plants. Each day we are throwing about 50 million litres of water into the sea from these water treatment plants. If this water is further treated, it will be suitable both for farming and for industry.

More control must be exercised on what is thrown into the sewer for this process to be successful. In countries such as Australia and Singapore, water treated from sewerage is used both for drinking and for agriculture. Large galleries and reservoirs can be dug in urban areas to store water. One other solution is for residences, hotels, public buildings and factories to have their own wells.

Such solutions, as well as an educational campaign against waste will possibly be enough for saving the water held in the aquifers of Malta.

Freshwater is allowed more time to percolate into the aquifer by the building of dams in valleys, as well as by the digging of ponds, reservoirs and wells in the fields.

Rivers

The water present in rivers comes from rainfall, melting snow and from groundwater. The source of many river lies in mountains where much rain falls and they continue downstream until they reach the sea or a lake. On their way downstream, rivers carry whatever lies in their path, they erode the rock and produce beautiful landforms.

Generally the source of rivers are small springs in highlands. These springs or tributaries join and drain their water into the main channel of the river. All the tributaries and the main channel of a river form a river-basin.

Appart from carrying large quantities of water, rivers can alter the landscape by means of erosion, transportation and deposition of rocks and materials. Erosion is greatest when the river is strong and fast in the hills. The water carries and rolls pieces of rock, stones and other material all along the valley. By the mass of the water, this material rubs, grates and erodes both the bed and the sides of the river. The pressure of the water, together with this material, can pluck other rocks from their place and like a brush, can continue to grate the bed and the sides of the river until a v-shaped deep valley is formed with vertical banks, as can be seen in the picture below.

Soft rock is more easily eroded than hard rock. When running water moves over from hard to soft rock, the softer rock is quickly eroded and a step is formed where the current of the river will fall to a lower level. The soft rock will continue to erode by the falling water and will form a plunge pool under the waterfall. The harder rock will also erdoe from the bottom and a sort of shelf is left hanging. This shelf or rock-lip will continue to weather until it too falls into the plunge-pool. In this way the waterfall slowly retreats upward until it leaves a deep gorge.

The Niagara Falls, between the USA and Canada is perhaps the most famous waterfall in the world. Every minute, thousands of litres of water fall 50 metres. This spectacle attracts millions of visitors and is considered one of the natural wonders of the world. There are many waterfalls in the world.

In Venezuela, South America, one finds Angel Falls where water falls 980 metres and where it dug a plunge pool of over 807 metres.

The highest one is Angel Falls in Venezuela which is 980 metres high.The widest one which carries the greatest amount of water is Victoria Falls on the Zambezi River in Africa.

Far form the hills, water moves more slowly in wide and open valleys. In the plains the river starts to bend and forms meanders. Whenever the river floods, its waters will cover the plains on each side of the river. Everytime this flooding takes place each year, this plain is covered in water and mud which accumulate in layers. The mud which covers the plain is very fertile and is coveted for farming. Fine soil thus formed is called alluvial soil.

Alluvial soil is fertile and it is found by the sides of flat valleys. Everytime a river floods it leaves a layer of fine and humid mud. The floodplain is made up of this type of soil which is much sought after for farming.

The material carried by the river finds itself in the sea and gradually builds up new land called a delta. In the satellite picture below we can see the birds-foot delta of the Mississippi River in the Gulf of Mexico. This is the place where the river deposits the material and sediment which it will have carried. These are low and flat lands and therefore are in danger of being submerged if the sea-level rises. However, these deltas provide fertile and humid land which are easily farmed. This is precisely the reason why these deltas attract thousands of people who make a living there. In fact the Nile delta in Egypt and the Ganges delta in Bangladesh are two of the most densely populated lands in the world.

Water is a much needed resource. This is why people always tried to settle in cities near large rivers with clear waters. One may mention the city of London on River Thames, or Paris on River Seine. Rivers provide water for domestic use, for drinking, for washing and for other uses. They are important means of communication and when most transportion was made by sea, major ports were found on navigable rivers. Rivers provide water both for industry and for irrigating fields. Above all it provides the farmer with alluvial soil which is most fertile. Rivers are also used for recreation. Many power stations are also found near rivers since water is necessary for electricity generation. Large rivers are also used for hydro-electric power production, a clean and renewable energy resource. Unfortunately for years on end, many rivers have been carelessly used for dumping people's waste. Sewerage, chemical substances from factories and fields and other toxic materials were dumped in them. This destroyed all living creatures in them and most of all, compromised people's health. Nowadays, after millions of Euros were spent in their clean-up and controls were enforced, many rivers have recuperated and have become ideal places for leisure and recreation.

River Nile in Egypt is the longest river in the world. The sources of this river lie in the hills of Burundi 6,671 kilometres away from its mouth in the Mediterranean Sea. For thousands of kilometres the river passes through the Sahara Desert and for millions of Egyptians who live in cities along its banks, the Nile is the only source of water. However, the largest river in the world, that is the one with the greatest capacity and volume of water, is the River Amazon in South America. It is 6,440 kilometres long and crosses South America from west to east. It pours about 94 million litres of water into the Atlantic Ocean every second. The mouth of River Amazon, where it joins the Atlantic Ocean, is 240 kilometres wide.

Freshwater courses

In the Maltese Islands there are many valleys which fill up with water in winter. After rain-storms water passes quickly through these valleys, carrying whatever may find in its path, while eroding the bed and the sides of the same valley. In this sheltered and humid environment live many animals and plants, some of which are endemic, that is very rare and quite unique for the Maltese Islands. Over the years many valleys have been built, others have been disturbed, their characteristic flora and fauna being uprooted or even destroyed.

Many valleys that are now found in the Maltese Islands were formed during the ice age when the Central Mediterranean region received much more rainfall. This rainwater formed rivers which eroded the soft rocks whence they passed and dug up valleys. Nowadays, since the climate is much drier, the valleys only carry water in the rainy season, while in the other months they are completely dry.

Most of the watercourses which supply the valleys with water have their source in the south-west high lands of Malta and they run quickly downstream towards the north-east according to the slope of land. In fact we find three main watercourse systems: those known as Wied l-Għasel, Wied il-Kbir and Wied is-Sewda. About 28 other smaller tributary valleys drain their waters into the three main valleys. In many Maltese valleys, one can find characteristics that are similar to those found in much larger river-valleys in larger countries.

Some valleys are V-shaped, with narrow beds and steep slopes. Others have wider beds and gentler slopes. One finds waterfalls in between different levels, as well as meanders formed by the waters, with deep, fine and fertile soil on the banks.The waters which these river-valleys carried used to drain into the sea. In fact one finds large estuaries at Burmarrad and Marsa which have both been reclaimed. There are also valleys that have been submerged by the rising level of the sea thus forming bays or inlets. This is what precisely happened to the estuaries of Marsmxett and Grand Harbours in Malta and Mġarr ix-Xini in Gozo. The Maltese have always thought of the valleys as a source of water for irrigation and for drinking. Moreover they built rubble walls in order to form terraced fields in the slopes of the valleys and they availed themselves of the fertile soil of such places. However, one might say that watercourses have all but dried up only to re-appear temporarily after

The valleys of the Maltese Islands were not formed in the same way. Some had their rocks eroded by the force of the water such as those of Għajn Rihana and Baħrija. This happened many thousands of years ago during the ice-age when the climate was much more rainy than in our times. Marsalforn Valley in Gozo was formed in this way too. Such valleys are wide and have gentle rather than steep slopes. On the other hand some valleys which have steep slopes were formed by the movement of the rock. Such valleys are Wied Babu and Wied iż-Żurrieq in Malta and Mġarr ix-Xini in Gozo. Some other valleys such as Wied il-Pwales, Għadira and Mistra have been formed by faulting. Such valleys have very wide and flat beds and a steep sheltered scarp on each side. After heavy showers, water collects in all these valleys and slowly keeps on eroding the rock upon which it passes on its way to sea.

some heavy rainstorm. The flora and fauna of which thrived in wetlands have almost disappeared because of excessive building near the valleys, as well as due to the many roads which pass both by the sides and in the beds of valleys. The creatures of the valleys are also being threatened by the high levels of nitrates coming from the overuse of fertilisers and manure in the fields.

With these one may add the cow plop and pig sludge that are dumped from animal farms. Apart from contaminating the watercourses this can also put people's health at risk. The beds of certain valleys are covered in layers of stone chippings, dust and sand which is carried by the wind from mounds of such material located in nearby quarries. Because of this many endemic species of flora and fauna are being destroyed, while many others are also threatened. The herding of sheep and goats is also harmful to vegetation in the valleys. Many corners of such naturally beautiful places of high ecological value are also being ruined by the laying of many bird trappers hides.

Some valleys have been turned from quiet recreational places to dumpyards. In them one finds cars, fridges, mattresses and all sorts of rubbish. Apart from making the place look ugly, they can obstruct the watercourse, destroy the fields and increase flooding.

There are many creatures which can live in the little freshwater available. Among them is the freshwater crab. This crab is only found in perennial watercourses such as Baħrija Valley in Malta and Lunzjata Valley in Gozo. This crab spends a lot of time in between stones and in holes it digs in the mud and soil next to the watercourse. It is carnivorous and by night it sallies from its hideout to prey on tadpoles, young frogs, snails, insects and other small creatures. The freshwater crab stays in these holes for shelter and for the much needed water. In olden times the freshwater crab was much more common but lately it has become very rare and in danger of becoming extinct. This has come about due to the destruction of valleys, drought, the contamination of watercourses by substances used in farming and by their capture by people. Since this species is endemic and in danger of extinction, it is now protected by law.

Creatures which live in freshwater courses such as the freshwater crab are in danger of extinction. Lately pollution has increased very much mostly due to activities by farmers. The large amounts of nitrates coming from the excessive use of fertilisers and manure are contaminating the waters where the freshwater crab and other creatures live.

Qlejgħa Valley

Perhaps the most popular valley in Malta, especially in winter and spring, is Qlejgħa Valley, also known as Chadwick Lakes. This time of year, the impoundments or lakes that formed behind the dams which were built to halt the passage of water to sea, would be full of water. It is a pleasant sight to watch the waters cascading over the dams in between the terraced fields which make the place so beautiful.

Qlejgħa Valley is a small part of a much longer Għasel Valley watercourse. Għasel Valley's source is in the high ground between Rabat and Dingli. Various tributaries feed the main course with water especially in three valleys called Liemu, Bużbież and Għammieri Valleys. These three valleys meet at Qlejgħa Valley down the northern slope of Mtarfa, which is a wide, gentle-sloped valley. The waters continue downstream to Speranza Valley which has a narrow bed and steep slopes until they reach Għasel Valley proper which is gorge-like at first, but which later opens up into the wide Għasel-Burmarrad floodplain where the water meanders. At Burmarrad the watercourses meets another three streams coming from l-Imselliet, Bidnija and Wardija. All this water finally drains into Salina Bay. In olden times Burmarrad area was a wide estuary

where freshwater and the sea readily mixed into brackish water.

The nearby land was marshy, muddy and saturated with water. The presence of brackish water led to contamination and disease and this may explain the name Burmarrad. In time canals were dug so that water quickly drained into the sea and the land was reclaimed for agriculture. Nevertheless, these areas still suffer serious floods after sudden and severe rainstorms which cause much damage to the fields.

Chadwick Lakes consist of a number of dams built in 1883 along Qlejgħa Valley after a report about the water supply situation in Malta was published by Engineer Osbert Chadwick. He

proposed that dams be built across Qlejgħa Valley so that the waters would not drain to sea quickly. The aims of this project were to provide the farmers of the area with a supply of water and to allow the waters ample time to percolate into the aquifer.

The artificial pools which form behind the dams and the cascading water offer an ideal habitat for many plants and creatures. For example in the past QlejghaValley was full with high deciduous trees which shed their leaves in Autumn. In the valleys and the watercourse one could find poplar, common ash, holm oak and willow trees growing. At Qlejgha Valley many of these trees have died. As one can see in the picture there are still a number of poplar trees. These are 30-metre high deciduous trees which shed their leaves in Autumn. The poplar trees look silvery when their leaves move since the latter are covered from the underside with white hairy material.

Another rare tree which grows by the side of the valley is the spiked centaury. This tree has long leaves with spikes and in summer it blossoms with purple flowers.

In Qlejgha Valley live many plants which thrive in wet environments and are strong enough to resist the water current. Many of them have long roots which anchor them well in the bed as do the reeds which grow up to four metres tall. In large tracts of the valley one can see large numbers of this plant which successfully compete with other plants by invading their habitats and plucking them out. Other plants are resistant to drought and can survive periods when the water is scarce or dries up altogether. Some of these include the water speedwell, the biżbula and buttercup. In such a rich environment one also finds many species of insects like the fly, wasp and beatle which congregate on the wet soil by the water in order to drink or to catch their prey.

Perhaps the most popular species at Qlejgha Valley is the frog, the only amphibian of the Maltese Islands. This is quite a stout frog which grows up to seven centimetres tall and varies in colour from grey to green, yellowish, brownish and sometimes red with black-spots. Frogs have become rare because of water pollution and because their habitat has been destroyed. This is why frogs and tadpoles have been protected by law and nowadays, no one can catch, kill, sell or export this Maltese frog species.

Due to lack of maintenance, the dams of Qlejgha Valley have been seriously damaged while some have been filled with sediment and other material that is carried by the waters. One result is that much less water is collecting behind the dams since there is much more sediment. This means that less water is available for irrigation and also less water is percolating into the aquifer. Another effect was that the impoundments were quickly becoming full after each heavy rainfall and when rain continued, the soil-laden water would continue its course down the valley, thus damaging the fields at Burmarrad before being lost at sea. Since the valley is accessible by car people sometimes dump their rubbish there. The introduction of alien and invasive species like the castor oil plant has also destroyed many habitats of indigenous plants. Since farmers use fertilisers for their fields, the water is now contaminated with nitrates and is no longer clear and pure as it used to be in the past.

In the picture below one can see a cage system that was put in place in 1997 to strengthen the sides of Qlejgha Valley. These gabions replaced the weaker rubble walls since they are strong enough to withstand the severe storms that occur year in year out. The gabions are cages made out of wire mesh and filled with stones. Like rubble walls they allow water to pass through but keep soil from being carried by the waters.

Floods

Floods cause natural disasters both in developed and in developing countries. Most floods occur and affect the floodplain and the banks. It seems that floods are increasing both in frequency and intensity.Many countries are taking measures to forestall floods or to lessen their negative impact.

Floods occur when watercourses overflow their banks and cover the nearby low lands. The surplus waters which cause floods may be the result of melting snow, heavy rainstorms or the onshore high winds like those of hurricanes which drive the waves on to the coast. Even earthquakes which occur in the seabed may stir the sea and create a large wave called tsunami that can bring destruction to the coast. When high winds blowing from the sea coincides with high tides, large waves are often formed which may flood the coastal lands too.

Human activities too may help bring about floods. Deforestation in mountainous regions is having disastrous effects. Rainwater is free to run its course without being infiltrated into the soil, thus increasing the risk of floods.

The cutting of natural vegetation to make way for the building of houses and roads is lessening

percolation into the ground and at the same time quickly channels large quantities of water into rivers. It is thought that climate change and the increase in torrential rainfall will cause heavier and more frequent floods in many countries.

Floods are very dangerous and every year they cause many deaths and leave thousands of people homeless. Moreover floods cause great damage to the environment, infrastucture and property of the places affected. Floods cover the land in contaminated water which causes health problems and sickness. Floods also destroy crops and damage the economy of the country involved.

However, floods may also have positive effects since they increase the water available for percolation into the aquifers as also the fertility of the soil since they provide the necessary nutrients which may have been lost to the soil. Rivers which flood annually are ideal sites for

Severe floods that occur regularly in many countries cause deaths and people to become homeless. Floods cause considerable economic losses – private homes, local infrastructure, transport networks, commercial enterprises, industry and agriculture all suffer greatly.

hydro-electric power stations where renewable energy is produced by means of water.

Over the years, many countries have taken concrete steps to avoid or lessen the impact of floods. They have afforested the mountain slopes so that the trees might absorb the excessive water and decrease soil loss. They shaped the slopes into terraced fields so that water may move downslope slowly and they also cleared the channels of rivers. High concrete and earthwork embankments have been constructed by the side of rivers. Reservoirs and dams have aslo been built in order to store the water in the

In the picture below one can see the River Thames Barrage which protects London from floods. This system includes locks which open and close to keep the sea from entering the River Thames estuaryand flooding London. A similar system has been constructed to defend Venice in Italy. However, these systems will not put the minds of Londoners and Venetians at rest if the sea-level continues to rise.

impoundments or lakes thus formed. The risk of flooding is also forestalled if river-channels are cleared of the mud which accumulates on their beds. However, sometimes these precautions are not enough and what remains to be done is only the placing of sand-filled sacks by the river-side for it not to overflow into the roads and houses.

Bangladesh is one of countries most prone to severe flooding. Lately the intensity of floods in this poor country has increased and is causing great problems and suffering for the people. In 1970, 450,000 people died and 34 million other lost their homes due to floods. In 1998 the rivers flooded again drowning 1,000 people and leaving 23 million homeless. Everytime floods occur, large part of the country is covered in water which kills a lot of animals and ruins the crops in the fields.

Bangladesh lies on the delta of three large rivers: the Ganges, Brahmaputra and Meghna. Most of the land is plain and not more than 2 metres above sea-level. Every year when the monsoon arrives the rivers overflow and half of the country is flooded.

With the help of foreign countries and international agencies, Bangladesh is planning to limit the damage caused by floods. The action plan which costs billions of Euros includes the dredging of the main rivers, the construction of large dams to control the level of water in the rivers and the building of high and strong embankments by the river-sides. Moreover many towns were re-located at a distance from the rivers so that they will not be damaged if the rivers flood. Rooms standing on high pylons were built along the banks of the rivers to provide shelter for people during floods.

Flash-floods in Malta

Although rain is scarce in the Maltese Islands, every year there are still many localities which end up flooded under rainwater. This occurs mostly after the hot summer months when there is sudden torrential rainfall, that is heavy rain which falls in a short period of time. This rainfall causes a lot of damage, as well as much inconvenience and many problems to the public.

In Malta storms which cause flash-floods occur mostly in September, October and November. This is caused by cool air currents which descend from northern Europe on to the still relatively warm sea around Malta. Whenever these rainstorms occur low-lying places such as Birkirkara, Msida, Marsa, Qormi and Burmarrad are negatively affected. Water coming from higher ground accumulates in these places. The water moves rapidly in the streets carrying whatever it finds in its path. It also enters and floods houses. During such floods cars are damaged, sewer manhole covers are pulled off, same as road tarmac and many high walls and other parapet walls fall. Damages may cost millions of Euros. Unfortunately floods caused by severe rainstorms sometimes cause people to drown. Some people get carried by the waters and drown; some others drown when they get caught in their

Each time floods occur they cost lots of money and sometimes loss of life too for the country. The September 2003 floods cost €30 million in damages to residents, business concerns, water and electricity infrastructure, as well as in the sewerage system.

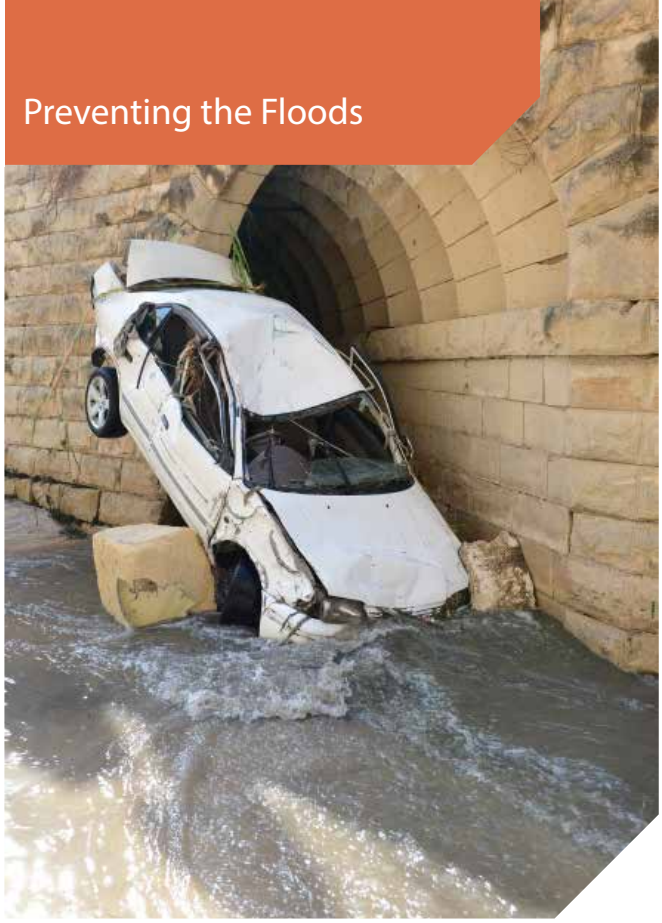
The crops in the fields are severely damaged because they are saturated with water and all the products are lost. Rainwater cause rubble walls to collapse and tonnes of soil are carried by the waters and are lost.

sinking cars; while others are buried under the falling roofs of their houses.

The problem of flooding has increased greatly in the past years due to the building of many new roads and houses. Because of this parts of Birkirkara and Msida end up under water. This is happening because towns such as Mosta, Naxxar, Attard, Lija, Balzan, and Iklin have all been built up and most of the rainwater which previuosly used to percolate into the fields, is now running in the streets on to Birkirkara and thence to Msida. The same happens where the valleys have been built over such as Valley Road between Birkirkara and Msida. Moreover buildings were allowed within the bed of valleys thus causing the same watercourses to be blocked.

Since many building do not have a well about 80% of rainwater which falls on the built-up areas ends up running in the streets or in the sewerage system. If each house had a well (as requested by law), large volumes of water would be stored and the problem of floods would be mitigated.

Preventing the Floods



One of the worst storms ever to hit Malta occurred on 25 October 1979. The Meteorological Office at Luqa reported that within 4 hours, between 3.00 and 7.00 pm, about 70 mm of rain fell.

The storm was caused by cool Atlantic currents and warm air coming from Libya that met over Malta. Four people died during this storm. A woman drowned in the basement of her house; at Qormi, another person who had abandoned his car got carried away by the waters and drowned; and two British tourist drowned in their car when they too got carried away by the waters. The torrential rain caused great damage to houses, roads and cars. The waters uprooted trees, carried animals with them, caused the collapse of high walls and parapet walls and also flooded many houses.

Over the years many projects were taken in hand to reduce the problem of flooding in Malta. Many open reservoirs were built to harness water which is later used by farmers. Watercourse channels have been widened to allow easier passage of water and the bridges over them were lengthened too. The banks and beds of some large watercourses have been concreted (see the picture at right.) to be able to channel a larger volume of water, while other canals were dug to reduce the risk of flooding in the same areas. From time to time, these channels are dredged in order to clear them from soil and materials which accumulate on the bed. In other places underground tunnels have been dug so that rainwater falls into them and is channelled directly to sea. These systems have been done in order to make it easier for water to drain into the sea rather than cause problems in the towns and villages.

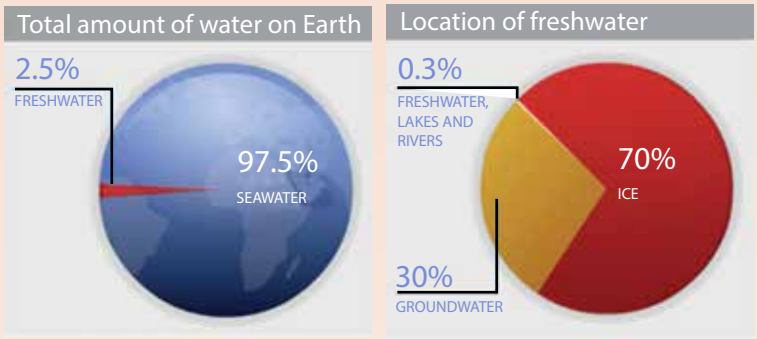
Perhaps it would be better if rainwater is harnessed before it reaches urban areas and not allow it to drain into the sea so that it may be used for different purposes. The law requiring all buildings to have a well may be enforced; more dams may be built in the valleys and the existing ones must be cleaned often. It is importanat that rubble walls be repaired in time, stop dumping rubbish in the valleys and regularly dredge the watercourses and the dams so that the impoundments will be capable of storing more water.

A 17-kilometre tunnel was dug under Attard, Balzan and Birkirkara in order to channel run-off rainwater. Rainwater which used to flood the streets is now finding its way into this tunnel and then to sea.

For the benefit of the public, a stormwater alarm system has been installed in some low-lying roads at Birkirkara for the prevention of damage or fatal accidents during rainstorms.

1

Look carefully at the pie-charts below which show the amount of water in our planet. Then write whether the information in the boxes is true or false.



In our planet we find more freshwater than seawater.

More than 97% of water circulating in our planet is found in the oceans.

30% of freshwater is stored in the pores of rocks.

More than half of freshwater lies in large rivers and lakes.

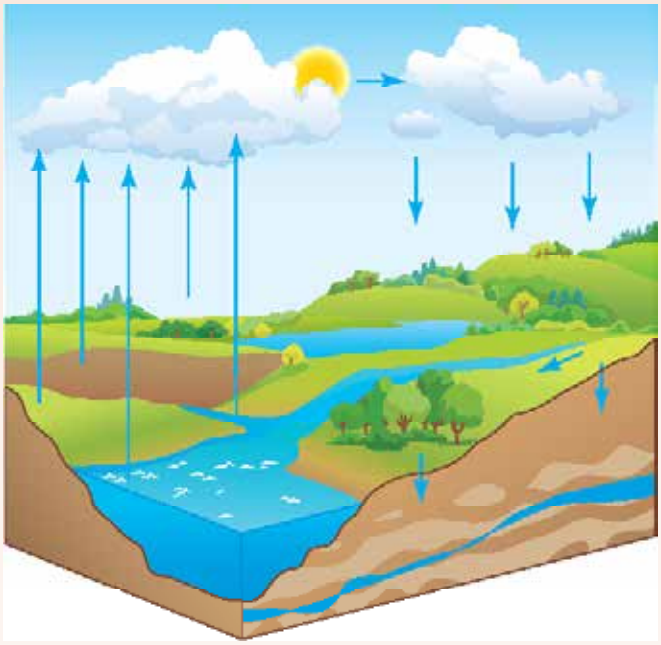
We only find ice on mountains and nowhere else in the world.

2.5% of water found in our world is good for drinking.

2

a. The diagram on the right shows the hydrological cycle. Complete the diagram by placing the words in the right places.

condensation | transpiration | clouds | evaporation | sea | water percolating into the rocks | river | running water | precipitation | lake | groundwater



b. Write the correct term.

i.	the process by which water in leaves turns to gas.	
ii.	the process by which water vapour in the air turns to small water droplets in clouds.	
iii.	the process by which water falls back to earth in the form of rain, snow and ice.	
iv.	water which outflows and moves over the land in rivers and springs.	
v.	the water that seeps into thr ground.	
vi.	the process by which water turns into gas.	

c. Use the graphs showing the Climate of Malta (p. 25) in order to explain the following:
   i. the reason why there is a scarcity of freshwater in the Maltese Islands.
   ii. Give some suggestions as to how this scarcity can be remedied.
   iii. Mention some ways how each one of us can save water.

3

a. Briefly explain the difference between porous, permeable and impermeable rocks.
b. For each of the following, give one example of rock in Malta:
   i. permeable; ii. porous; iii. impermeable.
c. Describe how rainwater can percolate into the rocks.
d. Briefly explain how the perched aquifer is formed over the blue clay layer.
e. Describe how over the years, farmers have successfully pumped up this water stored over the blue clay layer.

f. Draw a diagram to show clearly the position of the two aquifers found in the rocks of Malta.
   i. Label the layers of rock and write whether each is porous, permeable or impermeable.
   ii. On the diagram name the perched aquifer and the mean sea-level aquifer.
   iii. Draw also a borehole and a pumping station.

g. Fill in the blanks of the following sentences in order to show how water is stored in the lower coralline limestone.

Water which percolates from the globigerina finally meets the hard layer of _____. Seawater too succeeds in percolating from the _____ of this rock, and therefore here one finds both freshwater and _____.

Freshwater which originates from rainfall settles at the surface of seawater since the latter has a greater _____ . This mean sea-level aquifer is shaped like a _____. The deepest part lies near the centre of the island and it thins out towards the coast. The more it rains the _____ will the aquifer become, but the more water we extract, the thinner it will be.

h. Explain how water is extracted from underground galleries and distributed into houses.

i. Recent studies carried out in Malta show that more water is being pumped up from the aquifer than is being replaced. Much of this water is pumped up illegally.

   i. Why is all this water being pumped up from underground?
   ii. What may happen to the quantity and quality of water in the aquifers if over-extraction continues?

j. What do we mean by term reverse osmosis plant?

   i. Why did Malta have to adopt such systems?
   ii. Describe the advantages and disadvantages of the use of reverse osmosis plants in Malta.

k. Imagine that you have been charged by the Water Services Authority to write a leaflet about the dangers and risks that the Maltese may face if the water in the aquifer is polluted.

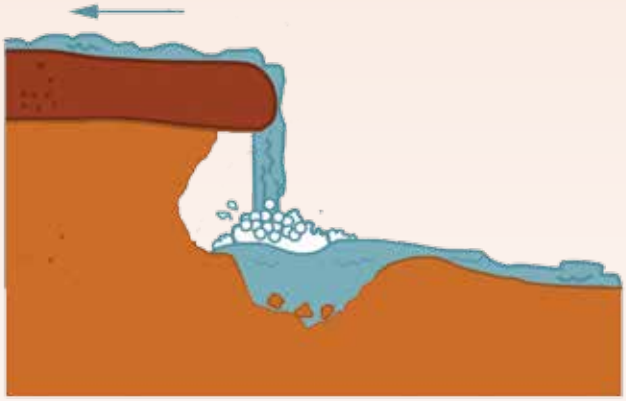
- Describe how aquifers are formed in the rocks.
- Mention sources of pollution and over-extraction.
- Explain what can be done to save the water stored in the rocks.
- What can be done in order to lessen extraction of water?

Use pictures and drawings to make the leaflet more attractive.

4

Draw a larger copy of the diagram on the right.
a. Mark the waterfall with the following words:

hard rock | plunge pool | hard rock lip | soft rock | erosion at the foot | waterfall retreats



b. Write these phrases in the correct order to show how waterfalls are eroded by the waters of a river.

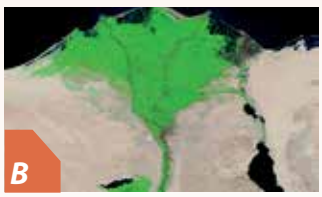
Soft rock is easily eroded | Hard rock is eroded from beneath | The hard rock lip collapses | The plunge pool continues to erode | The waterfall retreats

c. On a map of the world mark the following famous waterfalls: Victoria, Niagara, Iguazu, Angel and Rhine. Find some information about one of these waterfalls and briefly write about it.

5

a. Look carefully at picture A.
   i. What are you seeing in picture A?
   ii. In which part of the river do we find these bends? Why?
   iii. Why are the plains on each side of the river used for agriculture?
   iv. What is the soil found near these river bends called?
   v. Explain how this soil formed and how it settled on each side of the river.

b. Look carefully at picture B.
   i. What is the physical characteristic or landform shown in B called?
   ii. Where do we find this physical landform, near the source or near the mouth of a river?

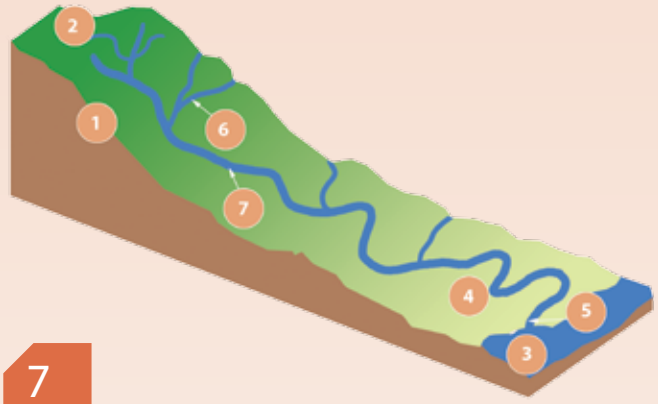


   iii. Draw a well-labelled diagram of the physical landform shown in B.
   iv. Under the same diagram show how this physical characteristic formed and give two examples.
   v. Why do you think many people are attracted to such places? What danger do people who live here face?

6

Look carefully at the diagram below.

a. Write what is found in each numbered place.



Choose from:

river channel

tributary river

meander

hills

river source

sea

river mouth

b. Use the words above to fill in the table below:

i.	A small stream which drains into the river channel	
ii.	Where the river bends	
iii.	Where the springs begin	
iv.	The main course of the river	
v.	Where the river flows into the sea	

7

a. Mention some natural causes of flooding by rivers.

b. Explain how the activity shown in the diagram on the right may cause flooding.

c. Discuss how the construction of more buildings and roads may lead to flooding.

d. Look at the pictures in pages 104 and 107 which show places covered under water due to floods in different parts of the world. Mention what were the damages suffered by the people because of the waters.

e. Use websites to find out more about two large projects, one in Italy called MOSÈ and another in England called the Thames Barrier.

i. Why were these two systems built?
ii. Which cities are they protecting?
iii. Explain how each system works.
iv. Why cannot countries like Bangladesh do such systems?

f. A number of countries have taken steps to lessen the impacts of floods.
Explain how each method can diminish damages caused by floods.

Method	How it can prevent flooding
dams	
afforestation	
high embankments by the side of the river	
large reservoir	
dredging the river-bed	

8

Deluge in Malta

23 October

Today the Maltese Islands were again hit by a rainstorm which caused serious damage. As usually happens in similar cases, the places which are most negatively affected are Msida and other low-lying places such as Birkirkara and Qormi. Buildings, cars and roads were damaged by continuous heavy rain which fell for many hours. A Meteorological Office spokesman said that such storms are normal for the months of September, October and November. The reason is that the surrounding sea is still relatively warm when compared to the cool air which descends from higher latitudes on to the Mediterranean. Rain was so heavy that after just a few minutes the water in the streets was so high that many cars, belonging to people on their way to work, broke down. Because of this many factories, offices and other places of work opened late. At Burmarrad the waters not only covered the crops and carried away many products, but also killed many animals and fowl which were carried away along the watercourse. In low areas such as at Birkirkara and Qormi, the water entered the houses and many residents were seen bailing it out. Once again in these places sewer man-holes were pushed open and the contaminated water entered the houses in some cases. Many traffic accidents were reported. At Valley Road, Birkirkara, many cars were carried by the waters. Fortunately this time no one was injured in these accidents. Many rubble walls collapsed too.

Read carefully the newspaper report.

a. Explain how the floods which occurred that day affected the people and the economy of the country.

b. Why was the rain so heavy?

c. In the table below write down the natural and man-made causes of such frequent and severe flooding in areas like Birkirkara.

Flash-floods in Malta	
Natural reasons	Man-made reasons

d. Mention some flood relief projects undertaken in Malta throughout the years.

A

afforestation
afforestazzjoni
The planting of trees in a particular place in order to form a wood or forest.

agriculture
agrikultura
The raising of crops in the fields and animal husbandry in the farms.

alfalfa
alfalfa
A crop raised for fodder.

algae
algi
Water plants, mostly microscopic. They are very common at sea, in water and in humid places.

alien species
speċi aljena
A creature which is introduced from a foreign country and which can harm the present ecological balance. Two alien species that were introduced in Malta were the chameleon and the prickly pear cactus.

alluvial soil
ħamrija alluvjali
Fine and fertile soil derived from silt deposited by rivers.

amphibian
amfibju
A creature which can live both on land and in the water, such as the frog.

animal fodder
ġwież
Animal food.

animal manure
demel naturali
Dry natural waste which fertilises the soil.

aquaculture
akkwakultura
The raising of fish, such as seabream or seabass, in large tanks or pens either on land or off the coast.

aqueduct
akkwadott
A channel which may be laid underground or built on arches that carries water from one place to another. In Malta the aqueduct built by Grand Master Alof de Wignacourt brought water from Rabat to Valletta.

arable farmer
bidwi
Who works in the fields.

artificial fertiliser
fertilizzant artifiċjali
Chemical that is spread and mixed into the field by the farmer so that the soil becomes more fertile and produces better and more abundant crops. Fertilisers are important to render back the vitamins and nutrients to the soil.

atmosphere
atmosfera
The layer of gases which covers the earth, made of a mixture of nitrogen, oxygen, carbon dioxide, water vapour and other gases.

B

bacteria
batterju
A microscopic organism, present in various environments, which breaks up and decomposes organic matter.

bay
bajja
An inlet on the coast.

biotechnology
bijoteknoloġija
The processes by which seeds, crops and animals are modified. In this way seeds which can grow quickly and sturdier animals have been developed.

bird trapper's nest
mansab
The place where bird trappers put up their nets to catch birds.

blowhole
minfes
A hole in the ceiling of a sea-cave from which the seawater juts out during storms.

blue clay
tafal
Light grey rock which darkens when wetted. It easily crumbles and falls over the underlaying layers. It is the only impermeable rock found in the Maltese Islands and therefore many natural springs rise where it outcrops on the slopes.

borehole
spiera
A deep hole dug in the rocks in order to pump up water to the surface.

boulder scree
tirxa
A large rock which collapsed from the cliff face on to the sea or coast.

brakish water
ilma salmastru
Slighty salty water, not quite as seawater.

breach (in rubble wall)
selħa
Collapsed part of rubble wall which must be readily repaired to avoid soil loss.

C

calcareous
kalkarju
Rock having a high percentage of lime or calcium carbonate.

cape / headland
ras ta' art
A promotory or narrow land jutting out at sea such as Ras il-Qarraba or Ras id-Dawwara.

carbonate raw soil
tal-bajjad
A whitish soil that was derived from blue clay, which includes a lot of calcium carbonate.

cargo
merkanzija
Loads of products for transport or sale.

carnivore
karnivoru
Flesh-eating animal.

cave
għar
A natural cavity in the land such as can be found at Għar Ħasan or Għar Lapsi by the sea.

cereal
ċereali
Edible seeds like wheat, barley, maize and rice.

chlorine
klorin
A substance which is added to water to render it bacteriologically pure.

cistern
ġiebja
A wide and deep store for irrigation water.

citrus
ċitru
Acidic fruit like lemons and mandarins. The citrus trees are evergreen with glossy dark green leaves that are aromatic when crushed in the hand. The citrus blossom in March and April.

cliff
sies/rdum
High perpendicular rock rising from the sea.

compost
kompost/terriċċju
Decomposed organic matter like dead leaves, crops and plants that are added to soil to increase nutrients.

condensation
kondensazzjoni
When water changes its state from water vapour gas to liquid droplets in clouds.

conservation
konservazzjoni
The protection and care of various environments.

consumer
konsumatur
The client who buys products or services.

continental shelf
blata kontinentali
The seabed of less than 200 metres deep, next to the coast. On it, a large number of creatures live since the rays of the sun penetrate to the bed and photosynthesis can take place.

crop rotation
newba
Arable farming by which different crops are cultivated every season in the same field.

crops
għelejjel
The edible plants which the farmer grows in the fields.

crustacean
krustaċju
Sea creatures like prawns and crabs. Some others live in freshwater, brackish water or even in humid places (like the slug).

D

dam
diga
A high wall which contains the waters of a river. A dam is built to generate hydro-electric power, store water and control floods.

deciduous tree
siġra ħofrija
Tree or bush which sheds its leaves in autumn.

deforestation
deforestazzjoni
The cutting of trees so that the land may be used for cultivation.

delta
delta
A triangular region at the river mouth made up of silt carried down by the river.

desalination
desalinazzjoni
A process by which sea water is turned into potable water.

dew
nida
Small water droplets which appear on cold surfaces in the morning when water-vapour turns into liquid. Dew is beneficial for crops.

drip irrigation
tisqija bil-qatra
A way of watering the crops by means of pipes punctured near to the roots of the plants so that the water drips slowly one drop at a time.

E

earthquake
terremot
A sudden movement of the earth which may cause widespread damage.

ecosystem
ekosistema
A system formed by the interaction of a community of organisms with their environment.

endemic
endemiku
A species which is only found in a particular place and nowhere else in the world. For example the fresh-water crab is endemic for Malta since it is only found there.

environment
ambjent
All the forces such as air, water, minerals and organisms surrounding and affecting a given organism at any time.

erosion
erożjoni
Natural process by which rocks are broken down to smaller pieces and carried away by waves, wind, rivers and ice. The rocks that are eroded are transported by wind or water are deposited in other places.

estuary
estwarju
A wide inlet where a river drains into the sea.

eutrophication
ewtrofikazzjoni
The process by which algae proliferate in polluted waters, decompose and absorb all the oxygen. This happens mostly when chemical substances like nitrates are used in farming.

evaporation
evaporazzjoni
When liquids such as water turns into vapour.

exportation
esportazzjoni
When products or merchandise are sold in a foreign country.

extensive farming
biedja estensiva
Farming that is carried out on very large fields.

extinct
estint
A creature that does not exist any more either in the world or in a particular place.

F

farmstead
razzett
A large country house where the farmer and his family used to live on the first storey while the animals lived on the ground floor sties and barns.

fauna
fawna
All animal species.

fish market
pixkerija
The market where the fisherman sells his fish, usually by auction.

fishing float
ċima
A float made up of blocks of jablow and palm leaves anchored to the seabed by means of stones. They are mostly used by Maltese fishermen to catch dolphin fish and pilot fish which take cover under them while on their migration.

fishing gear
rkaptu
All the implements used by the fishermen such as nets, long-lines, traps, cork pieces and flags.

fishing pot
nassa
A fishing gear made of cane or metal wire mostly used to catch bogue and pilot-fish. Their shape is like that of a pear and they are dropped into the sea with bait inside them. Fish enter the pot for the bait but are unable to find their way back. There are other larger pots that are lowered without bait on to the seabed to catch picarel. Other special pots are used to catch octopus.

fishing vessel
skuna tas-sajd
A ship which includes cabins where fishermen may rest that is fully geared for long haul fishing.

flash floods
għargħar tal-ilma qerried
Occur after a great storm when heavy rain falls. Many places, more especially urban areas, are covered by water.

floodplain
pjanura tal-għargħar
Flat land on each side of a river, mostly composed of alluvial soil.

floods
għaragħar
Occur when the land is covered in water mostly due to rivers overflowing their banks. Floods may also occur by means of high waves caused by high winds or an earthquake.

flora
flora
All species of the plant kingdom.

foliage
faxxina
Branches and leaves of plants and trees.

food chain
katina tal-ikel
The sequence by which the nutrients and matter in food is transfered from one organism to another by way of feeding.

fossil fuel
fjuwil fossilu
Energy source like oil, coal and natural gas. Fossil fuels are derived from creatures that lived millions of years ago. They are mostly used in power stations.

fungus
fungu
Plants which do not bloom, like mushrooms and mould. Some fungus are decomposers of organic matter while others take their nourishment form other plants and animals.

furrow
radda
A shallow trough dug by the plough in fields.

G

gabion wall
gabbjun
A wall constructed with of a number of boxes made of wire mesh filled with stones. Such walls were built at Wied il-Qlejgħa and Fiddien to replace rubble walls since they withstand storms better. They allow water to pass through them.

gallery
passaġġ taħt l-art
A mine dug horizontally at sea-level in the lower coralline limestone as can be found at Ta' Knadja. The water which filters through the ceiling of this gallery is channelled by gravity to a central reservoir and pumped up to the surface.

garigue / scrubland
xagħri
In Malta refers to an ecosystem consisting of low scrub vegetation growing on areas of potholed hard coralline limestone.

globigerina limestone
globiġerina
A common layer of rock outcropping in the east of Malta and the west of Gozo. This rock is subdivided into three members called lower, middle and upper globigerina limestone. The lower globigerina is used for producing building stone in Malta. This is porous rock and its colour varies from white to grey according to the minerals and chemicals it may contain.

gorge
ħondoq
A narrow and deep valley with steep sides.

grazing / pasture
ragħa
Taking the animals to the open country where they can eat fresh grass.

greenhouse
serra
A structure in the fields, made of plastic or other material which allows the sun's rays to penetrate so that crops may be grown all the year round under controlled conditions.

greensand
rina
Orange-coloured thin layer of rock, also called ramli or ġebla safra in Maltese. Large blocks of greensand frequently slide down slopes since it is soft and easily weathered.

groundwater
ilma tal-pjan
Water stored underground in the pores of rocks.

H

headland
lsien ta' art
A long piece of land jutting out into sea such as Ras il-Fenek or Qawra Point

heavy metal
metall tqil
Metals such as chrome, zinc, copper and mercury which may be harmful to the environment and people's health.

herbivore
erbivoru
An animal that eats only plants.

humus
humus
Organic matter made up of dried leaves parts and other dead creatures which make the soil fertile.

hurricane
uragan
A tropical storm of the Americas characterised by very strong winds.

hydroelectricity
enerġija idroelettrika
A clean energy generated by the force of water. These are mostly found in countries where rivers fall quickly on steep slopes.

hydroponics
biedja idroponika
A modern system of cultivation where the crops are grown in large panels with much water and nutrients rather than soil.

hydrosphere
idrosfera
All the water stored in the oceans, lakes, rivers, ice-caps, rocks and soils.

I

ice age
żmien is-silġ
A cold period of time when the ice caps at the poles and the mountains spread out to large areas.

impermeable
impermeabbli
Rock which does not allow water to pass through.

indigenous
indiġenu
Plant and animal species which have lived in a particular place for a long time.

infiltration
infiltrazzjoni
The passage of water inside soil.

inlet
qala
A small bay.

insecticide
insettiċida
Chemical poison, in liquid or particle form, which is used to kill insects and worms that are harmful to crops.

intensive farming
biedja intensiva
Farming that is normally carried out in small areas and which involves huge investment of human resources, technology and work.

irrigated fields
raba' saqwi
Fields that are provided with water all year round.

irrigation
tisqija / irrigazzjoni
Watering the fields.

K

kajjikk
A fishing boat having a pointed bow and a flat stern. Since it is rarely longer than six meters, it is only used for fishing near to the coast.

L

lake
għadira
A large expanse of freshwater.

lampara
A fishing method by which a large lamp's light is used to attract fish which is then easily caught.

landfill
miżbla
A place where all kind of unseparated waste is thrown away.

legumes
legumi
Crops such as beans, chick-peas and peas.

lichens
likeni
Small plants which grow in leaflike or crustlike form mostly on rocks or trees.

longline fishing
konz
A fishing gear made up of long lines with hooks used to catch large fish such as tuna and swordfish.

lower coralline limestone
qawwi ta' taħt / żonqor
The lowermost layer of hard rock found in the Maltese Islands. It forms high cliffs rising from the sea as well as garrigue areas with potholes and pointed rock.

lower globigerina limestone
ġebla tal-franka
The lowermost layer of globigerina limestone rock which is mostly used as building stone in Malta.

luzzu
A wide and sturdy fishing boat with pointed bow and stern.

M

mammal
mammiferu
A fur or hair covered creature. The female gives live birth and suckles the young. Some examples include dolphins, bats, hedgehogs and weasels.

manufacture
manifattura
The processes of production carried out in factories and workshops.

mean sea level aquifer
ħażna tal-ilma tal-pjan
Rainwater which collects inside the pores and fissures of the globigerina limestone rock and the lower coralline limestone layer.

metereological station
uffiċċju meteoroloġiku
A place where experts try to predict the weather by means of special instruments.

microscopic organism
organiżmu mikroskopiku
A minute creature that can be only seen through a microscope.

moist lower soil horizon
tira
The humid layer below the dry soil at the surface.

mollusc
mollusk
A soft and boneless animal such as the snail, calamari, octopus and seahell. It may have a protective shell.

monsoon
monsun
A South or south-westerly summer wind which brings torrential rain to South and south-east Asia.

N

natural hazard
diżastru naturali
A disaster resulting from natural processes such as floods, hurricanes and earthquakes.

neptune grass
alka
A sea plant which blossoms in spring and bears fruit in autumn. Its scientific name is 'posidonia oceanica'. Its leaves are long, looking like ribbons. It has rhizomes that anchor it to the sand. It forms large meadows on the seabed where many fish and other creatures take shelter and reproduce.

nitrate
nitrat
A chemical substance based on nitrogen which is found in natural manure and in artificial fertiliser.

non-irrigated lands
raba' bagħli
Fields that are only watered by rainfall and therefore are dry in summer.

O

ocean
oċean
A large expanse of sea such as the Atlantic Ocean between Europe and North America.

organic farming
biedja organika
Farming by which products are raised, grown and processed without the use of artificial fertilisers and pesticides, thus not harming the environment.

P

pastoral farmer
raħħal
A person who raises animals such as cows, pigs, sheep, goats, rabbits and fowl.

pasture land
mergħa
A grassland area where animals graze.

perched aquifer
ħażna naturali tal-ilma ta' fuq it-tafal
Rainwater which collects inside the pores and fissures of the upper coralline limestone rock and the greensand layer.

permeable
permeabbli
Rock which allows water to pass through it.

pesticide
bexx / pestiċida
Liquid or powdery poison which kills insects, worms and other creatures which damage crops from time to time.

petrochemical plant
impjant petrokimku
A large factory which produces chemical substances and products made out of oil.

photosynthesis
fotosintesi
The process by which green plants change carbon dioxide and water into carbohydrates by means of chlorophyll and energy from the sun.

pig sty / cattle pen
maqjel
The place where animals are raised on a farm.

plankton
plankton
Microscopic sea-organisms which are eaten by fish.

pod
ħaxix tal- miżwed
Crops producing edible seeds which grow inside a pod or husk such as beans and peas.

precipitation
preċipitazzjoni
Part of the water cycle when water falls back to land or sea in the form of rain, ice or snow.

predator
predatur
A creature which preys on other creatures.

pumping station
impjant għall-ippumpjar tal-ilma
The place whence groundwater is brought up to be distributed to consumers.

purse seine
tartarun
A large funnel-shaped fishing net whose sides and bottom may close, catching fish inside.

Q

quarry
barriera
A place where rock is cut and shaped into spalls or stones for the building industry.

R

reeds wind breaker
qannić
A wall made of reeds put up by the sides of a field to provide shelter from high winds.

reef
sikka
A rock placed just under the surface of the sea. It is dangerous for ships.

renewable energy
enerġija tiġġedded
Energy generated by sources that flow naturally like hydroelectricity, geothermal, wave, tide, wind and solar energy. These energy sources are clean and they do not harm the environment.

reptile
rettili
Cold-blooded thick-skinned vertebrates which lay eggs, such as lizards, gechos and snakes.

reservoir
ġibjun
A covered storage place for water which is much larger than a cistern.

reverse osmosis
reverse osmosis
A desalination plant by which seawater is filtered and turned into potable water.

river basin
ħoġor ix-xmara
The area through which the main river and all its tributaries pass and drain on their way to sea.

river bed
sodda tal-wied
The bottom of the channel where the river flows.

river mouth
fomm ix-xmara
The place where the river meets the sea.

river tributary
xmara tributarja
A small side river which joins and drains its waters into a the channel of a larger main river.

rubble wall
ħajt tas-sejjieħ
A low wall that separates fields made up of undressed stones and constructed without the use of mortar.

running surface water
ilma ġieri
Water that springs out of the rocks.

rural area
post rurali
Any place found in the countryside.

S

sea arch
ħnejja / tieqa
A sea-cave which erodes right through a promontory such as the Blue Grotto or Wied il-Mielaħ arch.

seafood
frott il-baħar
Sea-creatures like the urchins, oysters, crabs and prawns.

sediment
naqal
All types of material carried by rivers such as soil, dust, tree trunks, reeds and stones.

sewage treatment plant
impjant għat-tisfija tad-drenaġġ
The place where sewage is cleaned and filtered before being either thrown to sea or recycled.

sheer cliff
rdum
High perpendicular rock rising from the sea such as ta' Ċenċ or Dingli Cliffs.

shoal of fish
ġliba
A large number of fish moving in water together.

shore / coast
xatt / xtajta
The land next to the sea.

slaughterhouse /abattoir
biċċerija
A place where animals are killed for the production of meat.

soil
ħamrija
Material made up of stone fragments mixed with organic remains derived from leaves and worms, which is needed for the cultivation of crops.

soil erosion
erożjoni / tgħawwir tal-ħamrija
The process by which soil is lost due to natural elements such as strong wind or heavy rain as well as through bad agricultural practices such as overgrazing and deforestation.

soil profile
profil tal-ħamrija
The different layers of the soil from the surface to the bedrock.

soil sediment
ħamla
The silt which the watercourse carries or which is deposited by floods.

species
speċi
A group of organism having similar characteristics.

spring / watercourse
nixxiegħa
An outflow of water from the earth and a run of water over the surface forming a stream.

sprinkler
ferfiera
A modern watering sytem by which water comes out of erected pipes under pressure and is spread around equally in the field.

stack
taqtigħa
A pillar of rock lying just off the coast. It is the remnant of an arch whose ceiling has collapsed.

stone fruit trees
frott irqiq
Seed or bone-bearing fruit like pears, apples, almonds, peaches and plums.

subsidy
sussidju
A financial grant to anyone who wishes to expand or modernise his business.

sushi
sushi
Japanese food made up of rice and raw fish.

sustainability
sostenibbiltà
Not being harmful to the environment or depleting natural resources, and thereby supporting long-term ecological balance.

T

temperature
temperatura
The scale by which heat is measured.

terra rossa soil
tal-ħamri
Reddish coloured soil found mostly where the coralline limestone outcrops. Its colour is derived from the large amount of iron-oxides it contains.

terraced fields
għelieqi mtarrġa
Rubble walled fields shaped on the slopes of hills, each one at a higher level than the other. The walls keep the soil in place while allowing the water to flow down the slope.

tides
frugħ il-baħar
The ebb and flow of the sea under the effect of the gravity of the moon and the sun.

toxic chemical
kimika tossika
A poisonous substance that can harm the environment.

trammel net
parit
A three-layered fishing net, the middle layer of which is small-meshed, the others wide-meshed, so that fish attempting to pass through the net will become entangled in one of the meshes.

transhipment
trażbord
Moving goods from one ship to another.

transpiration
traspirazzjoni
The process by which plants lose water by their leaves.

trawler
bastiment tat-tkarkir
A fishing vessel geared with modern equipment for weeks-long voyages. It has cold stores for keeping fish frozen and may also have machinery which processes the fish. It uses large funnel-shaped nets which are dragged along the seabed to catch octopus, rock-fish, prawns and other fish.

trawling
tkarkir
A fishing method by which a large funnel-shaped net is dragged on the seabed from the stern of the vessel.

tropical rainforest
foresta tropikali
The richest ecosystem, found astride the Equator having a warm and humid climate. It hosts two-thirds of all known species in the world.

tsunami
tsunami
Large waves whose origin is an earthquake way out at sea.

tunny net / tunny fishing ground
tunnara
A way of cathcing tuna fish by being led into a labyrinth like net. While migrating the tuna would go into the net and thus be trapped. The fishermen would then lift up the tuna one by one with the aid of large hooks.

U

upper coralline limestone
qawwi ta' fuq
Hard rock outcrop found in the Maltese Islands which is used by the construction industry to provide spalls and aggregate. It forms high cliffs and scarps, as well as garrigue areas with potholes and pointed rock.

urban area
post urban
A city where many people live.

V

valley
wied
A low lying land from where water passes on its ay to sea.

vegetation
veġetazzjoni
Wild plants and trees that grow in the countryside, as well as the crops grown by the farmer.

veterinarian
veterinarju
Animals' doctor.

W

waste
skart
Discarded materials since considered useless.

water channel
sieqja
A channel dug out of stones through which irrigation water flowed. Any large system of such channels is called saqqajja.

water mill
sienja
An irrigation system where water was brought up from underground by means of a blindfolded donkey or mule.

water / hydrological cycle
ċiklu idroloġiku
The continuous process by which water found on land and at sea is evaporated by the sun, becoming gas, then condensing to form water vapour, clouds and finally rainfall.

waterfall
ċarċara
The waters of a river as they fall from the height of a scarp on to a lower level.

wave-cut platform
blataforma
A rocky plain emerging just a few centimetres from sea level.

wind pump
raddiena tar-riħ
A large screw postioned on a steel tower which pumps up water from underground when it is turned by the wind.

woodland
masġar
An area covered with trees such as Miżieb or Buskett.


Il-Gżejjer Maltin
Il-Baħar Mediterran
TORĊIQ
BINI
GHOLITAL-MIT
(METRI
0 - 25
25 - 50
50 - 100
100 - 150
150 - 200+


Għawdex
Malta