Table S1. Promising Nature-Based and Climate Smart Solutions to support climate adaptation of Arizona's local food entrepreneurs and optimize One Health

Examples of observed climate-related threats: soil health degradation, water scarcity, extreme weather events, pest, disease and weed pressure.

Entry points within AZ food systems: gardens, small-scale farm areas, small rangeland units, housing and facilities for ruminants, backyard and community garden plots.

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
SOIL HEALTH DEGRADATION: Refers to the deterioration and decline of the overall health and quality of the soil. Soil health degradation is used to describe certain situations in which the soil functions, properties, and nutritional balance are negatively affected by several factors that contribute to the overall health of the soil. There are a multitude of factors that contribute to the overall health of the soil, including erosion, chemical contamination, salinity, nutritional balance, biodiversity, climate change, and compaction. These factors are the primary driving forces in the overall influence of the soil and have severe negative consequences on the overall crop yield and nutritional balance of the specific crops that are produced. With the increased effects of climate change becoming more persistent, Soil health Degradation is a major concern because it highlights the overall factors that contribute to the health of not only your soil to maintain nutritional balance and sustainability to grow crops but also how your soil can influence the nutritional value of the crops you are producing. Substantial and sustainable land management practices are essential to maintaining soil health, typically in a changing environment where factors like water scarcity, extreme heat, and nutritional composition are among the top major concerns that farmers, ranchers, and small-scale food production individuals are facing with growing crops in the state of Arizona.			
Biochar application Biochar commonly refers to charcoal made from organic wastes such as tree trimmings, scrap wood, and plant material left from agricultural harvests.	Biochar can improve soil quality and soil fertility, thereby enhancing crop productivity, enhance resilience to climate variability, and reduce greenhouse gas (GHG) emissions. It creates a use for waste organic material.	Adverse yield effects of biochar amendment have been reported. The positive responses were commonly reported in nutrient-poor and acidic soils, with no responses found in nutrient-rich soils and negative yield responses for alkaline soils.	https://extension.arizona.edu/biochar-workshop-kiln-demonstration https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1752-2017.pdf (Huang et al., 2023)
Bokashi Fermentation	When the bokashi digestate is mixed into the soil, it improves	Despite its benefits, the process may require special equipment	(Olle, 2021; WIPO, 2022)

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Bokashi technology is a straightforward yet innovative technology to recycle and valorize various kinds of biowaste into a nutrient-rich product that can be used as an organic fertilizer. Bokashi technology is a method for treating biowaste in general and food waste in specific, using controlled lactic acid fermentation under anaerobic conditions.	soil structure and increases water retention. Moreover, the process promotes beneficial soil and root microbiomes. Bokashi technology – coming from Asia (Japan) – is an innovative technology to improve soil fertility, plant health, yield and food quality.	and temperature control, limiting its application to certain waste types.	
Use of Biofertilizers Biofertilizers consisting of cyanobacteria, fungi (arbuscular mycorrhizal fungi, AMF) and bacteria (plant growth promoting rhizobacteria, PGPR). These microorganisms support the growth of plants by enhancing the nutrient supply to the host plant when given to seeds, plants, or the soil.	Biofertilizers can (i) improve and supply plant nutrients, (ii) regulate plant-growth, and (iii) improve soil condition and microbiome.	Biosafety of biofertilizers has received little attention.	(Rai, Rai, Sharma, Singh, & Kumar, 2023; Zhao et al., 2023)
Climate-smart/Desert Agroforestry Farming with land-use system in which trees, crops, and	The benefits include: the increased biodiversity, pest control, pollination, the recovery of degraded land, contribution to carbon storage. In arid areas like	The specific features of each of these systems vary strongly according to system design, objectives, and species involved. For example, potential food	The Southwest Agroforestry Action Network (SWAAN), https://swaan-site.org

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sometimes animals are combined within a managed farmland. Examples are windbreaks, alley cropping, silvopasture, annual and perennial crops under shade, live fences, food forests, etc. In a desert agroforestry system, winter vegetables are alley cropped between arid-adapted tree crops (e.g., mesquite) in fields edged with hardier desert crops (e.g., agave, prickly pear).	Arizona, selecting native or arid adapted trees, shrubs, and crops with high water use efficiency will support water conservation. Multiple harvests on the same acreage increases crop value per acre by while reducing water use and increasing yield stability.	safety issue with zoonotic pathogens must be considered in the planning stages to ensure livestock will not contaminate crops that are destined for human consumption. Limited water availability is a challenge for the adoption of agroforestry practices in the region.	(Isaac K. Mpanga, Schuch, & Schalau, 2021; Nabhan, Richter, Riordan, & Tornbom, 2023; Ntawuruhunga, Ngowi, Mangi, Salanga, & Shikuku, 2023)
Zero or no-tillage farming No-till, low-till or zero-till farming entails leaving the soil undisturbed to the extent possible by avoiding tillage before sowing and planting, and leaving plant residues on the soil surface after harvest. It is considered a highly effective soil conservation system.	Low- or no-till farming is reported to have many benefits including soil health and fertility, erosion control, water infiltration and use efficiency, soil structure improvement, carbon sequestration, weed control, etc.	The use of no-till and reduced tillage is associated with increases in herbicides and pesticide used especially in the early years of transition from intensive tillage.	(I Mpanga, Neumann, Schuch, & Schalau, 2020; WIPO, 2022)
Stubble-return with no till Stubble-return with no till, also known as no-till with stubble return, is an agricultural process that involves leaving residue	Technique is the best conservation tillage strategy in the semi-arid environmental zone that increased crop yield	Some Investment in equipment may be needed, depending on the plot size.	(Yuan et al., 2022; USDA, 2022)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
from previous crops that were harvested in the soil to be used as a natural mulch. This method is to promote overall soil health, with additional benefits like erosion control, moisture control, nutrient cycling, and more.	without significant increasing soil N2O emissions. Improve soil structure and helps with moisture conservation. Can reduce the presence of weeds being able to cover and inhibit weed growth by creating a barrier that hinders the emergency of weeds and other invasive growth. Can help regulate soil temperature, especially in areas that receive extreme temperature changes, particularly during the winter months in Arizona.	Some crops may not be suitable for no till. Transitional wait periods between no till with double retention, may be longer than usual, and may not be suitable depending on the crop growth cycle or season. Maintenance and surveillance for soil compaction is needed to be maintained and controlled. Potential reduction in soil warming can interfere with the growth, during springtime and during warmer, seasonal growth.	
Cover crops Cover crops are grown to cover the soil surface. They are planted between main crops or as an alternative to cash crops. Cultivation of mixed summer cover crops (buckwheat, pea, cowpea, and teff Grass) in high tunnels.	Cover crops add organic matter and help break down organic materials such as manure, increasing the availability of nutrients to the main crops that will follow. Cover crops improve soil aeration and water infiltration through their growing roots, which penetrate the soil and leave	The cover crop could serve as a host to plant disease and pests. For example, leguminous cover crops (lablab and hairy vetch) are reported to be a host for plant-parasitic nematodes. Cover crops, such as Sudan grass and millet are aggressive growers. Termination of these crops could be challenging	https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1982-2022.pdf (Idowu & Grover, 2014; I Mpanga, 2022; USDA, 2020)

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Compared to a standard greenhouse, a high tunnel is a low- cost structure, often with in-ground production, and low operating costs. One of the ways for cover cropping in semi-arid dryland systems is to combine no-till or minimum tillage with cover cropping. Reducing tillage intensity can help improve soil health, promote water infiltration, and reduce evaporative losses during the period that the cover crop is growing. Moisture utilization by the cover crops is counterbalanced by the improved infiltration and reduced evaporative losses that occur in no-till and minimum tillage systems. Cold season cover crops Winter cover crops provide ground cover during late fall, winter, and early spring.	spaces for water and airflow after decay. Cover crops increase biological activity and diversity in the soil, improving soil health. Root exudates are carbon sources for soil microbes, which stimulate beneficial soil microbial communities. Legume cover crops such as peas convert or 'fix' atmospheric nitrogen into plant-available forms through symbiotic relationships with Rhizobium bacteria in root nodules. Cover crops serve as catch crops by holding minerals from leaching for the subsequent main crop, which could reduce fertilization requirements for that season. Cover crops provide pollinator habitat for bees and other beneficial insects such as ladybugs. These beneficial insects may help pollinate the main	without heavy machinery such as tractor. The use of cover crops among small-scale farmers can be challenging due to the limited space, resource, equipment needs, water scarcity and the nature of operations. Cover crop success depends on selection of the best adapted cultivar or variety that meets the planting objective.	

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Crops that are selected as winter covers must be cold-tolerant. There are several cool-season grasses (wheat, rye, oats, and barley) and legumes (clovers, vetches, and field peas) that are adaptable to the Southwest. When using winter covers, attention must be paid to how early or how late in the season a cover crop is planted.	crops and control detrimental insects. Cover cropping makes the soil more resilient to drought and other extreme environmental factors.		
SMART Nutrient Management This approach includes the 4Rs of nutrient stewardship – the right Source, right Method, right Rate, and right Timing – and emphasizes smart activities to reduce nutrient loss by Assessment of comprehensive, site-specific conditions.	The SMART nutrient management plans optimize plant yields while reducing the amount of nutrients lost to the environment, where they can impact greenhouse gas emissions and air and water quality. It is tailored to the unique farm location, soil, climate, crops grown, management conditions, and other site-specific factors.		https://www.farmers.gov/conservation/nutrient-management (USDA, 2022)
The Zai Technology ("planting pockets", "planting basins," "micro-pits," and "small water harvesting pits")	This conventional farm technology is designed to rehabilitate degraded lands, conserve soil moisture and improve farm yield.	Small-scale farmers may face difficulties in implementing Zai technology due to the labor and time requirements.	(Osei Danquah, Ankrah Twumasi, & Asare, 2019)

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The Zai technology refers to small planting pits in which organic matter (manure, compost or dry biomass) is buried before planting the seed in those pits. The addition of organic matter improves infiltration and increases soil nutrient making degraded land available again for cultivation. The organic matter buried in the soil attracts termites and other soil insects, which help in maintaining soil structure. When maize or millet is planted in the pit, the seedlings are protected from wind damage. The Zai pits can hold water over 500% of the water holding capacity of the soil.			
Green Manure Green manure is a process that refers to crops that are grown on a plot of land for the sole benefit of improving soil health rather than being harvested. These crops are incorporated into the soil while they are still green to promote soil health.	Benefits the soil for crops as plants are grown and then plowed to improve its fertility and structure. Provides nitrogen, balance to soil and regulates soil nutrition. A reduction in soil compaction, helping slow and reduce erosion.	A reduction in seasonal limitations can interfere with how frequency can be used incorporated into the soil. Improper incorporation of green manure into the soil can lead to a reduction and seed to soil contact, while improper incorporation can also lead to the	(Valizadeh et al., 2023)

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		increased risk of pest and rodents.	
Gypsum Gypsum, a mineral composed of calcium sulfate dihydrate, is used for agricultural purposes and for soil health. It is used for soil structure, enhancements in nutrient compositions, salinity balance, and more. The rate of gypsum used depends on what soil outcomes or issues need to improve overall soil health.	Improvements and soil structure, allowing for the aggregation of soil particles, while reducing soil, compaction and enhancing water filtration. Gypsum can help to flocculate clay particles making the soil more pliable for growing. Regulates an increase calcium content within soil to help plant nutrition improving route development. While increasing water movement within the soil. It's shown to improve soil structure of being able to balance, sodium ions and salinity within the soil.	Gypsum Works best and soil structures that are high in clay contents, and work well in soil with high sodium contact. Soil with low clay content or in sandier/loser soils has a reduction in the overall benefits from gypsum. Overuse can lead to an excessive accumulation of calcium in the soil need to improper nutrition balances when used incorrectly and two frequently. Application of gypsum can be affected by the dryness and the wetness of the soil, as well as potential cost related to the use.	(Xin et al., 2023)
Compost blankets Compost blankets are erosion control devices that are used for crops to reduce erosion from the soil caused by watering, wind,	Using a 50-50 mixture of compost and mulch reduces the most erosion on fields. Using different slops, the 50-50 mixture of mulch was able to reduce soil erosion by 39%, 74%, 78%, at their	The rates of which the decomposition occurs that can be increased due to heat. Prone to wind, erosion, and open arid areas. Regular monitoring,	(Bhattarai et al., 2011)

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slope, and weather. These blankets can come in different forms to better address erosion and are usually made from compost held together by bridgeable netting.	respective slops. Using both a mix and mulch covers had a more effective erosion control measures for 4% slope, when compared to compost cover. By using compost blankets and using mix and mulch covers can reduce erosion of plots caused by storms and watering. Using at different slops reduce the speed of erosion, and using a mix method showed the most effective results, by using a mix method. Erosion is a major issue with farms and being able to reduce erosion can prevent from soil being less nutrient and control the salt/mineralization. While it can improve moisture absorption and regulation using less water and decreasing water loss.	and maintenance is essential to ensure the effectiveness as well as reducing the cost of attributed to using compost blankets.	
Zeolite Zeolites are hydrated aluminosilicates of alkaline and	Zeolite soil conditioners or amendments may provide many benefits such as improved water infiltration and reduced surface water run-off and nutrient leaching. Benefits from zeolite	Many factors such as soil texture type, water, fertilizer, and spreading capabilities affect applications of zeolites, which makes it difficult to give specific application rates that work for	(I Mpanga, Walworth, & Braun, 2020; Isaac Kwadwo Mpanga, Gaikpa, Koomson, & Dapaah, 2023)

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alkaline-earth metals with very porous structure. Those commonly used in crop production as soil conditioners are clinoptilolite, erionite, and mordenite.	application could translate to increased yield, more efficient use of nutrient inputs, and reduction in environmental pollution of nitrogen (N) and phosphorus (P) in bodies of water, as well as reduction in greenhouse gas emissions. The high cation exchange capacity and porosity of zeolites allows them to absorb and trap greenhouse gases such as methane (CH4) and carbon dioxide (CO2).	all. Appropriate application rates should be determined using test plots before applying on a broad scale. The major challenge with zeolite application in alkaline Arizona soils could be potential increases in soil pH. Removing zeolite from the soil after application is not practical, so it's very important to initially test for effectiveness in very small areas of land.	
Buffer strips Buffer strips are areas of vegetation that are placed in areas between framing land or urban areas to combat flooding and water runoff. Buffer strips are used to help with flood control while also promoting water quality, ecosystem health, and sediment and pollutant filtration to reduce the impacts of contaminants in water.	Buffer strips can be used as a Natural filter that helps traps, sediment, nutrient, and other pollutants from runoff before they reach water or irrigation systems. Buffer strips can reduce the impacts of flooding by absorbing the excess water that happens during heavy rainfall. Buffer strips can be implemented on larger plots of land. It can help control flooding around	Consistent maintenance is required to ensure the effectiveness of buffer strips, as well as adapting the buffer strip to the natural landscape, and ensuring that buffer strip can be designed to fit the area it's to be implemented in. Can be a substantial cost, depending on the ratio of land available to construct buffer strips.	(Dunn et al., 2022)

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	infrastructure of the home and other farming related facilities. Reducing in erosion and sediment loss.	During heavy rainfall sessions and floodplain areas, buffer strips may need more maintenance than other areas to ensure their effectiveness, but also the structural components.	
Rotational grazing Rotational grazing involves the frequent movement of livestock through a series of pasture subdivisions called paddocks. This frequent movement allows plants to rest and regrow to grazing height while livestock graze other paddocks. The length of grazing and rest periods is ecosystem dependent and differs depending on forage yield. Each paddock must contain forage, water, and adequate shade. Rotational grazing has been implemented with livestock including cattle, sheep, goats, and horses.	Rotational grazing has many potential environmental and economic advantages. Improves soil structure, biodiversity, cover, organic matter, and carbon sequestration. Prevents overgrazing, reducing runoff, limiting soil erosion, and improving water quality. Increases pasture drought resilience. Better distributes nutrients from manure throughout a pasture. Increases forage for livestock and animal productivity.	Requires more fencing and labor (though virtual fencing is an effective alternative to traditional fencing). Requires water and shade to be accessible in each paddock. May result in soil compaction and degraded water quality if livestock are not moved regularly. May increase internal parasites in irrigated rotational pastures (compared to rangelands). May only be effective on rangelands when combined with lower stock density.	https://www.climatehubs.usda.gov/hubs/international/topic/rotational-grazing-climate-resilience#:~:text=Rotational%20grazing%20could%20help%20ranchers,of%20pasture%20subdivisions%20called%20paddocks.

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	Reduces costs and increases profit. Results in fewer herd health problems. Makes livestock tamer and easier to move (with continuous handling). Reduces pesticide use. Can reduce greenhouse gas emissions from livestock by eliminating manure storage facilities, improving forage quality, and sequestering soil organic carbon in rangelands.		
WATER SCARCITY: Refers to situations where the demand for water access exceeds the available water supply that currently exists. Water scarcity leads to an influx of insufficient and inequitable access to clean and safe water for drinking, agriculture, and hygienic purposes. Water scarcity is influenced by both natural and human factors. With climate change increasing the severity of this issue, it's important to note that population growth, climate change, poor water management, extraction of groundwater and aquifers, land use changes, urban infrastructure, droughts, and political conflict instability are the major factors that equate to the unequal distribution of water and the increase of water scarcity among both rural and urban population centers and industries. Addressing water scarcity requires a combination of sustainable water management practices, conservation efforts, and innovative water-efficient technologies to adequately adapt practices that use water to ensure the sustainability of those specific industries and practices while also maintaining ecological sustainability to reduce the threat and severity of water scarcity in particularly desert regions like the state of Arizona. While major industries in Arizona use substantial amounts of water, it's important to highlight that individuals, small-scale farmers, and food entrepreneurs can make great strides in reducing their overall water consumption and innovating water management without sacrificing the importance that water has in influencing and sustaining crop growth.			

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Water scarcity will be a continuing threat within the state of Arizona, thus ensuring a strong push for innovative and sustainable nature-based solutions to water management without the major sacrifice of crop yield or economic growth.			
Rainwater harvesting (RWH) RWH is the practice of centralizing, collecting, and storing rainwater for later use. The rainwater harvested is mostly clean and suitable for drinking and domestic use after treatment, and can be used directly for crop irrigation, livestock and poultry, and post-harvest activities that add value to crops. Technologies available: photovoltaic panel rainwater harvesting system.	RWH requires minimal engineering and construction, low cost, and maintenance all while collecting water that can support outdoor purposes, particularly, irrigation for crop production. It is feasible in arid and semi-arid climates and can improve rain-fed farming systems to help manage water demands, water scarcity, and food insecurity.	The decrease in average annual precipitations that can be attributed to the ongoing drought dominated the Southwestern US in the last two decades. Harvested rainwater needs to be extensively treated since it can be a source of chemicals and pathogens that can diminish the safety of fresh produce. There is the prevalence of organic matter such as bird/small animal excreta containing pathogens.	https://www.ifad.org/documents/38714170/44974319/water_harvesting_systems_e.pdf/db7f07db-1348-8608-aaf0-0ca8b8b648d5?t=1645448163566 (Hernandez Rosales & Lutz, 2023; Rao, Patel, & Pradhan, 2022)
Sustainable atmospheric water harvesting Atmospheric water harvesting (AWH) devices are categorized by energy source—active devices use external energy sources whereas passive devices rely solely on atmospheric conditions	Atmospheric water harvesting shows promise to accelerate decentralized access to underserved communities. AWH devices have the potential to be low-cost.	Fog harvesting technology is obviously limited by fog occurrence. In contrast, dew water harvester is available everywhere but requires a cooled condensing surface. If water is being collected for drinking water, then attention	(Jarimi, Powell, & Riffat, 2020; Lord et al., 2021)

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that allow for pre-condensed dew or fog to be harvested.		must be paid to potential contamination. Fog nets, passive radiation and even desiccant collectors may be fouled with algal and bacterial growth and bird droppings, so the water obtained may need to be treated before being drunk. The problem of legionnaire's disease in a/c water tanks is well known. Atmospheric pollution, such as soot particles, might also be a hazard. Comparable problems might occur with active collection devices.	
Swales Swales are small, shallow ditches or channels used for flood management and water filtration during times of increased water presence to combat flooding and runoff. Swales are adaptable to the area they are being placed in and can act as a mini ecosystem when excessive flooding and water runoff are not present.	Swales are small shallow ditches along contours to capture and slow down the rainwater runoff. These can help retain water reduce erosion and improve soil fertility. They can remove metals and other solids from water runoff by using pretreatment grass filter strips or vegetated check dams. Can reduce potential of floods from streets and storm drains by diverting the water away from	Depending on the size of the swale, it could be costly, depending how built the road Infrastructure is to see if their space suitable for integrating a swale. The slope dependency can determine whether you will provide an effective way of filtering water runoff. Limited water storage capacity, during large weather events, these can overflow because they	(Stagge et al., 2012; Yu et al., 2001; Monrabal-Martinez et al., 2018)

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	farmland and farm infrastructure, from city streets and highways that contain higher number of metals, oils, and other toxic pesticides. Can be used in more arid and desert landscapes by diverting water from industrial and or city streets, to avoid contamination to farmland.	have a limited water capacity and often not free flowing, which can also raise the issue of mosquito breeding grounds if water is stagnate or not removed and treated.	
Grey Water Harvesting Grey water harvesting involves collecting and treating water from domestic uses like laundry, dishwaters, showers, and sinks for non-portable uses. Grey water harvesting can be used for other larger-scale land management purposes and hygienic uses as it is treated for pathogens and relatively clean, which can be used for non-vegetable farming and other activities.	Small scale gray water harvesting can use water from dishwashers, washing machines, and showers to be used to water trees, and other vegetation that is not fruit or vegetable based. That same graywater can be used for flushing toilets, cleaning farming equipment, other non-vegetable, and fruit-based farming. Gray water can be used more effectively, if the water collected from dishwashers and washing machines use biodegradable soap. That water can be collected and used for free flow irrigation	Making sure individuals use biodegradable soap for washing machines, and dishwashers to ensure that no further purification is needed for free flow irrigation, and for other purposes, like flushing toilets and cleaning cars, etc. Information regarding proper use, and safety measures for using graywater, especially without using any sort of chemical treatment for pathogens. Increase sodium and chloride levels in graywater can cause	(Khajvand et al., 2022)

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	intensive purification or sterilization of water.	damages to plants and other agriculture. Graywater cannot be the only source of irrigation as it could reduce the ability for soil to retain water, as well as changing the salinity.	
Olla irrigation Use of low-fired, clay ceramic vessels (ollas) an ancient technique for the efficient irrigation of crops.	Olla irrigation is a conservation irrigation system, which may save between 60 – 70% of water when compared to the conventional irrigation system. Olla irrigation is a simple technique that is rather inexpensive and easy to execute.	Since they must be buried in the ground, ollas take up their share of space in the garden, which can prove to be a challenge for very small gardens. Hand filling can be time consuming and unreliable if one forgets to check the ollas, or needs to go on vacation, etc. Salts may build in the olla and clog the pores of the olla. Additionally, seedlings and new transplants will need supplemental water for some time until their roots can find their way towards the olla in	https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1911-2021.pdf (Bainbridge, 2001)

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		order to tap into the consistent water source. This can take up to a month or more before the plant is able to subsist on water from the olla alone.	
Drip-draining Drip-draining irrigation is where water is directly delivered to the roots or the base of plants through a network of tubes and hoses to reduce water evaporation and water loss. This method can be formed and adapted to fit different plots of land and vertical farming while drastically reducing water loss during peak heat and drought-prone areas.	Reducing in water loss during watering and reduced the amount of salt produced. Can fit small and different shaped plots and slops. Works well in areas with consistent drought issues and watering time practices. Less water is wasted provides more consistent watering system to the crops. Can be effectively used in tower farming structures and adopted into less traditional method of farming.	Spacing between spouts can change the rate of which the soil stays most at, can lead to improper watering if spouts are spaced, too large apart and too little spouts. Improper water pressure controls can affect the rate of which water is being distributed. The design of the drip draining system can limit the overall flow of water and affect the distribution of the water, with improper water flow. Regular maintenance is needed to ensure that pipes and tubes are not clogged to mineral buildup.	https://www.nrcs.usda.gov/sites/default/files/2022-11/2022-small-scale-solutions-factsheet-LOW-COST-IRRIGATION-SYSTEM.pdf (Jiang et al., 2023)

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Gravity Micro Irrigation N Drip Irrigation provides an easy-to-install economic solution that uses the field's existing infrastructure and is powered by gravity (i.e., a low-pressure, low-flow system). As a result, water flows efficiently using sustainable energy while lowering labor costs and money spent on fertilizers.	There are several evidence-based benefits produced by the technology: Maximizing Yield Potential, up to 33% increase in yield. Saves up to 70% of water use and manages water flow. Saves up to 70% of energy consumption due to less water usage. 100% Recyclable, both dripper & lateral are made from the same polymer, enabling complete recycling. Protects soil fertility, due to no runoff. Eliminates runoff and top-soil erosion and saves on the cost of annual field leveling. Ensures efficient use of fertilizers. Irrigation method easily adapts to changing weather conditions.	It is necessary to determine N-Drip's overall effectiveness over multiple seasons.	https://ndrip.com

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Bio-based hydrogels Hydrogels prepared from biopolymers are considered non-toxic, biocompatible, biodegradable, and cost-effective. Hydrogels based on biopolymers finds important applications in the agricultural field where they are used as soil conditioning agents as they can increase the water retention ability of soil and can act as a carrier of nutrients and other agrochemicals. Hydrogels are also used for the controlled delivery of fertilizer to plants.	Water retention – increased water holding capacity. Controlled release of nutrients – more efficient nutrient uptake, reduce nutrient leaching, and minimizes fertilizer wastage. Improved soil structure – improve soil structure and porosity, leading to better aeration and root penetration. Reduced water runoff and soil erosion – reduce soil erosion and nutrient loss, preserving soil fertility and ecosystem health.	Low mechanical strength – natural materials typically have lower inherent mechanical strength. Limited nutrient range – certain complex nutrients or trace elements may not be suitable for encapsulation in hydrogels. Expensive to produce – the initial investment might be a barrier to adoption for farmers, particularly those with limited financial resources. Application logistics – require specialized equipment or techniques. Ensuring uniform distribution throughout the soil can be challenging.	(Tariq et al., 2023)
Breathable sand technology Breathable Sand is produced by treating typical desert aeolian sand with special technology to make it water-repellent and air permeable.	The breathable sand, the only one of its kind in the world, delivers on two key challenges farming in semi-arid and arid areas as well as water conservation. Made up of regular sand particles, coated using a special technology, this 'magic sand' can retain water much	More pilot studies on scaling up the technology among small-scale food producers and entrepreneurs are needed.	https://www.sustainabilitymenews.com/agriculture/dake-rechsand-fostering-sustainable-farming-with-breathable-sand https://english.alarabiya.net/News/gulf/2023/03/31/-Breathable-sand-How-the-UAE-s-deserts-

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
So, in agricultural applications, Breathable Sand retains the provided water for an extended period of time while allowing free passage of air, thus enabling optimal nutrient supply to the roots. The efficient nutrient supply, along with water retention and fertilizer preservation, leads to optimal agricultural yield. In local case studies (the Middle east), it was observed water retention up to seven days after one-time irrigation. On average, that reduces water requirements by nearly 80% compared to conventional farming practices.	longer while also allowing free circulation of air, unlike other hydrophobic materials. Even traditionally high water consumption crops like rice and several varieties of fruit and nut trees can be easily grown in desert regions, without the need to for excess water or chemical fertilizers and pesticides.		can-be-a-solution-for-climate-change
Precision agriculture (PA) technologies More efficient production, especially input optimization, is the core element of PA, e.g., site-specific nutrient management. PA can be a modular system that allows small-scale farmers to introduce this gradually, element	The benefits related to lower input use (seeds, pesticides, fuel, working hours, etc.). Due to savings in GHG emissions, PA can contribute to climate change mitigation. PA can contribute to achieve higher production efficiency, either by lower/optimized input use or by higher outputs;	The extremely small size of the farmland seems to be the major obstacle to the increasing spread of precision farming technologies. However, PA can be used modularly; therefore, they can be introduced step by step. The purchase of new machinery may not be feasible, but the	(Mizik, 2023)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
by element – according to their financial opportunities and farming needs.	therefore, they can result in higher revenues and/or profits. Higher profits are important for small-scale farms as they have fewer financial resources compared to large(r) farms.	update of existing ones is a promising option due to the integrated, built-in PA technologies.	
EXTREME WEATHER EVENTS: Refers to unusual, severe, or unanticipated weather conditions that are far from the norm for that region and time of year. Extreme weather events create significance and devastating impacts on ecosystems, infrastructure, communities, and economic loss to a particular region or community. In the state of Arizona, the major extreme weather events that mainly occur here are prolonged extreme heat waves, flooding, droughts, and wildfires. While other extreme weather events can occur within the state, heat-related extreme weather events are the most threatening factor to the state and pose an increased risk to crop production, ecosystem balance, and human activity. Thus, it is important to have adequate and innovative solutions to counteract extreme weather events within the state.			
Photo-selective shading screens/nets made of biobased plastic/natural materials	In summer seasons, combining external movable shading screens with evaporative cooling, could decreases greenhouse air temperature by 5–10 °C, the transmitted solar radiation by 30–50% and increases the relative humidity by 15–20% than the outside temperature. Shading screens are used for reducing the vulnerability of hail and wind damage; extension of the growing period and delay of fruit ripening; reduction of radiative heat loss and cooling at night.	There is a lack of information regarding shading nets made of natural materials. Nonbiodegradable plastics are the materials of choice in agricultural applications. Different crops might show different growth and quality responses under the same shade nets.	(Mahmood, Hu, Tanny, & Asante, 2018; Maraveas, 2020)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
Planting of climate-resilient crops: heat and cold-tolerant Climate-resilient crops and crop varieties have enhanced tolerance to biotic and abiotic stresses. They are intended to maintain or increase crop yields under stress conditions and thereby provide a means of adapting to diminishing crop yields in the face of droughts, higher average temperatures and other climatic conditions. Adoption of climate-resilient crops, such as early-maturing cereal crop varieties, heat-tolerant varieties, drought-tolerant legumes or tuber crops, crops or varieties with enhanced salinity tolerance can help farmers to better cope with climate shocks.	Extreme weather tolerant crops, grasses, and native plants, which may assist in maintaining agricultural production for food and feed and sustain grasslands and rangelands in the arid Southwest. Alternative crops can provide essential nutrients, cover nutritional gaps in Arizona, diversify existing production systems, and improve sustainability.	Existing demand is still relatively small, which could pose an implementation barrier for farmers. Alternative crops could lead to a transformation towards more sustainable and climate-resilient agro-food systems only if they are complemented by behavioral changes on the consumer side.	https://extension.unr.edu/publication.aspx?PubID=2205 https://extension.usu.edu/apec/files/Drought-TolSWAgEdibleProd.pdf (Acevedo et al., 2020)
Biostimulants Biostimulants are compounds and materials that can be applied to plants, seeds, or growth components, in the form of	Biostimulants are designed, among other activities, to support plants when abiotic stress occurs, caused by the	Food producers should consider biostimulants that have been used in a set up that is similar to their own growing operation. Currently, much of the research on biostimulants is on herbs,	https://www.extension.iastate.edu/smallfarms/biostimulants-101#:~:text=Biostimulants%20are%20a%20fast%2Dgrowing,a%20v

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
formulations that are intended to promote plant growth and development, as well as stress resistance, without the influence of a nutrient. Biostimulants products often fall into one or more of these categories below: humic and fulvic acids, plant and seaweed extracts, symbiotic bacteria, fungi, protein hydrolyzates and amino acids.	environment, where high salinity or drought can occur. The use of natural plant products, with such a wide range of activities, allows reducing the amount of artificial chemical compounds introduced into the environment during agricultural cultivation. Such products are considered safe for the environment.	vegetables, and other horticultural crops within greenhouses rather than row crops such as corn and soybeans. Prior biostimulants research has revealed that many products have highly variable effects depending on the crops it is used on, the timing of application, and environmental conditions.	ariety%20of%20biological%20processes. (Sojka & Saeid, 2022)
Firebreaks/Fuel breaks Firebreaks, also known as fuel breaks, are strips of land or blocks of vegetation that are more fire-resistant to reduce the spread of wildfires or help gain control over fires. Fire brakes can be used to help add additional protection for vulnerable ecosystems, as well as being implemented to help reduce the economic loss from lost crop yield and infrastructure.	Firebreaks can be implemented to be a buffer that can be reduce the spread of wildfires that can pose a threat to crops and framing infrastructure. Fuel banks help with land management and can prevent a reduction in biodiversity loss up to 30% compared to areas with no fuel breaks or firebreaks. Low-cost land management for rural farms in closer proximity to forest and city edges.	Limitations for firebreaks can included maintenance levels, some areas will need more consist of land management as cost more time but can be kept still a low cost. Misunderstanding of the direction of wildfires and the potential for embers to cause fuel breaks to be less effective. Drought can impact the effectiveness of fuel breaks and firebreaks which can lead to more issues if firebreaks are	(Carrasco et al., 2023; USDA, 2022)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
		solely made from vegetation and other flammable debris.	
Landscape Vines Landscape vines can be used as insulation for cooling and maintain temperatures in more arid and desert landscapes. These vines can provide shade during the hottest and most sun intensive months of the year but can also provide additional benefits during winter months as they can help with insulation.	Can help with cooling and maintain steady temperatures during peak heat and cold seasons. Evergreen vines can be suitable to be beneficial year-round without major maintenance to building structure or the vines themselves. Deciduous vines are seasonal and can provide more shade during the summer months while during winter months they allow sunlight to hit buildings and infrastructure. They lead to a reduction in energy use for cooling leading to less use of energy and temperature stabilization.	Depending on the location a evergreen may be not as effective as a deciduous vines maybe during the time of the year. Trellis installation would be needed to reduce potential infrastructure damage and allow for vines to grow along the walls of the building or man-made structure. Frequent maintenance would be needed to maintain health of vines and overgrowth. Direction of wall can effect growth of the vines and should be facing south or west facing walls to block sunlight during the hottest times of the day.	(Warren, 2013)
Locally adapted livestock breeds The use of heritage cattle breeds (Criollo cattle)	Cattle adapted to harsh desert ecosystems may offer genetic opportunities for optimizing beef production from arid ecosystems.	While raising Criollo cattle has its benefits for ranching operations, there are challenges to getting Criollo meat to market. Criollo cattle are smaller than other	(Cibils et al., 2023; Lamonaca et al., 2023) https://www.goodfoodfinderaz.com/blog/2023/2/2/criollo-cattle-

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The Criollo, a heritage breed, descended from Spanish cattle brought to Mexico centuries ago and evolved in northern Mexico's rocky, arid climate. The breed has adapted to dry rangelands and could help regenerate soil while needing less water and feed than other cattle.	The anticipated benefits are the reduction of veterinary costs, the improvement of animal performance, the increase in quality of the products. Grass-fed, naturally raised, locally produced meat products (healthy beef products).	breeds and there are few existing meat processing plants that are suited for small-framed animals.	as-a-solution-for-ecosystem-regeneration
Locally available alternative feed resources rich in bioactive compounds Feeding strategies based on agro-industrial by-products, both raw and processed animal feeds (e.g., date and artichokes scraps, pomegranate pulp and grape pomace, olive cakes) may upscale the efficient use of underutilized by-products.	Local alternative feed resources rich in bioactive compounds, such as agro-industrial by-products, could play a key role in small-scale livestock farming systems, allowing animals to cope with the adverse environmental conditions through their methanogenic mitigation, reproduction promoting, antimicrobial/antiparasitic, antioxidant and product quality enhancing properties. The potential methanogenesis reduction should also contribute to mitigating climate change indices related to the livestock sector.	Unexpected obstacles may occur during the ensilaging of by-products when upscaling the processes at the small-scale farm level. The variability of final products could not meet the standardization requirement of end user. The presence of pollutants above legal limits in agro-industrial by-products used as alternative feeds might prevent their use in some feeding strategies. The seasonality of production that could hinder the availability of agro-industrial by-products to be used as alternative feeds in small-scale farming systems or to	(Lamonaca et al., 2023)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
		the availability of critical mass for animal feed.	
Heat stress management in small ruminants Climate change is the most serious long-term challenge faced by small ruminants' owners as it impacts animals' production and health. A variety of methods should be adopted by small ruminant producers/owners to overcome the negative effects of heat stress (HS), including the use of shades, feeding and grazing strategies, providing water, handling time, the use of fans and evaporative cooling, and site selection of animals' housing.	Heat stress management strategies address animals' comfort, water consumption, feed intake, milk yield and quality, meat quality, and reproduction and fertility. Control is based on the provision of drinking water, adjustments in animals' diets during HS (such as increase in the energy density of rations, the use of feed additives, etc.), use of cooling mechanisms (shade and fans), the use of strategies to reduce the impact of HS on fertility (i.e. timed mating programs during summer), and scheduling animal activities in the early morning and evening when temperatures are not as extreme.	For optimal results, the people who care for animals should have appropriate education and experience, understand the species requirements and have good observational skills.	(Al-Dawood, 2016)
Evaporative cooling Evaporative cooling is a high-potential technological innovation that can help preserve fresh foods. Evaporative coolers	Passive evaporative cooling has a huge potential for helping to preserve fresh fruit and vegetables longer after harvest.	The evaporative cooler should be used in a location with the right environmental conditions and at the right time of the year to enable sufficient cooling.	(Defraeye, Shoji, Schudel, Onwude, & Shrivastava, 2023)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
extract heat from the surrounding air and the fruit or vegetables in the cooler. The reduced rate of food deterioration at lower temperatures and the reduced moisture loss help preserve the fruit or vegetables longer. Evaporative coolers work best in dry and warm regions. Several types of evaporative cooling systems are known.		There is little economic incentive for companies to produce and disseminate such small-scale cooling. As a result of this limited scientific and economic interest, the scientific basis of evaporative cooling devices is also rather limited.	
INCREASED PEST, DISEASE, and WEED PRESSURE: The effects of climate change have been a driving factor in increased risk from pests, diseases, and weed pressure. The indirect threats have been increasing in frequency and severity because of climate change. Factors like warming temperatures extended growing seasons, altered precipitation levels, shifts in plant phenology, invasive species expansion, water scarcity stress, urbanization, monocultural practices, and pesticide resistance have led to an increased threat to agricultural and ecosystem development and resilience in the state. This need for nature-based solutions is vital to mitigating the effects and reducing the threat of pesticide and weed resistance. Creating and adapting to pests and other related threats is essential to mitigating the economic and ecosystem impacts on small-scale farmers and ranchers.			
Biopesticides Biological pesticides (biopesticides) are substances produced from biological agents. Biopesticides are an effective alternative for the control of	Biopesticides are cost-effective, environment-friendly, specific in their mode of action, sustainable, do not leave residues, and are not associated with the release of greenhouse gases.	Biopesticides are often ranked as having low efficacy and a slower rate in the control of pests and diseases. Commercial biopesticide products are highly expensive	https://www.epa.gov/pesticides/biopesticides (Cardoso & Carmello, 2022; Ngegba, Cui, Khalid, & Zhong, 2022)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
pests, diseases, and weeds in food production. Biopesticides can be sourced from microbes (e.g., metabolites), plants (e.g., from their exudates, essential oil, and extracts from bark, root, and leaves), and nanoparticles of biological origin (e.g., silver and gold nanoparticles).		and not readily available in the global market. Biopesticides also face quality control problems and concise shelf-life.	
Semiochemicals Semiochemicals (the chemical signals used by pests) are signaling molecules produced by organisms, including plants, microbes, and animals, which cause behavioral or developmental changes in receiving organisms. The best known and developed group of semiochemicals is pheromones.	Semiochemicals are very specific to insect species, so they will not affect nontarget organisms. They are nontoxic to the environment due to their natural origin. Wider focus on vector control, food security/ safety, and pesticide risk reduction.	Semiochemical formulations are physically unstable and volatile, and the active ingredient may be sensitive to temperature and light. There is high cost compared to traditional methods that employ manual application and irregularity that comes with the formulation to achieve a certain release rate.	(Egan et al., 2021; Thomas et al., 2023)
Companion planting	While the benefits of companion planting vary depending on the crops selected, certain benefits	However, there are also drawbacks to planting a companion crop. These disadvantages include: the	https://extension.arizona.edu/sites/extension.arizona.edu/files/at

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
Companion planting is a gardening technique where different plant species are grown near each other for mutual benefits. Companion planting is best defined as the practice of planting different plant species in close proximity so that they can offer identifiable benefits to one another. Sometimes the benefit is one-sided, with one plant selflessly offering most of the partnership advantages to the other.	are common to most plant groupings, such as: *Increased yields.* The main benefit of companion planting is its ability to maximize crop yields. The exact mechanism behind this varies according to the different plant combinations. Cornstalks, for instance, provide a living trellis that beans can climb and thrive on without needing an artificial structure or trellis. *Maximizing space.* One of the few companion planting benefits shared by most plant species is maximizing garden space. *Soil health.* Certain plants can improve the nutrient quality of the soil. Beans, peas, and clover are some of the most popular choices because they add nitrogen to the soil. Other species, such as carrots and radishes, can help prevent the soil from getting too compacted.	potential for competition over water and nutrients, which could lead to a decrease in overall vitality the requirement of the main crop to fill in any vacant spaces once the companion crop is removed; otherwise, weeds may take hold. Many crops can be used for companion planting. But each plant will interact differently with the other species present on that plot of land, so it is important to research combinations before starting.	tachment/CompanionPlantingApr 2023.pdf

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
	Repelling pests and weeds. Some plants can act as a repellent for both pests and weeds. Dill, for instance, attracts predators that feed on pests. Marigold releases a chemical that repels root-eating nematodes.		
Beneficial insects and natural predators Encouraging the presence of beneficial insects, like ladybugs and parasitoid wasps, can help control pest populations. Farmers can provide habitat and food sources for these insects to attract and retain them on their farms. Plants can be used to attract beneficial insects or repel destructive insects. Three primary ways plants attract insects: 1. Producing a variety of smells/scents. 2. Providing habitats and food.	Beneficial insects perform vital functions of the environment through pollination, soil aeration, breaking down dead materials and waste, feeding wildlife, devouring harmful insects. There are three types of beneficial insects: predators, pollinators, and parasitoids. Beneficial insects around Arizona help control pests through a variety of mechanisms. Some species will use the pests as a food source, while others will use them as hosts for their eggs. Buying beneficial insects is a lot faster than waiting for the populations to increase naturally.	In general, releasing large numbers of beneficial insects has not proven to be an effective method of pest control in the home garden, especially in the case of adult lady beetles. All beneficials require a reliable food source, and some require a very specific food. Some beneficials also require specific temperature and humidity conditions.	https://extension.arizona.edu/sites/extension.arizona.edu/files/attachment/vegetablegardeninsects-schalau-jul2020.pdf https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw550.pdf

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
3. Visually distracting or attracting. Encourage the presence of natural predators like birds, spiders, and frogs on the farm by providing suitable habitat and minimizing chemical pesticide use.	Examples of pollinators and beneficial insects: Green lacewing, Solitary native bee, Assassin bug, Big eyed bug, Syrphid fly.		
Crop diversification Crop diversification is the increasing of the diversity of crop cultivars, crop species and crop functional groups in space and time. Diversifying crops on small-scale farms can help disrupt pest cycles. Planting a variety of crops can confuse pests, reducing the likelihood of infestations. Furthermore, some crops naturally repel pests when grown together.	Temporal crop diversification can limit pest, weed and disease pressure through several mechanisms. Alternating crop species belonging to different botanical families and sowing periods can disrupt the biological cycles of pests, weeds and diseases, such as soil-borne diseases and soil-dwelling insects or weeds. The introduction of crops with high competitive ability against weeds or low sensibility to insects, diseases, etc. can also result in reduced pesticide reliance.	The effect of temporal crop diversification on pesticide use still needs to be quantified.	(Guinet et al., 2023)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
	Temporal crop diversification could promote more diversified communities of soil microorganisms, thereby increasing the probability of maintaining soil pest-pathogen antagonists. The introduction of unharvested crops, such as cover crops, represents another option to diversify crop rotations and improve weed management, especially when combined with no-till strategies. Temporal crop diversification can upscale to diversified landscapes with more complex mosaics of crop fields which strengthen resource dilution effects for pests and limit their spread from one field to another.		
Trap crops Planting specific crops that are particularly attractive to pests can serve as "trap crops." Pests are drawn to these plants, allowing farmers to monitor and	By using trap cropping, farmers can reduce inputs (fuel, labor, time, and insecticides) resulting in increased income while protecting pollinators and other beneficial insects.	While trap cropping can be extremely beneficial, it is often not a complete solution. Trap crops will not control all insects and the use of integrated pest management (IPM) is necessary. IPM practices include rotating	https://extension.arizona.edu/sites/extension.arizona.edu/files/attachment/CompanionPlantingApr2023.pdf

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
control them more effectively while protecting their main crops. Common trap crops: • Radishes – this is quick growing vegetable is one of the easier trap crops to grow and is beneficial among many varieties of vegetables. • Nasturtiums – an excellent trap crop for flea beetles and aphids. • Mustard – brassica's best friend. Most of the insects that love brassicas love mustard more. • Sunflowers – this is a great trap crop for the yard. Aphids and stink bugs are among the insects that love sunflowers too. • Stinging Nettles –while not a crop itself, stinging nettles attract a broad spectrum of insects both pests and beneficials.	With some planning, using trap crop plants can be easy and inexpensive.	crops, attracting beneficial insects, and prudently using organic and synthetic chemicals. Factors influencing the efficacy of trap cropping include (1) having trap crop (for example, Blue Hubbard squash under water / nutrient stress, (2) having cash crop plants bigger in size than the trap crop plants, and (3) not removing the pest from trap crop plants.	https://ipm.missouri.edu/MEG/2017/3/Trap_cropping/ https://extension.uga.edu/publications/detail.html?number=C1118&title=trap-cropping-for-small-market-vegetable-growers#:~:text=While%20trap%20cropping%20can%20be,using%20organic%20and%20synthetic%20chemicals.

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
Push-pull technology The Push-Pull technology based on the use of repellent and trap companion plants intercropped with maize (and to a lesser extent sorghum), is seen to be similarly effective in minimizing the impact of major pests on yields, including striga weed (Striga spp.), maize stemborers, and the fall armyworm (Spodoptera frugiperda).	This technology controls stem borers, fall armyworm, striga, mycotoxins; improves availability of nitrogen and phosphorus, and stores increased carbon in biomass and soils.	Widespread adoption of the push-pull technology has been limited by access to seeds of companion plants, lack of flexibility for crop rotation/diversification, and the amount of labor required at the initial stages.	(Librán-Embid, Olagoke, & Martin, 2023; WIPO, 2022)
Colored insect-proof and shading screens/nets Shading and insect-proof screens are widely used in agriculture for passive microclimate control and for insect exclusion. It is an efficient tool for crop production in adverse climatic and environmental condition.	The anti-insect nets permit unimpeded water permeation to the plants during rainfall or watering. During heavy rainfall the nets act as a buffer and reduce the risk of damage being caused through erosion. The range of insect protection nets also offer protection against wind and reduce the need of watering. The controlled climate and water regulation under insect protection nets allow the plants to grow in optimal conditions and	Different crops might show different growth and quality responses under the same shade nets and the effects can be further modulated by applying shade nets alone or in combination with additional plastic sheet covering. In arid regions, a disadvantage of internally shaded naturally ventilated greenhouses is that when the screen is fully deployed below the roof, it will decrease the effectiveness of natural ventilation through roof	(Mahmood et al., 2018)

Proven Nature-based and climate smart solutions	One Health Benefits/ Climate Adaptation Strength	One Health / Climate Adaptation Limitations	Informational resources and References supporting the implementation
	as a result leads to a considerable yield increase. There benefits are the exclusion of virus-transmitting insects and birds, consequently reduced pesticide requirements and sensitive spectral absorption of light for pest control. While comparing different colored nets with same shading factor, researchers revealed that, red and yellow nets kindle the vegetative growth rate and vitality of foliage and cut flower crops, while the blue nets caused dwarfing, and the grey nets enhanced branching and bushiness. Pearl nets have the greatest light-scattering capability in the visible range and also absorb light in the ultra-violet (UV) range, thus found to best increase fruit size and yield in fruit tree crops, as well as postharvest quality of fresh produce.	openings. Additionally, shading materials absorb a portion of solar radiation and re-emit it again into the greenhouse as heat. As a result, the reduction of the greenhouse air temperature would be smaller than that expected. Although shade nets and insect-proof screens have been used to maintain favourable growth microclimates, detailed information of the spectral quality of photo-selective nets on the phytochemical content, aroma compounds and shelf life of fresh aromatic herbs are limited.	

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