Tip Sheet

Techniques

Aim: After mapping resources for maximum efficiency, select and combine techniques to improve soil and water health, agricultural production, and the resilience of the whole farming system.

Key Takeaway: The selection and combination of techniques is uniquely dependent on the specific site location and its particular opportunities and constraints determined in the site analysis. Examining the site through the site assessment, analysis, and design allows farmers to choose, modify, and evolve the techniques that are right for them and their unique conditions.

SOIL TECHNIQUES

Techniques to Improve Soil Health				
What it is	**Benefits**	**Where to use**	**Cautions**	**Variations**
COMPOSTING				
Decayed organic material used as a plant fertilizer.	Adds organic matter to the soil and improves soil fertility. Increases soil moisture-holding capacity. Helps suppress weed growth. Improves crops' resistance to pests.	Particularly useful for home gardens. Also useful for field crops, but producing sufficient quantities is a challenge.	Keep compost moist, particularly in hot and dry areas. Keep compost covered or in the shade and be sure to water it.	Hot compost Compost tea Vermi-compost Cold compost In large fields, copy nature by layering organic materials (manure, dry leaves, green mulch, etc.) to create conditions for humus creation.
SOIL AMENDMENTS				
Adding locally available materials such as animal manure and bird droppings, charcoal, and dry leaves to soil.	Adds nutrients and organic matter to soil to improve soil biology and structure.	Use in the field for crops.	Be careful not to add too much wood ash, as it affects the soil's pH and can affect the plant's ability to uptake nutrients.	Use a moveable chicken coop to bring manure directly to fields. Build a pigeon house upslope of a field to bring valuable phosphorous from wild pigeon waste.

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COVER CROPS				
Planting herbaceous crops (normally legumes) during "off season" in order to protect the soil and boost fertility for the next season.	Reduces evaporation. Increases soil fertility. Reduces erosion.	Use in fields during "off season" (such as in the summer or winter between main crop plantings).	Some cover crops can become weeds if allowed to flower and reseed.	Cover crops can be incorporated with field crops to help boost fertility and growth. Manage cover crop to ensure it does not compete with field crop for sunlight and water.
CROP PATTERNING				
Patterning crops according to observation of landscape.	Helps protect soil against potential erosion and runoff. Creates water- and nutrient-harvesting opportunities.	Use in any field, garden, or orchard. Taller, perennial crops can be planted to the west to deflect hot, summer afternoon sun or on the windward side to deflect harsh winds.	Plan for the plants' full size at maturity to ensure harvesting access and sunlight access in the future.	Pattern crops along successive contour lines at different heights to enable the capture of water, soil and nutrient runoff to improve production conditions.
IMPROVED FALLOWS				
Planting leguminous trees, shrubs and herbaceous cover crops on land resting from cultivation in order to replenish soil fertility more quickly.	Replenishes soil fertility. Conserves nutrients from one season to the next. Interrupts life cycles of pests and diseases.	Use on land that has been intensely cultivated.	Fallow land left bare could lose soil and fertility to wind or storm water runoff. The more vegetative anchors there are, the less likely soil is to be lost and the more likely it will be gained.	Cut back some legumes for mulch and to release root mass into the soils as food for microorganisms.
CROP ROTATION				
Rotating crops in a sequence to ensure soil fertility. Mostly used where monoculture is practiced.	Enhances soil fertility and structure. Reduces the incidence of pests.	Particularly for fields where mono-cropping is used, or for farms with declining yields and/or problems with pests and disease. Where inter-cropping or polyculture is practiced, crop rotation may not be necessary.	Sequence crops so that they extract or add nutrients to the soil in a beneficial order (see variations).	Ideal rotation for each growing season would be from a leaf crop (kale, spinach, etc.) to a main fruiting crop (millet, sorghum, maize, tomatoes, etc.) to a root crop (potato, cassava, beet, etc.) to a legume (bean, cow pea, etc.) to a green manure (Desmodium, lucerne, etc.).

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INTERCROPPING				
Combining two or more different crops (usually one of them a legume) in the same space, typically parallel to each other.	Improves nutrient recycling and moisture retention. Extends cropping seasons and reduces land areas required for fallowing.	Use with all crops.	Ensure crops are good companions before planting them together. Be sure to choose crops that will not compete with each other.	Alley cropping or hedgerow intercropping, which combines crops with trees of fast-growing woody species. Polyculture, which combines multiple crops (and animals) in the same space.
AGROFORESTRY				
Combining crops with trees of fast-growing woody species, such as shrubs.	Improves soil fertility. Increases soil moisture. Increases tree cover.	Use with staple crops. Depending on the system's needs, choose trees that provide income, human nutrition, perennial fertility for annual crops, fodder, building materials, or firewood.	If shade becomes too dense for crops between trees or hedgerows, prune the trees or hedgerows to allow in sunlight.	
WINDBREAK				
Placing a line of trees to protect a field from strong winds.	Limits stress that wind puts on plants. Reduces erosion. Creates microclimates. Reduces crop damage and evaporation.	Use on farms where wind is causing stress to plants. Note: A windbreak is most effective up to 10 times the distance of the height of the trees in the downwind zone (for example, if trees grow to 30 feet, the protected area would be about 300 feet.).	Be careful not to make a wind tunnel where wind will move more forcefully through an opening in the windbreak. Stagger a second or third windbreak upwind or downwind of the opening (perhaps for road access) in the original windbreak.	Use trees that can provide fodder, food, firewood, or mulch.

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NO – OR MINIMUM – TILLAGE				
Planting in holes, rather than ploughing, to minimalize soil disturbance.	Reduces soil exposure to sun, compaction and wind. Protects from loss of essential microorganisms and moisture.	Use on land used for field crops.	Ensure crop residues used in the soil are pest- and disease-free. It may take time to see benefits if the land it has been tilled for a long time.	Combine with other techniques such as mulching to further reduce need for tillage.
NUTRIENT CASCADING				
Placing nutrient sinks, such as a cow paddock, upslope of a production crop.	Uses gravity to cascade nutrients down slope to the crops, reducing energy requirements.	Use anywhere possible on the farm.	Make sure household health is not negatively impacted when locating animal structures on the farm site.	Consider other external influences such as wind for ideal placement of nutrient sinks.
INTEGRATED PRODUCTION SYSTEMS				
Integrating intensively managed animals into the farming system.	Adds organic matter to the soil in the form of manure. When livestock eat grasses, it releases root matter into the soil to feed soil microorganisms.	Use in grazing fields.	Do not introduce livestock where they may damage or compact the soil for crop production.	Integrate chicken or pigeon pens into the system.
MOUNDED OR RECESSED PLANTING STRUCTURES				
Strategically placing plants on mounded structures (such as a berm or bund) or in recessed or sunken structures (such as a swale, pit, furrow or basin) rather than on flat ground.	In dry/ arid areas, recessed structures help concentrate water and nutrients in the root feeder zones, and protect the plant from too much wind and sun. In humid/wet areas mounds help avoid root rot.	Use recessed structures in arid, low-rainfall areas. Use mounded structures in humid, high-rainfall areas.	Plan an overflow route for recessed structures so they are not flooded in heavy rains. Use mulch on mounded structures to avoid erosion.	Can also use recessed structures with organic matter to build soil fertility, including bio-swales, half-moon or semi-circular basins. Tassa/zai pits (planting pits), Katumani pits, Negarim micro-catchments.

WATER TECHNIQUES

Techniques to Improve Water Management				
Variations	**Benefits**	**Where to use**	**Cautions**	**Variations**
VEGETATION				
Plants and plant life in a given area help build, shelter, and anchor soil. Along with living soil, vegetation is the main living element of all earthworks.	Increases water's ability to sink into the soil. Supports soil microorganisms Reduces erosion. Produces food, fiber, wildlife habitat, and more.	Use in watershed from flat areas to slopes, within or beside earthworks, and in drainages if stabilizing banks and not inhibiting water flow.	Locate and space plants based on expected mature size, water needs, water sources, and tolerance to flooding. Keep root crops away from grey water.	Contour plantings Reforestation
MULCH				
Porous organic or mineral materials on the soil (e.g., compost, aged manure, straw, wood chips, gravel).	Increases infiltration rate. Reduces evaporation. Limits soil erosion. Suppresses weed growth. Improves soil fertility.	Use on soil around crops. In drier areas, use a thin mulch layer to help rain penetrate. In wet areas, or with drip irrigation, use thicker mulches to retain moisture.	On slopes, find ways to slow or stop runoff before it comes in contact with mulch, to reduce loss of mulch. Do not use in drainageways.	Cover crops Rock mulch Vertical mulch
TERRACE				
Relatively flat "shelf" of soil built parallel to the contour on sloping land.	Creates a level planting area to intercept direct rainfall and some runoff from upslope to help sink rain into the soil.	Use on land sloped up to 2:1 ratio, 26 degrees, or 48.8% grade. Make it big enough to handle a typical large rainstorm in the area.	Do not use in areas with soils prone to waterlogging or areas with a high water table. Do not use in drainageways.	Terrace with a retaining wall Terrace without a retaining wall
INFILTRATION BASIN / RAIN GARDEN				
Shallow, wide, and level-bottomed hole with gradually sloping sides or banks.	Catches and sinks rainfall, runoff, and/or grey water to store water within the soil.	Use on flat to gently-sloped land. Intercept runoff from multiple or all directions. Make basin large enough to handle a big rainstorm or maximum amount of grey water at one time.	Do not use in areas where groundwater is close to land surface, which could result in standing water. Do not use in drainageways.	Basins around or beside existing vegetation Raised pathways creating basins Sunken garden beds Raised sunken garden beds

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Variations	**Benefits**	**Where to use**	**Cautions**	**Variations**
CONTOUR EARTHWORKS				
Berm set at a right angle to slope, typically made of soil moved to make an adjoining, upslope basin.	Stops, spreads, and sinks runoff water in the soil.	Use on land sloped up to 3:1 ratio, 18 degrees, or 32.5% grade. Make them large enough to handle a typical large rainstorm.	Try to preserve existing perennial vegetation. Do not use in drainageways.	Boomerang berms
DIVERSION EARTHWORKS				
Berm and basin constructed slightly off the contour.	Gently and gradually moves water downhill and across a landscape, while promoting infiltration into the soil.	Use to divert water off one surface (e.g., a road) where it is a problem, to another surface (e.g., road-side plantings) where it is an asset. Direct overflow from one water-harvesting earthwork to another.	Do not use in alkaline soils prone to salt buildup or waterlogging.	Rolling dip or diversion berm
ONE-ROCK-HIGH DAM				
Small dam (only one layer of loose rocks) used to slow, spread, and sink more of the water's flow into the drainage bed and banks.	Slows, spreads, and sinks water flow to reduce flooding, reduce erosion, and stabilize land.	Use in small, low-volume, low-speed water channels. Can address eroding gullies, stabilize roads or paths across drainages, and reduce erosion below culverts. Use in temporary water channels.	Placement and correct construction is critical to avoid damage. For vegetation to grow through the rocks and to stabilize the structure, never lay rocks more than one layer high.	One-rock-high check dam Filter dam Brush check dam
ROCK-LINED PLUNGE POOL OR ZUNI BOWL				
A rock structure used to control small headcut erosion. It consists of rock-lined step falls in the shape of an arc, leading into a constructed plunge pool where the pooled water spreads the energy of the water falling over the steps.	The pool moistens the soil above, below, and within the structure to sustain growth of more stabilizing, sediment-accumulating vegetation between the structure's rocks.	Use in waterways with small headcut erosion to prevent it from migrating upwards.	Never lay rocks more than one layer high. Length of plunge pool should be 3-4 times the height of headcut. Use one-rock-high dams downstream of the Zuni bowl, to create a second stabilizing pool, a distance of 6-8 times the height of the headcut from its location.	

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ROCK MULCH OR VEGETATED RUNDOWN				
A one-rock-high layer of mulch or perennial vegetation such as grass used to stabilize a sloped, low-energy waterway.	Directs flowing water to a less erosive, more gradually sloping location where it can be more easily and effectively harvested and sunk into the soil.	Use to stabilize overflow spillways carrying water from one water-harvesting earthwork to another. Use to direct falling runoff from a roof to a water-harvesting earthwork Use to control headcut erosion (where a deepening channel erodes or heads upslope toward the 'head' waters) but only on low-energy headcuts like those at the top of upland rills and gullies where calm sheetflow concentrates into more channelized flow.	Rundown must be lower in the middle than on either side to ensure that water flows down the middle of the structure and not around it. Do not use within water channels with moderate- to high-energy flows, such as below headcuts. In those instances consider one-rock-high check dams or a rock-lined plunge pool, if appropriate.	Rock-mulch rundowns for dry areas where vegetation is lacking at the beginning of the rainy season. Vegetated rundowns for areas where rainfall and land management supports year-round vegetative cover of the rundown. Native perennial grasses are typically used.
SHEET FLOW SPREADER				
A level-topped, one-rock-high, crescent-shaped rock mulch structure (where the ends of the crescent point uphill), laid on contour. Only the downstream, largest rocks are anchored into the soil; others are on the soil's surface. Usually built of rocks at least 15 cm in diameter to avoid movement in a water-flow event.	Slows, spreads, and sinks flowing water, and transforms channelized water flow into calmer, shallower, and more spread-out sheet flow.	Use on relatively flat to gradually sloping, alluvial fan-shaped ground. Use where water carries a lot of sediment, so the structure can catch and hold sediment, thus slowing and capturing more water.	Ensure the ends of the structure are higher upslope than the middle of the structure, so water flows through and over, not around it. If water begins to flow around, add more rock on the ends of the structure.	If rock is unavailable, brush can be used with cut ends facing upslope, and staked in the ground with wooden stakes no higher than the brush. Pack tightly together and maximize contact with the soil below.

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RESERVOIR				
A pond catching and holding water on top of the surface of the soil.	Provides readily accessible water for irrigation and raising fish in times of no rain.	Place where gravity can freely distribute water to plantings below. Place where water naturally collects, and there is enough clay in the soil to retain water and slow infiltration. Place on gradual slopes where sediment naturally drops out of runoff flow, not on steep slopes where soil is carried away by runoff flow.	Stock with mosquito-eating frogs, fish, etc. to prevent the spread of disease. Slopes must be gradual enough that people and animals can crawl out of water. The shallower the reservoir, the hotter the water, and the more rapid the evaporation rate, so less efficient in hot and dry climates.	
RAINWATER TANK				
A tank collecting rainwater runoff.	Stores readily accessible water for irrigation or domestic use in times of limited or no rain.	Use to capture runoff from a roof or other clean surface. The cleaner the catchment surface, the cleaner the harvested water. Direct overflow to where it can be used as a resource.	Keep sunlight (which grows green algae) and mosquitoes out of the tank. A filter that keeps insects and other materials out but does not restrict flow is recommended. Overflow pipe/outlet must be as big as the inflow pipe/inlet.	Above-ground tank: gravity can freely move water in and out of tank. Below-ground tank: pump, siphon, or rope-and-bucket needed to access water in tank.
GREY WATER HARVESTING				
Once-used water, such as water from bathing or washing dishes or clothes, which is harvested or used again to irrigate plants.	Cycles or uses water more than once.	Use to irrigate perennial plants close to grey water source. Direct grey water to perennial plants whose edible parts will not come into direct contact with the water, the soap, or what was washed. Avoid using grey water to irrigate low annual plants.	Soils that are too wet for too long become anaerobic and start to smell, so: Direct the grey water to various places, rather than always putting it in the same one. Apply to well-vegetated and mulched areas that will rapidly absorb and use it. Do not put it in a tank because it will go septic and stink.	Grey water directed to mulched and vegetated basins on the surface. Grey water directed to subsurface basins.