



Conservation and rehabilitation in agricultural soil-water-plant systems: Insights from research and practice

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ABSTRACT

Agricultural sustainability is increasingly constrained by interacting pressures including soil degradation, water scarcity, salinization, environmental contamination, and climatic variability. This integrative review examines conservation and rehabilitation from an Agricultural Soil-Water-Plant System (ASWPS) perspective, drawing on established and recent literature together with selected evidence from research and practice on erosion, water management, soil functional quality, salinity and sodicity, contamination, plant-based rehabilitation, and soil amendments. The review distinguishes degradation processes, affected functions, diagnostic indicators, management interventions, functional responses, and broader outcomes. Conservation is appropriate where essential functions remain sufficiently operative and further degradation can be prevented, whereas rehabilitation is required where important functions have been substantially impaired; both objectives may coexist within the same agricultural system. Evidence across the reviewed degradation types indicates that improvement in a single diagnostic indicator does not necessarily establish functional recovery. Effective management therefore requires identification of the dominant degradation process, diagnosis of the soil, water, and plant functions affected, selection of interventions appropriate to those processes, and evaluation of function-relevant responses over time. The mechanisms governing erosion, water movement, salinity and sodicity, contaminant behavior, soil functional quality, and plant responses are broadly applicable, but their relative importance and management implications remain site-dependent. A function-centered ASWPS perspective provides a common basis for linking diagnosis, conservation, rehabilitation, monitoring, and adaptive management.

Keywords: Agricultural Soil-Water-Plant System, Conservation, Rehabilitation, Functional diagnosis, Functional recovery, Site-specific management

INTRODUCTION

Agriculture is increasingly challenged by climate change, land degradation, freshwater scarcity, salinization, environmental contamination, and growing food demand. These interacting pressures threaten crop productivity and the natural-resource base supporting agriculture. Global assessments identify land degradation, water insecurity, and climate change as major challenges to agricultural resilience and food security (UNCCD, 2022; IPCC, 2023; UN-Water, 2024). Sustainable management should therefore maintain environmental quality and

crop productivity while strengthening resilience under climatic variability.

Agricultural productivity depends on coupled interactions among soil, water, and plants. Soil regulates infiltration, water storage, drainage, aeration, nutrient retention, and biological processes; water links soil processes with nutrient and solute transport and plant physiological activity; and plants modify soil and water through rooting, transpiration, canopy interception, rhizosphere processes, and organic-matter inputs (Keesstra *et al.*, 2016; Hatfield and Dold, 2019; Lal, 2020). Consequently,

degradation affecting one component can alter several functions of the agricultural system.

Major constraints include erosion, declining soil organic matter, nutrient depletion, compaction, acidification, salinization, contamination, and water scarcity (FAO and ITPS, 2015; FAO, 2021; UNCCD, 2022). Salt-affected soils constrain crop production through osmotic, ionic, and, in sodic soils, structural effects (Rengasamy, 2010; FAO, 2024), while potentially toxic elements may impair soil and water quality, crop safety, and ecosystem functioning (Alloway, 2013).

A central management challenge is that environmental problem labels and individual indicators do not necessarily identify the process limiting agricultural performance or demonstrate recovery after intervention. Similar reductions in crop growth may result from inadequate water availability, poor soil structure, nutrient imbalance, salinity, contamination, or combinations of these constraints. Conversely, correction of the indicator defining a degradation problem may not restore all functions affected by that degradation. Effective management therefore requires distinction among the degradation process, affected function, diagnostic indicator, intervention, functional response, and broader outcome.

In this review, the Agricultural Soil-Water-Plant System (ASWPS) is used as an organizing framework for examining these relationships. Conservation refers to management intended to maintain essential functions and prevent further degradation where those functions remain sufficiently operative, whereas rehabilitation refers to recovery of functions that have been substantially impaired. These are operational definitions for this review rather than universal categorical boundaries, and the two objectives may coexist within the same agricultural system.

The review is integrative rather than systematic. It draws on foundational sources, authoritative international assessments, recent reviews and meta-analyses, and selected field and experimental studies that illustrate interactions among degradation processes, functions, and management responses. Evidence is examined through a common sequence—degradation process → functional impairment → diagnosis → intervention → functional response—to identify principles that are broadly applicable while recognizing the site dependence of specific management prescriptions.

CONCEPTUAL FRAMEWORK OF AGRICULTURAL SOIL-WATER-PLANT SYSTEMS

The ASWPS framework distinguishes among processes, functions, indicators, responses, and outcomes so that measured properties are not treated as functions in themselves. Processes include infiltration, runoff, drainage, evapotranspiration, erosion, nutrient cycling, solute transport, root uptake, and biological transformations. Their interactions support functions including root-zone water regulation, soil structural and hydraulic functioning, nutrient retention and supply, plant resource acquisition and growth, and environmental protection. These functions contribute to broader outcomes including productivity, resource-use efficiency, environmental quality, and resilience.

This distinction is important because no single measurement represents overall system functioning. Electrical conductivity (EC), for example, is commonly used to characterize salinity, infiltration reflects hydraulic behavior, and crop growth integrates multiple soil, water, and plant constraints. Recent soil-function literature likewise emphasizes multifunctionality, function-specific indicators, and possible trade-offs among functions rather than reliance on a single universal soil-quality measure (Wubs, 2025). Degradation occurs when one or more processes are altered sufficiently to impair functions required for agricultural or environmental objectives. One degradation process may impair several functions, while the same function may be impaired by different processes. These relationships are summarized conceptually in Figure 1.

Diagnosis as the Basis for Environmental Management

Effective conservation and rehabilitation begin with diagnosis of the dominant constraint, its severity and spatial extent, the process responsible, and the function or functions affected. Diagnosis should therefore combine problem-relevant soil, water, and plant evidence rather than apply a universal indicator set. Soil measurements may include bulk density, aggregate stability, soil organic carbon, pH, EC, nutrient status, or contaminant availability; water-related measurements may include soil water content, infiltration, drainage, evapotranspiration, irrigation performance, and water quality; and plant responses may include rooting, growth, biomass, nutrient or contaminant uptake, transpiration, and yield.

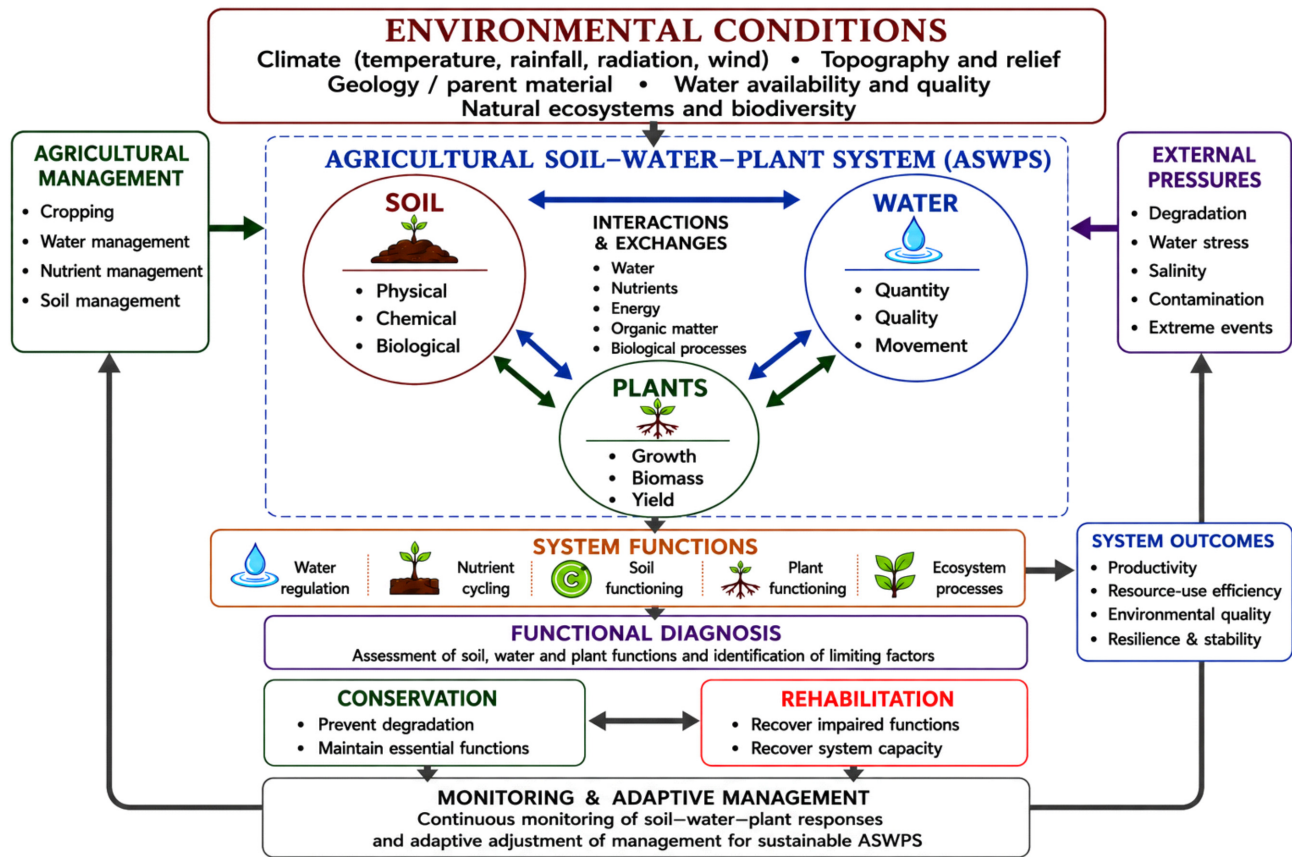


Fig. 1. Conceptual framework of the Agricultural Soil-Water-Plant System (ASWPS), linking environmental and management conditions with soil-water-plant interactions, degradation processes, affected functions, functional diagnosis, conservation or rehabilitation, function-relevant response and recovery assessment, system outcomes, and monitoring, reassessment, and adaptive management

Field observations and laboratory measurements remain fundamental, while proximal sensing, in situ monitoring, GIS, remote sensing, and modeling can extend diagnosis across spatial and temporal scales. These technologies are most useful when linked to the process being evaluated and supported by appropriate field observations. Where essential functions remain sufficiently operative, management can emphasize conservation and prevention of further deterioration; where degradation has substantially impaired required functions, rehabilitation is necessary.

Functional recovery is used here to mean measurable improvement in the soil, water, and/or plant functions impaired by degradation toward conditions sufficient to meet defined agricultural or environmental objectives. It does not necessarily imply return to a historical, pristine, or pre-disturbance condition.

CONSERVATION STRATEGIES IN AGRICULTURAL SOIL-WATER-PLANT SYSTEMS

Conservation aims to prevent or limit degradation while maintaining the soil, water, and plant functions required for productive and environmentally sound agriculture. Appropriate measures therefore depend on the process threatening those functions.

Soil Conservation and Erosion Control

Both water and wind erosion contribute to agricultural land degradation, although their relative importance varies with climate, soil properties, vegetation, topography, and management. The discussion here focuses primarily on water erosion. Water erosion involves detachment, transport, and deposition driven by interactions among rainfall, soil properties, topography, vegetation, and

management. Its significance extends beyond soil loss because preferential removal of surface soil, organic matter, and nutrients can impair rooting, infiltration, water storage, and nutrient retention while increasing off-site sediment and nutrient transport.

The Universal Soil Loss Equation (USLE) and Revised Universal Soil Loss Equation (RUSLE) provide empirical approaches for estimating long-term soil loss, whereas the Water Erosion Prediction Project (WEPP) represents a more process-based approach incorporating infiltration, runoff, erosion, sediment transport, and deposition (Wischmeier and Smith, 1978; Flanagan and Nearing, 1995; Renard *et al.*, 1997). Their appropriate use depends on purpose, data availability, and spatial and temporal scale.

Field evidence illustrates the conditional nature of erosion responses. Studies in Japan identified relationships between event-scale soil loss and rainfall characteristics and demonstrated effects of vegetation configuration and field geometry on erosion (Kusaka *et al.*, 1994; Roy *et al.*, 1995, 1996, 2008a). These findings reinforce a process-based principle: surface cover, residues, mulches, cover crops, and conservation tillage are particularly relevant where raindrop detachment and exposed soil dominate; contouring and vegetative strips can interrupt runoff; and terraces, grassed waterways, or engineering controls may be required where runoff becomes concentrated. Effectiveness should be evaluated through both reduction of soil/sediment loss and maintenance of the soil functions threatened by erosion.

Water Conservation and Water-Use Efficiency

Water conservation seeks to maintain adequate root-zone water availability while improving effective use of rainfall and irrigation. Following precipitation or irrigation, water may infiltrate and be stored in the root zone, be taken up by plants, drain below the root zone, return to the atmosphere through evaporation and transpiration, or leave the field as runoff. The relative importance of these pathways depends on climate, soil hydraulic properties, crop development, topography, and management.

Crop evapotranspiration consists of soil evaporation and plant transpiration, and reference evapotranspiration together with crop coefficients

provides an established basis for estimating crop water requirements (Allen *et al.*, 1998). Water-use efficiency relates biomass or yield production to water use, but its numerical value and interpretation depend on scale and definition (Hatfield and Dold, 2019). Water-saving irrigation should therefore not be equated simply with applying less water. Pitcher irrigation provides one example of a simple method investigated under arid-land conditions (Imamura and Roy, 2011). The broader principle is to coordinate water supply, root-zone storage, drainage, and crop demand. Reducing irrigation can conserve water but increase crop water stress, whereas excessive irrigation can increase drainage losses, waterlogging, or salinization where drainage is inadequate.

Conservation of Soil Functional Quality

Soil functional quality depends on physical structure, water regulation, nutrient retention and supply, and biological activity. Loss of organic matter, compaction, structural deterioration, nutrient depletion, and acidification can impair these functions. Organic amendments can improve aggregation and aggregate-associated organic carbon, although responses depend on amendment characteristics, soil properties, and management (Ma *et al.*, 2024). Crop diversification through cover crops, rotations, and intercropping can also promote aggregation and soil organic carbon accumulation, with effects varying among environments and management systems (Li *et al.*, 2024). Biochar can modify bulk density, porosity, aggregation, and water retention, but responses depend strongly on biochar and soil characteristics (Blanco-Canqui, 2017).

In two contrasting Japanese agricultural soils, charcoal application was evaluated using both plant growth and nutrient leaching as responses (Roy *et al.*, 2012). This case illustrates a broader principle: an amendment should not be judged from a single soil property or crop response, but according to the functions it is intended to maintain and any relevant environmental trade-offs.

Vegetation-Based Conservation

Vegetation contributes to conservation through surface protection, rooting, aggregation, infiltration, and hydrological regulation. Protective vegetation can reduce erosion and influence soil physical and

hydrological functioning. Cover crops, in particular, can improve aggregate stability and infiltration, although responses vary with soil and management (Basche and DeLonge, 2019; Blanco-Canqui and Ruis, 2020). However, additional vegetation also consumes water and nutrients and may compete with the principal crop where resources are limiting. Its net effect therefore depends on climate, soil-water availability, species, rooting characteristics, growth period, and management. Vegetation serves a conservation role when it maintains existing functions and a rehabilitation role when it is used to recover substantially impaired functions, stabilize severely degraded land, or immobilize or remove contaminants.

Integrated and Site-Specific Conservation

The processes governing erosion, water movement, soil structure, nutrient cycling, and plant response are broadly applicable, but their relative importance varies among environments. A conservation practice suitable for humid sloping land may be inappropriate for an arid sandy soil, while increasing water retention may be undesirable where inadequate drainage and aeration are already limiting.

Spatial assessment can help identify the distribution and severity of degradation before management is selected. Remote sensing and GIS have been used to integrate vegetation cover, runoff, water-use efficiency, and soil loss in heterogeneous landscapes (Shrestha and Roy, 2008). In desertification-prone Inner Mongolia, cotton material and artificial zeolite applied individually improved water retention and supported plant growth in sandy soil, whereas their combined application did not consistently provide additional benefits (Roy *et al.*, 2015). This result illustrates that individually beneficial interventions cannot automatically be assumed to produce additive effects when combined. General mechanisms are transferable more readily than management prescriptions, which require site-specific diagnosis.

REHABILITATION OF DEGRADED AGRICULTURAL SOIL-WATER-PLANT SYSTEMS

Rehabilitation is required where degradation has substantially impaired functions necessary for agricultural production or environmental protection.

Its objective is not necessarily restoration of an original condition but recovery of the functions required to meet defined management objectives.

Rehabilitation of Salt-Affected Agricultural Soils

Salt-affected soils constrain agricultural production in arid and semi-arid environments, poorly drained irrigated areas, and coastal regions. FAO (2024) estimates that more than 1.381 billion ha, or 10.7% of global land area, are affected by salinity and/or sodicity. Salinity and sodicity should be distinguished because their dominant mechanisms and management implications differ. Salinity restricts plant water uptake through osmotic stress and may cause ion toxicity and nutrient imbalance, whereas sodicity additionally promotes clay dispersion, structural deterioration, and reductions in infiltration and hydraulic conductivity. Management therefore depends on the type, severity, and source of salt accumulation. In saline soils, soluble salts may be displaced from the root zone by leaching with suitable-quality water where adequate drainage is available. Without adequate drainage, irrigation can contribute to renewed salt accumulation. In sodic soils, exchangeable Na creates an additional structural constraint; where Ca supply is inadequate and sodicity is the dominant problem, a calcium amendment such as gypsum may be required to replace exchangeable Na and facilitate subsequent leaching. Salt source, irrigation-water quality, groundwater conditions, soil permeability, drainage, and crop tolerance should be considered together (Rengasamy, 2010; FAO, 2024).

Agronomic and biological measures can complement physical and chemical reclamation. In northeastern Thailand, *Sesbania rostrata* green manure was applicable to slightly to moderately salt-affected rainfed rice land, whereas more severely affected land required more intensive rehabilitation, alternative land use, or salt-tolerant vegetation (Pongwichian *et al.*, 2013). Management of recharge areas was also identified as relevant to controlling salt movement into affected lowlands.

Two cases illustrate why rehabilitation cannot be assessed from one indicator alone. Artificial zeolite produced from alkali-treated coal ash increased aggregate-related resistance to water erosion in sodic soil, but the improvement was not accompanied by a proportional reduction in surface

runoff (Kaneuchi *et al.*, 2013). Following the 2011 Tohoku-oki tsunami, salinity varied markedly among affected agricultural sites in Miyagi Prefecture (Roy *et al.*, 2014), and subsequent investigation showed that reduction in salinity after restoration did not necessarily indicate recovery of soil fertility (Roy *et al.*, 2017). Reduction of the dominant stress therefore does not necessarily restore all functions altered during degradation. Rehabilitation should be evaluated using a problem-specific combination of salinity or sodicity indicators, structural and hydraulic responses, nutrient status, and crop response as appropriate to the diagnosed impairment and management objective.

Rehabilitation of Contaminated Agricultural Soil-Water-Plant Systems

Agricultural contamination can impair soil and water quality, crop production, food safety, and environmental functioning. Potentially toxic elements such as As, Cd, Pb, and Cr may originate from natural or anthropogenic sources and persist in agricultural environments. Their mobility and bioavailability depend on chemical form and environmental conditions including pH, redox status, organic matter, mineral interactions, and soil-water dynamics, while plant species and cultivars differ in uptake and translocation (Alloway, 2013). A useful diagnostic sequence is therefore source → transport and transformation → bioavailability → exposure or plant uptake → risk.

Arsenic contamination associated with groundwater irrigation illustrates these connections. Investigations in Bangladesh documented As across water, soil, and plant media (Roy *et al.*, 2008b). Irrigation with As-contaminated groundwater can introduce As into agricultural soils, while flooded rice conditions influence As speciation and mobility and consequently plant uptake and food-safety risk (Heikens *et al.*, 2007; Sandhi *et al.*, 2022). Continued use of contaminated groundwater can sustain As inputs even when soil-directed rehabilitation is applied. Interventions reviewed for West Bengal and Bangladesh include irrigation management, soil fertilization, alternative crops, and As-tolerant rice cultivars (Senanayake and Mukherji, 2014). The relevant endpoint is not simply reduction in total soil contaminant concentration but a function-relevant reduction in contaminant mobility, exposure, or transfer to crops and water, as

appropriate to the risk pathway and management objective, while maintaining safe production.

Plant-Based Rehabilitation and Phytoremediation

Plants can contribute to rehabilitation through phytoextraction, phytostabilization, rhizofiltration, erosion control, and nutrient removal. Plant-based approaches may be less disruptive than intensive physicochemical treatments, but effectiveness can be constrained by slow remediation rates, rooting depth, contaminant availability, plant establishment, and management of contaminated biomass. An important distinction is that plant tolerance does not demonstrate phytoextraction. Tolerant species may restrict contaminant uptake or translocation and therefore function primarily through phytostabilization (Ali *et al.*, 2013).

Vetiver grass (*Chrysopogon zizanioides*) has been used for soil stabilization and environmental rehabilitation because of its extensive root system and tolerance of adverse conditions. Its tolerance of potentially toxic elements and retention of many metals predominantly in roots can support phytostabilization (Danh *et al.*, 2009). Vetiver has also been investigated in floating treatment systems. Reductions in nitrogen, phosphorus, and chemical oxygen demand have been reported under experimental conditions (Mahmoudpour *et al.*, 2021). In temperate Japan, Vetiver floating treatment systems reduced total nitrogen and suspended solids across different water types, whereas total phosphorus and chemical oxygen demand responses varied among waters (Roy *et al.*, 2025). Plant establishment or survival is therefore not itself evidence of rehabilitation success; evaluation must correspond to the intended function, such as stabilization, extraction, nutrient removal, or water-quality improvement.

Rehabilitation through Soil Amendments and Resource Recycling

Soil amendments can support rehabilitation when selected to address a diagnosed physical, chemical, or biological constraint. Organic amendments can supply carbon and nutrients and influence aggregation and biological activity, whereas biochar can modify porosity and water retention (Diacono and Montemurro, 2010; Blanco-Canqui, 2017). Mineral amendments can address particular constraints: gypsum supplies Ca for amelioration of sodic soils, whereas zeolitic

materials can influence ion exchange and nutrient retention (Jarosz *et al.*, 2022). Amendment selection should therefore begin with the limiting process and intended function, not simply with material availability.

Resource recycling can convert suitable crop residues, compostable wastes, and agricultural or industrial by-products into potential soil amendments. Such materials may contribute organic matter, nutrients, water-retention capacity, or sorption capacity while reducing waste. However, recycled material is not inherently beneficial: suitability depends on composition, contaminant content, application rate, soil characteristics, crop, water regime, and intended use. Physical, chemical, biological, and agronomic measures may be combined where they address complementary constraints, but their combined effects should be evaluated rather than assumed to be additive or synergistic.

SYNTHESIS AND FUTURE PERSPECTIVES

Four cross-cutting principles emerge from the evidence reviewed. First, different degradation processes can impair the same function. Reduced infiltration, for example, may result from surface sealing, compaction, sodicity-induced dispersion, or other structural constraints. Similar plant responses may arise from inadequate water supply, salinity, poor rooting conditions, nutrient limitations, or contamination. Observation of the impaired function therefore does not by itself identify its cause.

Second, a single degradation process can impair several functions simultaneously. Erosion can reduce soil depth, nutrient stocks, infiltration, and water storage while increasing off-site sediment transport. Salinity can affect plant water acquisition, ion balance, and nutrient relations, whereas sodicity can additionally impair soil structure and hydraulic functioning. Management directed toward only one manifestation may therefore leave other constraints unresolved.

Third, improvement in a diagnostic indicator does not necessarily demonstrate functional recovery. The cases considered here show that improved aggregation need not produce proportional improvement in runoff, reduction in salinity need not restore fertility, plant tolerance need not demonstrate contaminant extraction, and individually beneficial treatments need not produce

additive effects when combined. Indicators remain essential, but they should be interpreted according to the process or function they represent, the management objective, and an appropriate reference or target condition.

Fourth, intervention effectiveness is conditional. Fundamental mechanisms governing erosion, water movement, osmotic stress, clay dispersion, contaminant mobility, nutrient cycling, and plant water uptake are broadly applicable, but their relative importance depends on soil, climate, hydrology, topography, crop, degradation severity, management history, and socioeconomic conditions. Management may also generate trade-offs among functions; an intervention that improves one function can be neutral or unfavorable for another. Function-specific assessment and recognition of such trade-offs are consistent with current soil multifunctionality concepts (Wubs, 2025). Table 1 summarizes the process–function links among diagnosis, management, and functional response.

A practical management sequence follows from this synthesis: degradation or stress → identification of the dominant process → diagnosis of affected function(s) → conservation or rehabilitation → function-relevant monitoring → reassessment and adaptation. This sequence is a management logic rather than a universal scoring system. Because functional performance is context-dependent, no universal indicator set or threshold is proposed here. Indicator selection should be parsimonious and hypothesis-driven, with each measurement linked explicitly to the diagnosed process, the function of interest, and the agricultural or environmental objective.

The literature considered here spans heterogeneous soils, climates, crops, experimental designs, intervention rates, and monitoring periods, limiting direct quantitative comparison among studies. Short-term changes in individual soil or water properties are also more frequently reported than long-term recovery of integrated soil–water–plant functions. The framework should therefore be interpreted as a diagnostic and management logic rather than as a universal index or proof that any single indicator establishes whole-system recovery.

Future research should place greater emphasis on linking measurable soil, water, and plant responses to explicitly defined functions; identifying parsimonious indicator sets capable of detecting both

Table 1. Linking major agricultural degradation processes with functional diagnosis, management, and evidence of functional response

Problem / dominant process	Function(s) at risk	Representative diagnosis	Management logic	Evidence of functional response
Water erosion: detachment, runoff, transport	Soil retention; infiltration; nutrient retention	Soil loss; runoff; cover; infiltration	Reduce detachment and runoff; manage concentrated flow	Reduced soil/sediment loss plus maintenance of threatened soil and crop functions
Water limitation: insufficient root-zone supply and/or excessive losses	Plant water acquisition	Soil water; ET; drainage; crop response	Coordinate water supply, storage, drainage, and crop demand	Improved crop water status or productivity without unacceptable water losses
Salinity: salt accumulation; osmotic/ionic stress	Plant water and nutrient acquisition	EC; ion composition; crop response	Control salt sources; leach salts where suitable-quality water and adequate drainage are available	Reduced root-zone salinity accompanied by relevant plant response
Sodicity: Na-induced dispersion and structural deterioration	Structural and hydraulic functioning	ESP/SAR; EC; aggregation; infiltration	Apply Ca amendment where required; facilitate Na displacement and subsequent leaching with adequate drainage	Improved aggregation, infiltration, and other relevant structural/hydraulic responses
Contamination: input, mobility, bioavailability, uptake	Environmental protection; food safety	Relevant contaminant fractions; water concentration; crop uptake	Control sources; reduce mobility, exposure, or transfer through appropriate immobilization or removal	Reduced contaminant mobility, exposure, or transfer to crops/water while maintaining safe production
Soil functional decline: SOM loss, compaction, nutrient imbalance, acidification	Water and nutrient regulation; rooting; biological activity	SOC; bulk density; aggregation; nutrient status; pH; plant response	Target the diagnosed physical, chemical, or biological constraint	Sustained improvement in the targeted function accompanied by relevant plant response

degradation and recovery; integrating field observations with sensing, spatial analysis, and modeling where appropriate; and evaluating intervention persistence, trade-offs, secondary effects, and treatment combinations over relevant timescales. The key question is not simply which technology works, but which intervention addresses which limiting process, under which conditions, and with what evidence of functional improvement.

CONCLUSIONS

Agricultural conservation and rehabilitation are most effectively understood through the processes linking soil, water, and plant functions. Conservation is appropriate where essential functions remain sufficiently operative and further degradation can be prevented, whereas rehabilitation is required where important functions have been substantially

impaired; both objectives may coexist within the same agricultural system.

Across erosion, water limitation, soil functional decline, salinity and sodicity, contamination, plant-based rehabilitation, and soil amendments, the evidence reviewed indicates that improvement in a single diagnostic indicator does not necessarily establish functional recovery. Management should therefore proceed from identification of the dominant degradation process and affected function to targeted intervention and evaluation using function-relevant soil, water, and plant responses.

The processes governing soil, water, and plant interactions are broadly applicable, but their relative importance and management implications depend on local environmental and management conditions. A function-centered ASWPS perspective provides a common logic for diagnosis, conservation or

rehabilitation, functional evaluation, reassessment, and adaptive management without implying universal indicators or management prescriptions.

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