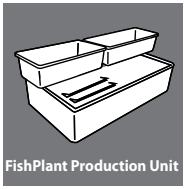
FishPlant™

Living food ecosystems

FishPlant System User Guide



www.fishplant.co.uk

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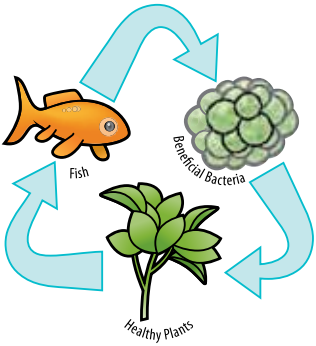
Family Unit

Production Unit

Introduction

AQUACULTURE + HYDRO**PONICS** = **AQUAPONICS**



Your **FishPlant** system is an aquaponic system, combining aquaculture and hydroponics. You are going to raise fish and grow plants in an enclosed ecosystem, with beneficial microbes providing the bridge that converts the fish waste to usable plant nutrients. When we feed the fish, we are also feeding the bacteria and the plants. In relation to a natural ecosystem, the **FishPlant** is small and simple, so we must help to maintain the correct balance.

Fish provide waste – Bacteria convert waste to nutrients – Plants clean water.

Sourcing Your Fish

The first decision you have to make is what fish to raise. This depends on whether you intend to eat them or just keep them for pleasure. While the principle of aquaponics is primarily to grow food, it may be that you prefer to raise ornamental fish such as koi carp or goldfish and just eat the plant produce. If this is the case you are likely to use lower fish densities (hence feed less) and therefore the amount of plants it is possible to grow will be reduced.

If you are planning to eat your fish, there are a number of species to choose from such as carp (common or mirror) and perch to name just a couple, but the one we strongly recommend, certainly if you are new to fish-keeping and/or aquaponics is **Nile tilapia (Oreochromis niloticus)**. It is a tasty fish, that is hardy and tolerant, which can be kept at a high density and is resistant to disease. With the right conditions they can easily be grown to harvest size in six months.

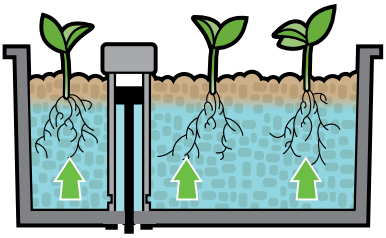
Fish should always be sourced from a reliable and reputable supplier, if in doubt, ask to see any paper work relating to where the fish stock came from. Generally speaking, fish that have been bought for ornamental purposes should not be eaten as they may have been treated with harmful additives. When buying fish that are held in a tank, avoid those that are being kept with sick fish or those that look stressed. When transporting your fish back to your fish plant system, try to keep stress to an absolute minimum.

If you want to raise edible varieties of fish you will require CEFAS registration (free to register) as an aquatic holding. Please go to www.defra.gov.uk/aahm for information and RW2 registration form or www.fishplant.co.uk for more details.

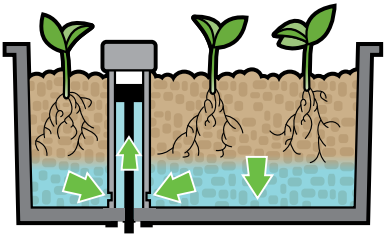
How Your System Works

The **PlantBed** of your **FishPlant** system is based on the 'Flood & Drain' (or 'Ebb & Flow') hydroponic technique – the 'flood' bringing water and nutrients to the plants roots, the 'drain' drawing fresh air (oxygen) into the root-zone.

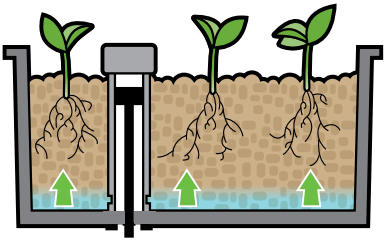
The water pump runs constantly and the **AutoSiphon** controls the flooding and draining. The **AutoSiphon** cycle starts when the water level in the **PlantBed** passes the overflow point of the downspout and starts to siphon back into the **FishTank** – this also helps oxygenate the water for the fish. The siphon will flow faster than the inlet flow rate and will drain the **PlantBed** until the water level reaches the siphon break point. Then it will start flooding again (see diagrams below).



1. The water in the **PlantBed** rises until it reaches the overflow.



2. The water is then siphoned back into the **FishTank** until the **PlantBed** is empty and air gets into the Siphon.



3. The **PlantBed** fills up with water again and repeats the cycle.

Do I Need Extra Water Circulation?

The **Flow Fitting** also directs some of the pumped water directly back into your **FishTank** which ensures constant circulation and helps oxygenate the water for the fish. If you add beds or nursery tanks to your system at a later date, a second circulation pump may be required then.

Do I Need Extra Aeration?

High oxygen levels in the water are important for healthy fish so you may wish to consider a **FishPlant Air-pump** and **FishPlant Air-stone** for your system. ***We strongly recommend this for heated systems as warm water naturally holds less oxygen.***

Do I Need A Heater?

This depends on the fish species you plan to keep and the environment your system is in, ***for tilapia you will certainly need one*** (tilapia require water temperature of 24-32°C), such as the FishPlant 300w Heater. **www.fishplant.co.uk** has tables which show ideal temperature ranges for a number of fish species.

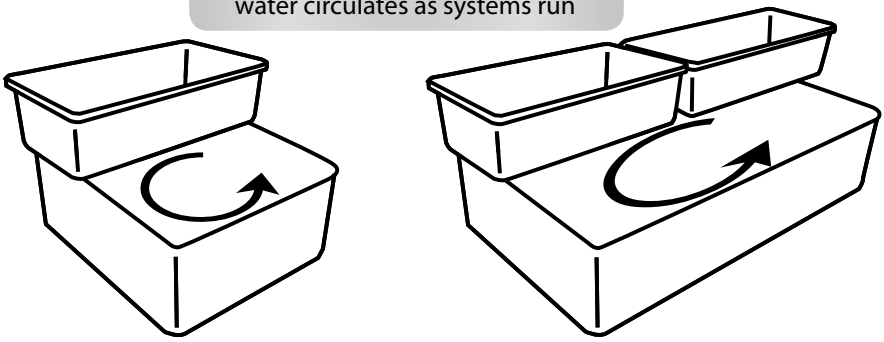
Starting The System

Fill your **FishTank** with water to 10cm from the rim:

Family Unit - approximately 300 litres.
Production Unit - approximately 800 litres.

With all valves on your **flow-fitting** fully open (in line with the pipe) switch the pump on. Water will start pouring into your **PlantBed** through the Inlet and the **SplashGuard** and you should also notice circulation of water in the **FishTank**.

water circulates as systems run



The **PlantBed** will fill and water will start flowing back into the **FishTank** through the **AutoSiphon**. Monitor it closely and if it does not start siphoning (*the difference between overflow and siphon should be obvious*) within a couple of minutes, close the return valve a fraction – keep adjusting until you have it right. **You should always have some water flowing directly back to the FishTank through the return valve.**

Once you are satisfied the system is cycling properly it is advisable to check the pH of the water. Proceed to add the de-chlorinating solution from your **FishPlant Starter kit** and leave to run for 24 hours. Follow the instructions with the **FishPlant Starter kit** to successfully colonise your system with the necessary bacteria – a pH above 7.0 (optimum 7.8) will help with this process, if it is above 8.0 it should be adjusted down slightly (use **FishPlant pH Down** for best results). Add the **Live Filter Bacteria** directly into the foam filter of the **SplashGuard**.

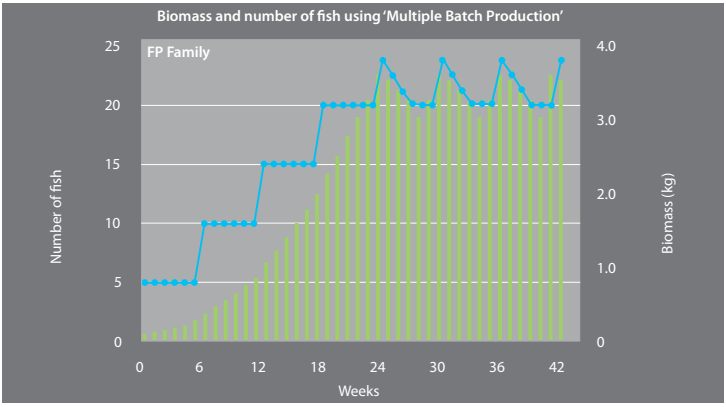
You should allow a week for this process. Keep an eye on the **AutoSiphon** to ensure it is cycling properly. If any remaining dust from the pebbles settles out in the tank, stir it up and it will get trapped in the **PlantBed**. It is advisable to check the pH again now. When you are happy the bacteria are colonising the system you are ready to begin stocking and planting your **FishPlant** system.

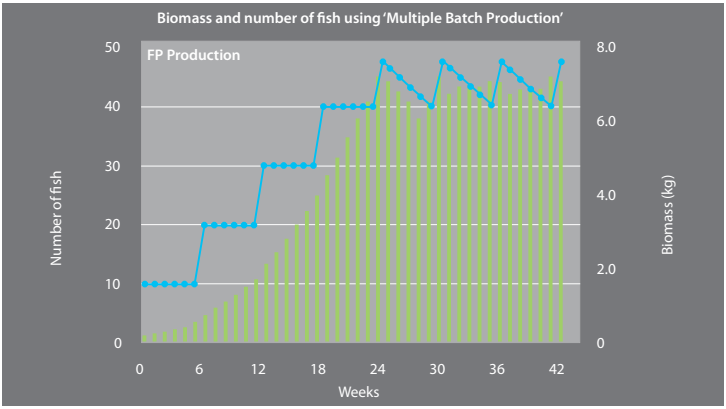
Stocking Your FishTank

Your **FishPlant** system should be stocked gradually, allowing the system to develop in harmony with the fish biomass. A target biomass should be about 1kg per 100 litres of water. So for the **Family Unit** about 3kg of fish with a maximum of 3.5kg, the Production Unit you should be able to stock up to 8kg of fish, however, with the standard two **PlantBeds** we would recommend a target biomass of 6kg going up to a maximum of 7kg.

You should put in a small number of fish at regular intervals, so that by the time the first fish are at a size fit to eat, you are at or about your maximum biomass: So, for example, with tilapia you could stock: **Family Unit** 5 fish every 6 weeks, **Production Unit** 5 fish every 3 weeks or 10 fish every 6 weeks. With an average start weight of 20g and a minimum harvest weight of 350g. By six months under good conditions, the biomass based on average weights of the fish, might have reached: **Family Unit** 3.5kg and 20 fish; **Production Unit** 7kg and 40 fish.

As with all living things some would grow faster than others so you may be able to harvest the first fish at about 5 months. From this point on you should be able to harvest 5 fish from the **Family Unit** or 10 fish from the **Production Unit**, every six weeks, so the biomass will fluctuate between 3 to 3.5kg in the **Family Unit** and 6 to 7kg in the **Production Unit**. With some slower growing cold-water species, you may have to plan the stocking programme over 12 months.





When stocking fish it is extremely important that the temperature of the culture water is similar to that in which the fish arrive. A temperature difference of greater than 2 degrees in 1 hour, will shock the fish, potentially fatally. Place the bags containing your new fish inside the fish tank to allow the water temperature to adjust gradually before opening the bags, gradually mixing the water and then finally releasing your fish into the tank. During their first 48 hours in the tank, closely monitor the fish and avoid causing any unnecessary stress. To start with, avoid feeding the fish, however after a few hours introduce a few pellets and observe their feeding behaviour. For the next 48 hours, continue to feed the fish sparingly, and only if they are eating all the food within a minute or so of it entering the tank.

Planting In Your PlantBed

Ideally the plants you put in your **PlantBed** will have been started in a pre-formed plug such as **ROOT!T** propagation sponges, **DO NOT USE STONEWOOL** as the fibres may cause a problem in the fish gills. They should have the first roots visible outside the plug and at least 3 or 4 true leaves, but the better rooted they are, the quicker they will establish. If you are using plants started in compost or soil, you will have to gently wash as much as possible off the roots before planting.

Leave a few days after putting the first fish in before planting your system and it is a good idea to only plant up a small area, planting up more of the **PlantBed** only when you stock with more fish (the bacteria will do their job irrespective of plants).

Scoop out a handful of pebbles place the plants in position and then replace the pebbles so the plug is just below the level of the pebbles, if the plant is 'bare-rooted' plant it only slightly deeper than if it was in compost or soil, ensuring the roots are deep enough for the 'flood' level to reach them.

In the early stages we only suggest you grow salads, leafy vegetables and herbs, but when your system is more mature you may wish to experiment with more demanding plants.

Plant Care

Please see **www.fishplant.co.uk** for more advice on propagating plants for your system. The conditions for the tops of the plants should be the same as in normal growing.

DO NOT USE SYSTEMIC PESTICIDES as they will be toxic to the fish. **ONLY** use physical modes of pest and disease control.

Many salads and leafy vegetables and herbs are described as 'cut and grow' so can be continuously harvested but even these will need replacing occasionally. To remove plants, take firm hold of the whole plant and gently ease as much of the root system out as possible, gently knocking the pebbles off as you go.

Feeding The FishPlant

When you are feeding your fish you are also, indirectly, feeding the plants! Hence there is a link between how much you are feeding and how many plants will grow. The maximum feed level a fully mature **PlantBed** will be able to process effectively is 30g per day and this is what limits the fish biomass.

DO NOT FEED MORE THAN YOUR FISH WILL EAT. They should be fed sparingly at first, but once established you should be feeding between 1% and 3% of **FishTank** biomass per day, so: 5 fish at 20 grams each (100g total) will only require between 1 to 3 grams of food per day; 30 fish with an average weight of 100 grams (3kg total) could be fed 30 to 90 grams per day – but this should be limited to 30 by the size of the **PlantBed**. ***Once the system is fully stocked and functioning, extra PlantBeds could be added to increase the food allowed and hence the speed the fish would grow.*** The daily feed ration should be split into ideally three feeds, morning, midday and evening, whenever possible and any left in the tank after 5 or 10 minutes should be removed.

We recommend the use of **FishPlant FishFood** for all omnivorous species such as tilapia, carp (both edible and ornamental) and goldfish, as well as some cold-water carnivores like perch. **FishPlant FishFood** is a complete balanced feed, with high levels of protein and vitamins for rapid growth and good health and is suitable for fish intended for human consumption. There are two sizes of pellet available, the smaller for young fish (up to about 70g) and the larger for more mature fish, but if you are stocking over a period of time to get a continuous supply (as previously described) you will find you are feeding a mix of both, but with higher ratios of the larger pellet.

Water Quality

Maintaining a healthy system for fish, bacteria and plants, is all about keeping things in balance. It is sometimes a compromise between what is ideal for the different living organisms. This is why monitoring water quality is always important, but particularly so in the early weeks, while the system is establishing itself. *It is a good idea to record all results and any adjustments and additions made to the water, both for your own reference and to make it easier for us to help if you require support.* A sample table is available at **www.fishplant.co.uk**

There are a number of different factors relating to water quality we must be aware of. How to monitor them and what to do are explained below.

Dissolved Oxygen

Fish use oxygen for respiration, therefore having dissolved oxygen above 5mg/litre is vital in a **FishPlant** system. Testing for dissolved oxygen is difficult and expensive, however, by ensuring all the other water quality factors are okay and there is sufficient water movement and aeration (and the water temperature is not too high) we can be confident there is enough dissolved oxygen in the water.

The return valve on the **Flow Fitting** will constantly move water around your tank, and the **AutoSiphon** draining into your **FishTank** both help increase dissolved oxygen.

Water will hold less dissolved oxygen when it is warmer, so if you are heating the **FishTank** above 16°C (e.g. for tilapia) we strongly recommend additional aeration – a **FishPlant Air-pump** and **FishPlant Air-stone** – though you may wish to add them even for cold water.

Acidity or 'pH'

Acidity is measured as 'pH' and is a scale of 1-14, with 7 being neutral, 1 being most acidic and 14 being most alkaline.

In your **FishPlant System** you MUST keep the pH between 6 and 8. Once the system is running successfully, the pH is likely to FALL and should be monitored and adjusted regularly.

The **FishPlant 'Fish Care' water quality test kit** contains a pH test, and also an alkalinity (or KH) test that helps monitor how stable the pH is. Once your system

is running effectively, the pH test is the one most used, there is also a separate **FishPlant 'pH Test kit'**.

The pH should be adjusted up using **FishPlant pH Up**, this is food grade potassium hydroxide in a relatively weak dilution for safe use, but should still be kept out of the reach of children. The potassium in it is available to the plants to use. Dilute further with either topping up water or water from the **FishTank** and pour back through the **PlantBed**.

Water 'Hardness'

Our water supply is normally described as either 'soft' or 'hard'. This depends on how much dissolved solids (mainly Calcium and Magnesium Carbonates) there is in it. Hardness is often expressed as 'mg/litre $CaCo_3$':

- Soft water 0-75 mg/litre $CaCo_3$
- Moderately hard water 75-150 mg/litre $CaCo_3$
- Hard water 150-300 mg/litre $CaCo_3$
- Very hard water >300 mg/litre $CaCo_3$

How 'hard' your water is, affects many other parameters within your **FishTank**, especially the 'pH' and how likely it is to fluctuate. Very 'soft' water may not contain enough calcium for plants to grow well, and very 'hard' water can lead to too much calcium building up in the water, than is good for the fish.

The **FishPlant 'Plant Care' water quality test kit** contains a '**General Hardness (GH)**' test, that is measured in **°DH**. If the water from your supply is less than 3°DH, it may be necessary to add calcium (in the form of either hydroxide or carbonate, please refer to **www.fishplant.co.uk** for more advice) for the plants and to help stabilise pH. If the GH in the FishTank builds up over time to 30°DH you should start doing partial water changes (not more than 10% at a time) to keep it below.

The Nitrification Process

The waste that fish produce contains ammonia, which *nitrosomonas* bacteria convert to nitrite, which in turn *nitrobacter* bacteria convert to nitrate. Ammonia and nitrite are toxic to fish when they reach high levels, whereas nitrate is the form of 'nitrogen' plants need most.

So we can see how important it is that the nitrification process works smoothly – this is why we must only stock the **FishTank** slowly, allowing the numbers of bacteria to increase to cope. Nitrates are safe for fish except at very high levels, so we should not run a system for a long time with no plants, unless we do partial water changes.

The FishPlant 'Fish Care' water quality test kit contains both ammonia and nitrite tests and shows the real danger levels, but we should be aiming for these to both be zero. More fish should NOT be added to a **FishTank** when either of these is above zero.

If either the ammonia or nitrite measurements show dangerous levels for fish, partial water changes should be carried out (NEVER more than 20%).

FishPlant Maintenance

Plant Nutrients

There are 13 mineral nutrient elements vital to healthy plant growth, split into three groups known as 'primary', 'secondary' and 'trace' elements. Of these, all are readily available from water or fish waste in the required amounts, with the exception of **iron**, and possibly calcium in very soft water.

The primary or macro-nutrients are nitrogen (available as nitrates), potassium and phosphorous (available as phosphates). The **FishPlant Plant Care Water Quality Test Kit** contains a nitrate test and a phosphate test, we should be looking to see the presence of these (but not necessarily in large quantities) in the **FishTank** water.

For healthy abundant plant growth it will be necessary to add iron in a soluble form. **FishPlant Iron** is a safe source of this iron for fish. Always dilute additives in a bucket of topping up water and pour through the **PlantBed**. **For the first few weeks and for a week or so each time you add new fish, test the ammonia and nitrite levels every day.**

Daily Tasks

Feed the fish. Ideally you will feed the fish three times a day or more. Auto-feeders can be used when on short breaks, but few will do it for a 2 week holiday, and it is better to arrange for someone to come and at least look at the fish every couple of days. Watch the fish when you feed them and do not leave uneaten food in the **FishTank**. The fish not eating is a good early indicator that something is wrong.

Check the system is functioning correctly. Check the **AutoSiphon** is cycling

correctly, the pump is working and water is circulating from the **Flow Fitting**. Also check any additional equipment like heaters and air pumps. Once you know the system this will become second nature and you will tell at a glance if there are any problems.

Check and adjust the pH. Again once you know your system, you may find this does not need doing every day, or possibly that you need to do it as often as you feed (it is better to make several small adjustments than one big one. Always add **FishPlant 'pH Up'** in a bucket of water, poured through the **PlantBed.**

Weekly Tasks

Water quality testing and recording. The more things you test for and record, the better you will come to understand the system, and the easier it will be to get advice if there are problems.

Pest monitoring. The key to successful pest control in plants is early identification, so research common pests of the plants you grow as well.

Tidy up. Remove any dead leaves or sick plants and keep things clean and tidy around the system. The water movement should prevent any settlement of solid fish waste, but if there are a couple of still points where settlement occurs, remove solid waste with a net. This will help prevent any disease problems for both plants and fish.

Harvest and replant the PlantBed. Herbs and salad leaves will benefit from regular picking and produce more in the long run. Even single harvest plants like 'head' lettuce will be better picked as soon as ready. Remember to keep the **FishTank** running well, you should keep the **PlantBed** planted accordingly.

Top up the FishTank. It should be kept as close to full (10cm from the top) as possible, remembering to check the level when the **AutoSiphon** has just stopped draining the **PlantBed**. ALWAYS top up through the **PlantBed** to help prevent temperature shock. Do partial water changes only when they are deemed necessary. **ALL WATER ADDED TO YOUR FishPlant System SHOULD BE LEFT TO STAND FOR AT LEAST 24 HOURS, OR DECHLORINATED.** Water loss from the system, by transpiration and evaporation, will be about 10-30 litres per week, dependant on environmental conditions.

Monthly Tasks

Clean the pump. When the **AutoSiphon** has just finished draining the **PlantBed**, switch off the pump, disconnect from the mains and then the **Flow Fitting**, take

it out and remove the inlet cover, and take out the impeller (taking care not to drop any seals) and wipe everything down, before putting back. This will help your pump last a long time.

Examine fish. This will mean catching a random sample (one at a time), and checking them over for obvious problems and signs of disease, once you are at a stage where you are harvesting fish, you will inevitably catch a few smaller ones in the process – take the opportunity to do this then.

Harvesting Fish

When your fish have reached a suitable size to eat, they **MUST** be dispatched as quickly and humanely as possible. Please ensure you have read the fish harvesting section at **www.fishplant.co.uk** for the most up to date information on the recommended procedures.

Notes

When removing any fish from the tank for whatever reason it is very important to keep stress to a minimum. Use a small net to take fish from the tank and keeping handling of the fish to a minimum. If you do handle the fish directly make sure your hands are wet and that you handle them carefully but confidently and remember to wash your hands thoroughly after every contact.

When carrying out sample checks, weigh the fish if possible. The easiest way is to fill a bucket with water from the tank, place it on the scales and set to zero before catching the fish. Repeat the whole process with a fresh bucket of water for each fish. Try and get a representative sample including a range of sizes, and use this to calculate on approximate biomass for the tank.

Always add any topping up water for the system through the **PlantBed** to help prevent temperature shock, this also applies to any water taken from the tank for diluting additives as this will help further equalise concentrations and prevent discomfort to any fish. It is a good idea to keep a water butt or similar container full of clean water for topping up, allowing it to stand for plenty of time before use.

1. Food Fish – Tilapia

Common Name(s):
Nile Tilapia, St Peter's fish
Species: ***Oreochromis Niloticus***

Tilapia are by far the most popular species in aquaponics. It is a hardy fish; tolerant to fluctuating water conditions and crowding, and resistant to disease. Tilapia are also omnivorous and can be grown very quickly to harvest size with little or no animal protein in the diet.

History: Oreochromis niloticus is the most popular species of tilapia for culture. Endemic to Africa and originally farmed in Egypt over 4000 years ago, tilapia is now cultured in over 100 countries and is 2nd only to carp in terms of global aquaculture production. No longer the 'poor mans fish' consumer popularity is increasing worldwide and there is now a large market in the US, South East Asia and Europe. Tilapia is a popular choice both for subsistence and commercial farmers due to its amazing capacity for domestication and tolerance of culture conditions. This has led to it being termed the 'aquatic chicken' a domesticated source of affordable protein that may be the most important aquaculture species of the 21st century.

Physiology: Body compressed and round, species is characterised by regular vertical stripes on the caudal fin. Greyish or black-green colouring with 6-9 indistinct vertical bars. Whitish belly.

Diet: Tilapia are omnivorous and, in the wild they feed mainly on phytoplankton, algae and aquatic plants. Complete pelleted diets, specifically tailored to tilapia, are available that are lower in fat than salmonid diets and contain less fish meal and oil in favour of plant based proteins. These diets can be supplemented with plant off-cuts as well as worms, soldier fly larvae, and other invertebrates.

Growth Rate: Tilapia can reach a harvest size of 500g after 6 months rearing within the optimal temperature range. Males grow faster and more uniform in size than females, thus all male cultures are preferable, and all male fingerlings are available from all major suppliers.

Nile Tilapia: 24-32°C

D.O. mg/l	pH Units	Un-Ionised Ammonia mg/l	Nitrite mg/l	Nitrate mg/l	Hardness mg/l	Alkalinity mg/l	CO_2 mg/l	Salinity ppt	Chloride mg/l
3-10	6-8	0-0.04	0-0.4	<50	50-350	50-250	0-30	0-5000	0-5

2. Food Fish – Carp

Common Name(s):
Common Carp
Species: ***Cyprinus carpio***

Carp are ideal for home food production. They are omnivorous and will eat a huge range of foods including worms and vegetable scraps. They are also very hardy fish tolerating very low oxygen levels and will survive cold winter periods if you decide not to heat your system.

History: Carp have long been popular as a food fish. They have been reared for over 2000 years in China and were a luxury food for the Romans who kept them in large purpose built storage ponds. Domestication of carp was spread across Europe by Christian monks who kept the fish in ponds for food, selecting the largest fish for breeding and subsequently carrying out artificial selection, albeit unintentionally. Common Carp have now been introduced to almost every part of the world and it is currently the third most cultured finfish species globally.

Physiology: Long and flat body with large scales. Thick, projecting lips. Two pairs of barbels at the angle of mouth and shorter ones on the upper lip. Colour varies from golden yellow, silver to brownish-green depending on the minerals in the water and the level of penetrating sunshine. Males are smaller than females, carp can grow to a maximum length of 1.2m and maximum weight of over 40kg.

Diet: Carp are omnivorous and will eat almost anything, saying this they have a strong preference for consuming invertebrate food such as water insects, insect larvae, worms, molluscs and zooplankton. Carp will also eat the stalks, leaves and seeds of aquatic and terrestrial plants, and decaying vegetation.

Growth Rate: The daily growth rate of carp can be between 2 - 4% of body weight. Carp can reach 600g – 1kg in 12 months in a heated system. They can survive lower winter temperatures but will take 2-3 times longer to reach harvest size.

Common Carp: 23-30°C

D.O. mg/l	pH Units	Un-Ionised Ammonia mg/l	Nitrite mg/l	Nitrate mg/l	Hardness mg/l	Alkalinity mg/l	CO_2 mg/l	Salinity ppt	Chloride mg/l
1-10	6.5-9	0-0.04	0-0.2	<50	50-350	50-250	0-30	0-3000	0-5

3. Food Fish – Perch

Common Name(s):
European Perch
Species: ***Perca fluviatilis***

European Perch is one of the best tasting freshwater fishes with distinctively flavoured, delicate flesh and relatively few bones. Native to the UK, they tolerate a wide range of temperatures and despite being carnivorous, can grow well on a diet supplemented with home-grown live feeds such as worms.

History: Perch farming has typically been confined to extensive pond culture in Eastern Europe and France. The fillets are a delicacy in countries such as Belgium and Switzerland retailing at double the price of trout and salmon, but the market suffers from irregular supply and an over reliance on wild capture. This has provided a niche in the market for farmers seeking to diversify from traditional cultured species where margins are tight. The European Union has therefore funded research into perch aquaculture since the 1990's, in line with policy for social and economic development, and the number of intensive recirculating perch farms has started to increase.

Physiology: Moderately deep body with rough edged scales. Short head and blunt, rounded snout. Teeth are small but numerous. Colour ranges from grey-green on the upper body to green-yellow for the abdomen with dark vertical bars across the upper sides. Pelvic, pectoral and anal fins are generally orange. It is a relatively small fish and can reach sizes of 35-50cm length and up to 5kg weight. The temperate range for Perch lies between 4-31°C with an optimum of 22°C.

Diet: Perch are carnivorous with a preference in the wild for small fish. Trout diets are recommended, however this can be heavily supplemented with live insects such as worms.

Growth Rate: Perch require around 10 months to reach a harvest size of 100g at optimum temperature. Females grow 20% faster than males and thus an all female stock will be ready to harvest after just 8 months.

European Perch: 16-24°C

D.O. mg/l	pH Units	Un-Ionised Ammonia mg/l	Nitrite mg/l	Nitrate mg/l	Hardness mg/l	Alkalinity mg/l	CO_2 mg/l	Salinity ppt	Chloride mg/l
5-13	6-9	0-0.02	0-0.1	<50	50-350	50-250	0-20	0-1500	0-5

4. Food Fish – Trout

Common Name(s):
Rainbow Trout
Species: ***Oncorhynchus mykiss***

A popular and well known cold-water food fish. Rainbow trout are relatively hardy, fast growing and tolerant of handling, however trout require good water quality and fast flow-rates to be reared at high densities. If you would like to grow trout we would therefore suggest doing so only in the large FishPlant production unit at no more than 0.5kg per 100 litres of water.

History: Since the late 19th Century Rainbow trout has been introduced to all continents except Antarctica, for recreational fishing and for food. Following the development of the flow-through tank system and pelleted feeds in the early 1900's, the trout aquaculture industry has grown exponentially. Rainbow trout is by far the most widely farmed trout in the world, mainly because it is a prized food fish and because it is relatively easy to culture.

Physiology: Long, elongated body. Adipose fin is present. Colouration is blue to olive green above a pink band along the lateral line and silver below. Back, sides, head and fins covered with small black spots. Trout can withstand wide ranges of temperature variation (0-27 °C) but optimum growth occurs between 12 and 16 °C. At water temperatures above 22°C, a trout's digestive system becomes inefficient and much of the feed ends up as waste in the water.

Diet: Trout are carnivores and in the wild, will consume a large range of organisms such as aquatic and terrestrial insects, molluscs, crustaceans, small fishes and freshwater shrimp which give the flesh its characteristic orange-pink colour. Pelleted diets have been modified and improved over the years, and are widely available. Due to the carnivorous nature of trout, these diets are typically high in energy/lipids and contain relatively large amounts of fish oil.

Growth Rate: Food market fish size can be reached in 9 months (30-40cm) but 'pansized' fish, generally 280-400 g, are harvested after 12-18 months.

Common Carp: 23-30°C

D.O. mg/l	pH Units	Un-Ionised Ammonia mg/l	Nitrite mg/l	Nitrate mg/l	Hardness mg/l	Alkalinity mg/l	CO_2 mg/l	Salinity ppt	Chloride mg/l
5-12	6.5-8.5	0-0.02	0-0.1	<50	50-350	50-250	0-20	0-1500	0-3