HYDROPONICS · NUTRIENTS · KNOWLEDGE

Hydroponic Systems Guide

A complete overview of the major hydroponic growing systems — operating principles, components, benefits, limitations, and crop suitability, for growers at every scale.

8 Systems
Kratky to Vertical Tower

Active & Passive
System Classification

Beginner → Commercial
For Every Grower

01 INTRODUCTION

Hydroponic Systems

A wide range of hydroponic systems are available today, each designed to deliver water, nutrients, and oxygen to plant roots through different methods.

Based on the mechanism used to supply the nutrient solution, hydroponic systems are broadly classified as **active** or **passive**. Active systems use mechanical components — water pumps, air pumps, timers, or pressure systems — to actively circulate the nutrient solution to the root zone. Passive systems rely primarily on capillary action, gravity, or a static nutrient solution, and generally require fewer mechanical components.

Systems can also be classified by how the nutrient solution moves: **recirculating** systems collect and reuse the solution after it passes through the root zone, while **non-recirculating** systems supply solution as needed without returning the excess to the original reservoir.

Complexity varies considerably — from simple containers with a static nutrient solution to highly engineered setups with pumps, filtration, and automated environmental control. This guide covers eight major systems in detail: their design, components, advantages, limitations, and the crops best suited to each.

THE SYSTEMS COVERED

1. Kratky Method
2. Wick System
3. Nutrient Film Technique
4. Deep Water Culture
5. Top Drip System
6. Flood & Drain (Ebb & Flow)
7. Aeroponics
8. Vertical Tower System

PASSIVE SYSTEM · NO POWER REQUIRED

Kratky Method

01

Developed in the 1990s by Dr. Bernard Kratky at the University of Hawaii — the simplest, cheapest way to start growing hydroponically.

The Kratky method is a passive technique where crops are grown in a bottle or small container, with roots suspended in a static nutrient solution — no electricity or pump required. A small air gap must be maintained between the floating raft and the solution surface, giving roots access to oxygen and preventing root damage. It's popular with beginners, home growers, and even cafes for decorative growing.

Components

- **Container/Reservoir** — from bottles to buckets.
- **Floating Raft** — usually Styrofoam, for larger setups.
- **Net Pot** — holds saplings on the raft.
- **Growing Medium** — clay pellets for initial support.

Suitable Crops

Best for leafy vegetables and herbs with a short life cycle and small root system — lettuce, arugula, basil, cilantro, kale, mustard green, mint, parsley, rosemary, swiss chard, coriander. Fruiting crops are not recommended in the Kratky method.

BEST FOR

Beginners, home growers, decorative setups, leafy herbs

Benefits & Limitations

- **Cost-effective** — no expensive equipment; buildable with household items.
- **Electricity-free** — no power source needed.
- **Minimal maintenance** — just top up nutrient water as needed.
- **Beginner-friendly** — simple, straightforward setup.

- Oxygen deficiency in standing solution
- Nutrient & pH imbalance over time
- Limited scalability for larger farms

PASSIVE SYSTEM · NO POWER REQUIRED

Wick System

02

Plants sit above the nutrient reservoir, fed entirely by capillary action through cotton wicks.

This passive system places plants slightly above the nutrient solution, with or without a growing medium. Cotton wicks placed between the solution and the growing medium (or directly at the roots) absorb and deliver nutrients through capillary action — one of the most straightforward hydroponic techniques, requiring no energy or pumps.

Components

- **Wick** — cotton or felt, carries solution to roots.
- **Growing Medium** — clay pellets, cocopeat, perlite, or a mix.
- **Reservoir** — tank below the growing media.

Suitable Crops

Any short-cycle, small-root crop suits the wick system — lettuce, arugula, basil, cilantro, kale, mustard green, mint, parsley, rosemary, swiss chard, coriander.

BEST FOR

Beginners, low-cost setups, small to medium crops

Benefits & Limitations

- **Electricity-free** operation, no pumps needed
- **Low-cost** — buildable from household plastic waste
- **Minimal maintenance** beyond topping up the reservoir
- **Beginner-friendly** setup

- Slower growth than active systems
- Unsuitable for high-demand, large-root crops
- Limited scalability for large farms

ACTIVE SYSTEM · RECIRCULATING

Nutrient Film Technique (NFT)

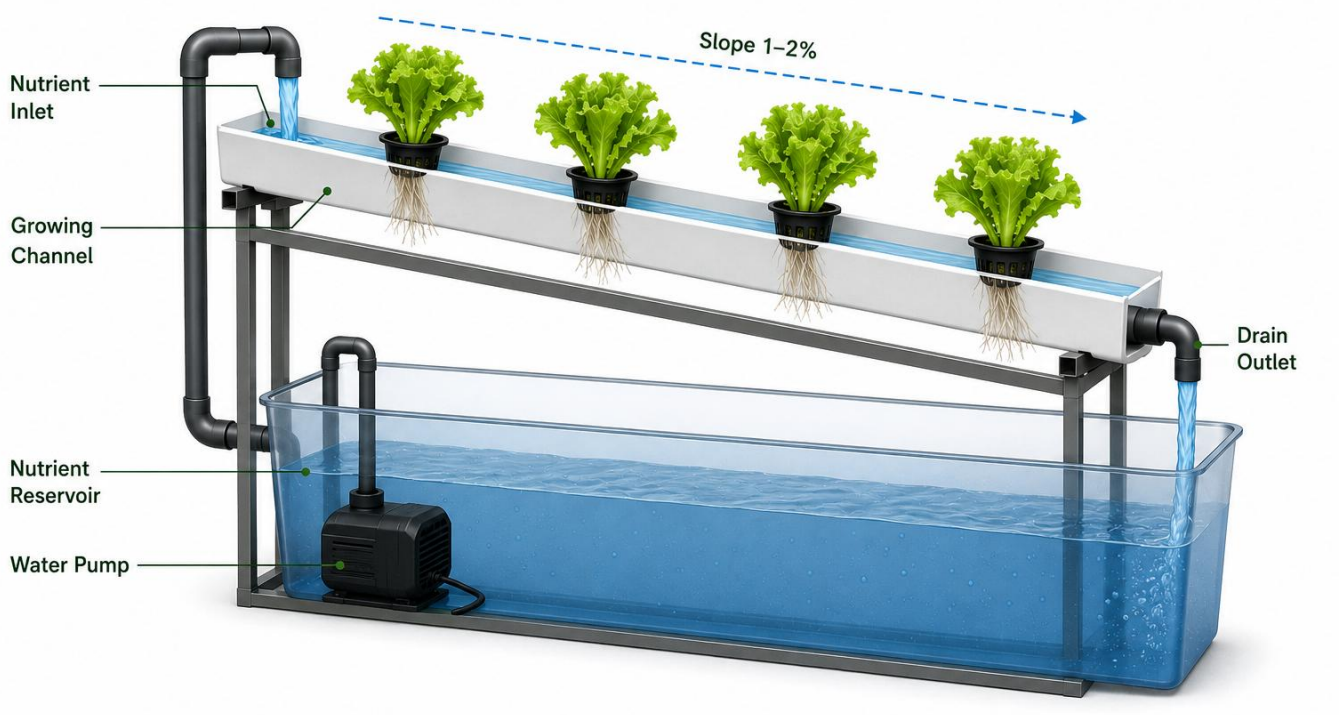
The most popular and commercially used hydroponic system in the world.

03

In NFT, a thin film of nutrient-rich water continuously circulates through channels, touching the plant roots directly. This recirculating system lets roots absorb nutrients directly from flowing water, optimizing nutrient uptake — it's the industry's central technique for leafy crop production.

Components

- **Channel** — PVC/UPVC, holds the water film and plants
- **Fittings & irrigation lines** — connectors, drip microtubes
- **Net Pot** — holds seedlings from the seedbed
- **Growing Medium** — clay pellets, rockwool, or oasis cubes
- **Reservoir** — holds and recirculates the solution
- **Air pump & air stone** — maintains dissolved oxygen
- **Water pump** — circulates solution with a gravity return slope
- **Frame** — usually iron, holds the channels



Types of NFT Structures

- **Vertical Bed** — the standard flat-layer setup; no extra lighting needed, ideal for polyhouses with sufficient area.
- **A-Frame** — angled like the letter 'A'; all plants get light from one source and fits ~20% more plants than horizontal NFT.
- **Tier-Based** — multiple horizontal layers stacked vertically; the most advanced form, suited to indoor farms with artificial lighting per tier.

BEST FOR

Leafy greens, commercial farms, indoor vertical setups

Suitable Crops

Almost any leafy vegetable or herb with a short life cycle — lettuce, spinach, arugula, basil, cilantro, kale, mustard green, bok choi, mint, parsley, rosemary, swiss chard, coriander. Crops with longer life spans and higher root density are not recommended, as they can choke the channel.

Benefits

- **Efficient** use of water and nutrients — minimal loss except via transpiration
- **Minimal growth medium** required — roots suspend directly in water
- **Increased yields** through multi-layer, space-efficient design
- **Scalable** from kitchen garden to commercial farm; channel lifespan 12–15 years

Limitations

- Root clusters can clog channels
- Not suited to long-cycle crops (tomatoes, cucumbers)
- Sensitive to water temperature swings
- Pump failure can dry out plants within hours

Related — Deep Flow Technique (DFT): A modified NFT variant that maintains a deeper layer of flowing nutrient solution for a greater water/nutrient buffer, reducing the impact of short pump interruptions. Suitable for the same leafy crops as NFT.

ACTIVE SYSTEM · RECIRCULATING

Deep Water Culture

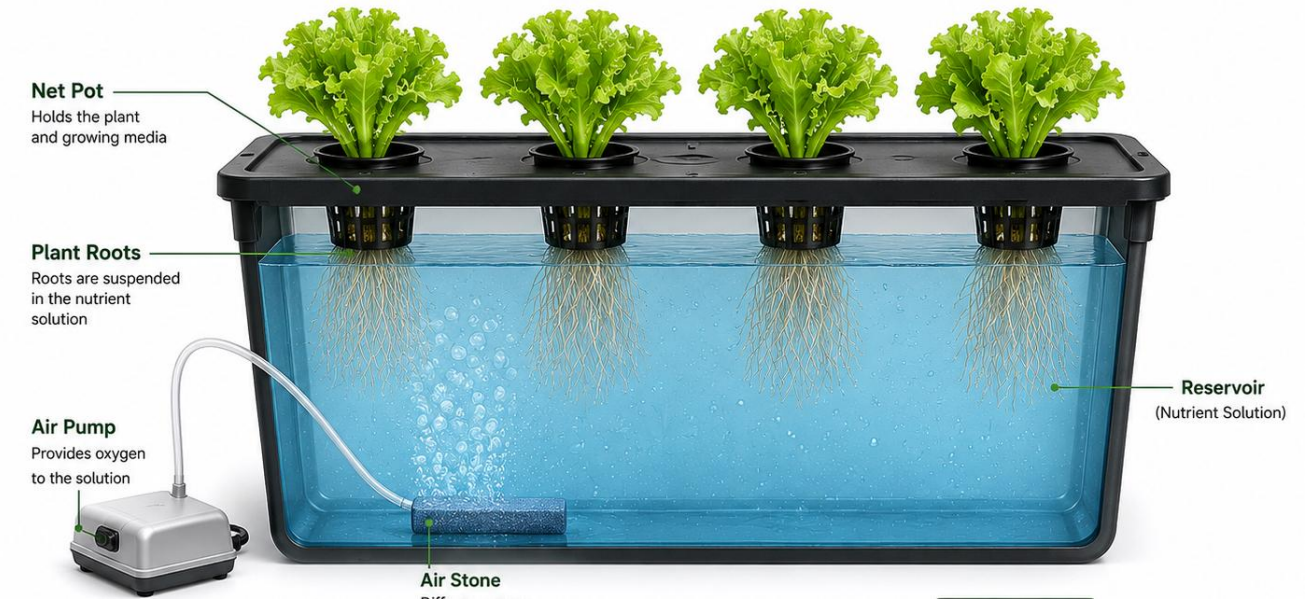
04

Also known as the floating raft technique — roots hang directly into an oxygenated nutrient reservoir.

In DWC, plant roots are suspended in a nutrient-rich, oxygenated reservoir. Plants sit in net pots placed within a floating raft, letting roots hang into the solution below. Optimal solution depth is **12–23 cm**. DWC can also serve as an intermediate culture stage for seedlings before transfer into a system like NFT.

Components

- **Reservoir** — holds the nutrient solution
- **Floating Rafts** — foam or polystyrene, sized to net pots
- **Net Pots** — hold plants, roots hang into solution
- **Air Pump & Air Stone** — maintains DO, prevents root drowning



Suitable Crops

Lettuce, basil, kale, swiss chard, bok choi, cilantro, and most leafy greens. Small-scale vine crops like peppers, cucumber, and tomatoes are also possible — raft weight and strength are the limiting factor.

BEST FOR

Leafy greens, seedling nurseries, home & commercial growers

Benefits & Limitations

- **Faster growth** from optimized nutrients & oxygenation
- **Minimal maintenance** , easy to run
- **Little to no substrate** required
- **Simple & beginner-friendly** — no water pump needed

- Sensitive to pH fluctuations
- Requires power for the air pump
- Pump/power failure risks oxygen crash

ACTIVE SYSTEM · RECIRCULATING OR NON-RECIRCULATING

Top Drip System

05

Delivers a controlled amount of nutrient solution directly to the root zone via driplines and emitters.

The drip irrigation system slowly drips nutrient solution onto the growing medium for efficient water and nutrient uptake. Highly adaptable and suited to vine crops with extensive root systems — water-efficient, low disease risk, and easy to automate and scale.

Components

- **Dutch Bucket/Grow Bag** — holds substrate and roots
- **Substrate** — clay pellet, cocopeat, perlite, or a mix
- **Drip Lines** — mainline, sub-main, and lateral
- **Arrow Drippers/Emitters** — feed the root zone directly
- **Fittings** — connectors, t-joints, grommets, microtubes
- **Water Pump** — feeds the drip line from the reservoir
- **Air Pump & Air Stone** — maintains DO in the reservoir
- **Reservoir** — for recirculating setups

Two Types by Flow

Recirculating (Dutch Bucket): Closed-bottom buckets drain back to a reservoir for reuse — no daily calculation needed as the same solution recirculates.

Non-Recirculating (Grow Bag): A cost-effective variant using UV-treated grow bags — solution flows one way and isn't returned.

Suitable Crops

Crops with extensive root systems and longer life cycles thrive here — tomatoes, cucumber, peppers, okra, radish, zucchini, beans, and eggplant.

BEST FOR

Vine crops, large-scale commercial farms

Benefits

- **Ideal for vine crops** with extensive root systems
- **Low power** use in non-recirculating setups
- **Low disease risk** — root zones are separated

Scalable for large commercial farms

Limitations

- Clogging risk from small particles
- Overwatering if flow is miscalculated
- High initial setup cost
- Requires regular maintenance

ACTIVE SYSTEM · TIMED CYCLES

Flood & Drain (Ebb & Flow)

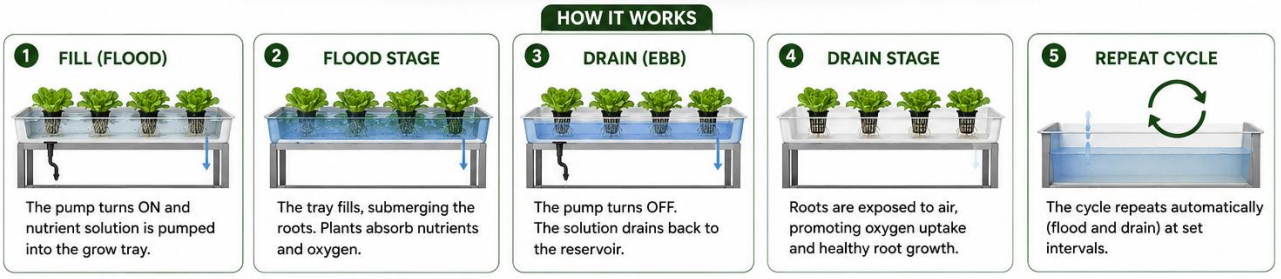
06

A growing bed is periodically flooded and drained on a timer — a proven technique in commercial hydroponics.

The growing bed, filled with a soilless medium, is flooded and drained on a timed cycle, with excess nutrient water returned to the reservoir. This gives roots access to both dissolved oxygen (during flood) and atmospheric oxygen (during drain).

Components

- **Growing Bed** — holds medium and plants
- **Substrate** — clay pellet, cocopeat, perlite, or a mix
- **Water Pump & Timer** — controls flood frequency/duration
- **Overflow & Drainage** — prevents over-flooding
- **Reservoir** — under the growing bed



Suitable Crops

A wide range — from microgreens to large fruiting crops — depending on system sizing. Nearly any hydroponically-viable crop can be grown here.

BEST FOR

Mixed crop farms, scalable commercial setups

Benefits & Limitations

- **Root zone oxygenation** from both water and air
- **Wide crop range** , easy to scale

- Fully energy-dependent; pump-sensitive
- High maintenance & system complexity
- Risk of rapid disease spread via shared solution

ACTIVE SYSTEM · ADVANCED

Aeroponics

Roots suspended in air, fed by fine nutrient mist — the most advanced hydroponic technique, for maximum growth and yield.

07

From the Latin "Aero" (air) and "Ponic" (labor), aeroponics is a vertical farming technique where seedlings sit in a growing chamber or tower, held by net pots or growing clips. A nozzle and high-pressure pump create a continuous fine mist that delivers nutrients directly to the root zone.

Components

- **Aeroponics Tower** — central chamber, roots suspended
- **Misters** — create fine mist (high-pressure)
- **Multiple Drip System** — splash-based (low-pressure)
- **Timer, Pump & Reservoir** — control and circulate solution

Two System Types

Low-pressure: drip or splash-based, less prone to clogging, suited to small-scale growing.

High-pressure: pump and misters create fine mist for maximum root-zone conditions.

BEST FOR

Leafy greens, microgreens, and vine crops with support

Benefits & Limitations

- **Fastest growth** from superior oxygenation
- **Maximum productivity** per unit area
- **Easy to scale** vertically

- Needs 24-hour power supply — total energy dependency
- High risk — any component failure causes rapid damage
- Complex, not ideal for beginners

ACTIVE SYSTEM · SPACE-EFFICIENT

Vertical Tower System

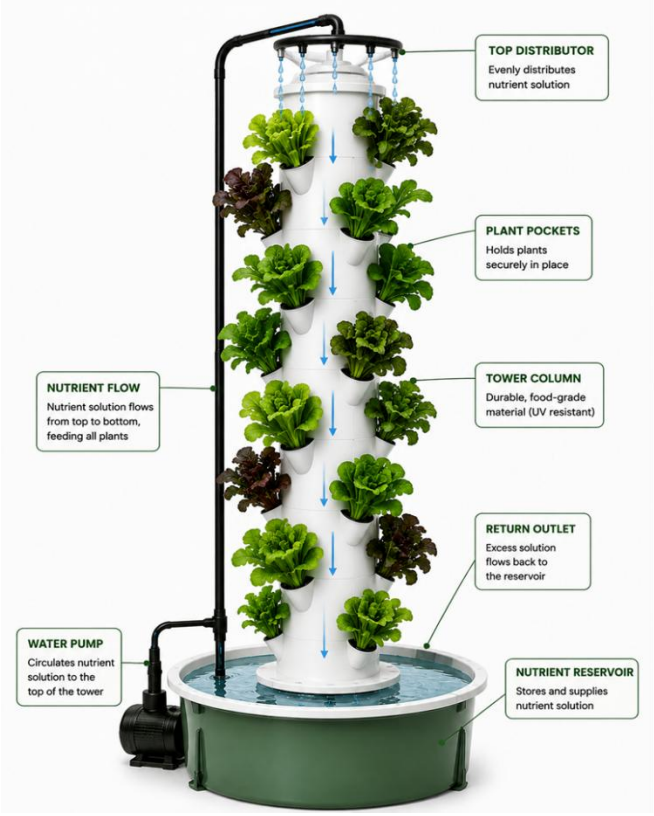
Plants arranged vertically along a column — maximum plant density within a minimal floor footprint.

08

Nutrient solution is pumped from a reservoir to the top of the tower and flows downward under gravity through the growing sites; any excess is collected at the base and may be recirculated. Depending on design, towers may use drip irrigation, nutrient film flow, or aeroponic misting.

Components

- **Tower & Planting Sites** — multiple vertical growing points
- **Net Pots/Growing Clips** — hold seedlings securely
- **Reservoir & Water Pump** — circulates the solution
- **Support Structure** — keeps tall towers stable



Suitable Crops

Ideal for lettuce, spinach, basil, coriander, mint, and other compact crops; strawberries are especially well-suited. Larger fruiting crops (tomato, cucumber, bell pepper) need specially designed towers with extra structural support.

BEST FOR

Urban farming, balconies, rooftops, indoor cultivation

Benefits & Limitations

- **Space-efficient** — high density per floor area
- **Easy to scale** — home to commercial use
- **Reduced ground footprint**

- Uneven light between upper/lower tiers
- Pump-dependent nutrient delivery
- Harder to clean internal components

GROW WITH US

Write to neoKesan

We're an education-first brand — beyond the bottle, we guide our growers through the intricacies of growing, from first sprout to full harvest. Whichever system you choose, our nutrient range is built to support it.

Website
www.neokesan.com

Email
hello@neokesan.com

LinkedIn
linkedin.com/company/neokesan

Made with care in India