A Global Halophyte Strategy

Draft Scope of Works

Context

Eco- systems are crashing, food production is stressed, and people are increasingly moving looking for safety, much of this is due to climate change for which a new agriculture is needed that can handle heat and degrading water resources.

Halophytes are plant adaptations to cope with heat, salinity, and degraded land. Accordingly, they intersect with many of the hazards of climate change and can provide many of the products and services more usually associated with plants bred to use fresh water. The usual action of humans faced with degrading soils and water due to salinity is to move on leaving poor people, stranded assets of water and logistical infrastructure, and wastewater and land of little value.

Water is the key agent of land scape and vegetative change but some 97.5% of all water is saline and about 68% of all fresh water is tied up in glaciers and 30% stored in aquifers and lakes. Climate change is exacerbating the loss of fresh water through depleting aquifers and pollution such that lack of water is counted as the single greatest threat to human health. Salt build-up in soils has been responsible for the demise of many agricultural societies. However significant quantities of brackish and saline waters in aquifers in waste land areas and even seawater is potentially usable for change.

Halophytes have a little publicly understood role in addressing the interrelated problems of water, land, and food supply. Much fresh water is 'wasted' on amenity and other uses that could be substituted using halophytes, increasing its value, and rescuing fresh water for more valuable uses. Much decay of water reticulation systems, roads and infrastructure occurs through rising salt, in Australia, exceeding agricultural losses. Much pollution of streams and lakes occurs due to nutrients that could be utilised by halophytes, 'cleaning' the water before discharge, some halophytes can also strip water bodies of heavy metals, including radioactive ones. Many halophytes can 'move' salts out of the topsoil and improve drainage gradually rehabilitating it for higher value uses. Halophytes can improve above and below ground biodiversity and so ecosystem resilience. Halophytes have a clear role in many carbon removal strategies as they can sequester carbon safely in wet and water environments.

COP 28 is the world's latest and largest collaborative activity to address the many factors related to human induced climate change. It's program devotes 2 days out of 9 on the impact of climate changes on i) Land, Water and Oceans, and ii) Food, Agriculture and Water - and in turn the impact of development of these on the rate of human induced climate change. However, a quick analysis finds only 3 participants overtly deal with salinity, of which two are engaged in breeding and evaluating halophytes and one is working on and demonstrating nuclear techniques to aid food production on salinized land, focusing on Arab lands. There is only one speaker in the agrifood systems seminar who addresses land and water degradation as a separate subject among a lot of attention to soil health and biodiversity.

However, much is known scientifically about halophytes in these roles. There are 10s of thousands of papers describing the losses due to salinity, the benefits from using Halophytes and descriptions of individual halophytes and their uses. We estimate there would be less than 100 good synthesises of these but for different purposes and not many about actual successes[i]. There also several readily available summaries of possible benefits and opportunities to profit financially and economically by

addressing these opportunities and new sources of funding to address these issues are emerging. These now exist in specialist libraries and on some websites[ii].

Strategy development

Short- and long-term strategies are required to assist investors and policy makers to utilize these resources for much more action over time. Strategies formulation would include:

- What is known?; a synopsis of species and circumstances in which halophytes can contribute to the mitigation and adaptation to Climate Change and past barriers to their use including:
    - Institutional barriers to multidisciplinary action across sectors and boundaries
    - Limited markets for public good benefits
- What has changed?: An account of developments that improve the conditions for investment in halophyte technologies.
    - The emergence of markets for ecosystem services, carbon sequestered into soils and water, biodiversity credits, and in some places salinity credits to facilitate substitution to release fresh water,
    - A recent McKinsey report lists 10 carbon capture technologies they suggest can store carbon for 100 + years as a basis for a trillion-dollar business. 7 out of this 10 could involve halophytes; Wetland and peatland restoration, Cropland, grassland, and agroforestry, Re afforestation and afforestation, Blue carbon management, Bio char and bio-oil, enhanced weathering, and bio energy[1].
    - Renewed interest in utilising saline wastewater to produce 'sustainable' food, fibre, and energy to earn ESG credits through green financing, including by utilising stranded assets due to salt build up.
    - Renewed interest in food security for remote and regions emerging from conflict.
    - Significant institutional and corporate interest in facilitating cross sectoral mixed finance activities towards ecosystem 'repair' and social responsibility.
- What opportunities are emerging? An account of medium- and long-term developments to utilize waste and saline waters far more effectively.
    - There are enormous quantities of irrigation drainage water in the Central Asian cotton areas, in US horticultural and tree crop areas and in many areas in China, Australia and elsewhere that could be put back to good use with halophytes.
    - There are opportunities for the use of brackish and even seawater in inland desert and some coastal areas to modify local climates and to produce food, land-based aquaculture, and algae production. Some countries have already invested such water movement initiatives.
    - Developments in water harvesting technologies and local power opens opportunities to develop low rainfall regions for a range of food, fibre and grazing uses while also improving biodiversity that could also suit the poor who live in such areas and depend on livestock.
    - There are opportunities for new functional food and pharmaceutical products from halophytes.
- What is required to facilitate action?
    - The development of specialist halophyte education products that can assist general educators and promoters of ecosystem action involving halophytes and associated products and services.

[1] Carbon Removals; How to Scale a New Gigaton Industry. McKinsey Dec. 2023

    - The development of specialist halophyte promotional material to inform and involve mainstream food producers in better use of the fringes of their production areas.
    - The development of a model that lists and maps areas where degraded land and or stranded assets exist in proximity to usable water and market logistics, including indicative costs and benefits for action.
    - The development of a model that lists emerging opportunities from technical and economic developments that mean greater use of saline and other waste waters and waste areas become possible.
    - Links to interested financial supporters, such as International Finance Institutions, private sector ecosystem payment brokers and Ethical Investment Funds
    - A system to facilitate objective and independent monitoring, evaluation, for short- and long-term learning and reporting.
- How long would strategy development take?
    - This would depend on the level of detail and model development required.
    - A concept paper may only take weeks and utilise Leake Squires and Young and Bushnell as a resource given in
    - A developed strategy including models might take months and include others such as remote sense, food processing, and economic modellers and specialists (this might be considered a phase 2).
- Output
    - Written papers suitable for consideration for publications as concept notes on the Millenium Project web site, consistent with present material
    - A full strategy would be a written document suitable for submission to interested institutions with other material suitable for web publication as may be required.
    - Perhaps a 'World Atlas of Halophyte Potential' with digital output, similar to The World Atlas of Desertification Vic Squires was involved in.
- The proposed team
    - John Leake Ph D T/L. Is a general agriculturalist with a long term professional interest in the problems of salinity, as a researcher, writer on salinity matters and manager of projects and planning studies in some 34 countries in Asia including central Asia, Africa, the US, and most parts of Australia, mostly as T/L; experienced with most International Finance Institutions and GEF https://researchers.adelaide.edu.au/profile/john.leake In addition to T/L I would cover institutional and practical developmental aspects of the strategy.
    - Dr Victor Squires Ph. D. A saline and desertification specialist experienced in most dryland regions of the world and writer or editor of many related books, particularly related to Halophytes and animal feeds, has also worked with many relevant agencies and GEF. He would provide detailed scientific input and access to his wide circle of collaborators in all dryland regions of the world.
    - Professor Mike Young, a world renown water policy specialist who has contributed much to water policy in Australia and more recently USA where he held a chair at Harvard https://researchers.adelaide.edu.au/profile/mike.young He would summarise the economic aspects and discuss economic incentives to facilitate action . His *Transformational Change in Environmental and Natural Resources Management, Guidelines for Policy Excellence* 2016 with international contributors, written while at Havard is particularly relevant.
    - Dennis Bushnell. Retired Chief Scientist at NASA with a lifelong interest in Climate coming from a background in fluid

mechanics. https://en.wikipedia.org/wiki/Dennis_M._Bushnell Dennis would contribute his high-level knowledge of salinity and climate change activities worldwide, and his links to policy makers.

- Cost and availability of the team
    - Subject to negotiation and timing but would be consistent with UN and IFI norms for the work, with Bushnell provided as a pro-bono resource.

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[i] Some books, papers and presentations by these authors include:
Halophytes: a Rapid, Inexpensive, and significant Way to Address Land, Water, Food, Energy and Climate. Dennis M. Bushnell 2023 Int. Jnl. of Climate Change.
Rethinking Rehabilitation of Salt-affected Land: New perspectives from Australian Experience. Review Paper. Leake J.E. Squires V & Shabala S Earth 2022,3,245-258 https://doi/10.3390/earthb3010016
Transformational Change in Environmental and Natural Resources Management, Guidelines for Policy Excellence Routledge 2016
[ii] *Climate/ecosystem Mitigation/remediation*. The role of Halophytes Dennis M. Bushnell 2020