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Sustainability of sprinkler- irrigated horticulture on sandy soils at Binningup - Swan Coastal Plain, W.A.

Eric Law

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SUSTAINABILITY OF SPRINKLER-IRRIGATED  
HORTICULTURE ON SANDY SOILS AT  
BINNINGUP – SWAN COASTAL PLAIN, W.A.

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## **ABSTRACT**

The sustainability of sprinkler-irrigated vegetable crops in the Binningup–Myalup area of south-western Australia was investigated. The main crops are carrots, potatoes and onions. The crops are grown throughout the year in sandy soils and require large volumes of sprinkler irrigation during the summer growing period and little during winter. The irrigation water is extracted from the underlying superficial aquifer.

The combination of water with a relatively high salt content, evaporation between the sprinkler and the ground, and subsequent high evapotranspiration, leads to escalating soil water salinity during summer. At Binningup, the necessary horticultural practice of daily watering in summer to maintain soil moisture accumulates salts in the root zone of the crops at levels that inhibit yield and occasionally results in crop failure.

This investigation confirms the hypothesis that short-duration, high-volume winter rainfall events are sufficient to rinse accumulated salts from the soil profile each year and sustain current horticultural practice. Occasional high-volume rainfall in summer similarly rinses salt from the root zone. Thus, it is not the average volume of winter rainfall that ensures sustainability but the fortuitous occurrence of summer storms and high-volume rainfall in winter. It is shown that, even in a year of 50 per cent of average rainfall, the soil was rinsed and the aquifer replenished. It is also shown that after 10 years of production, the irrigation water supply monitored at the surface three to four metres, is stable in salinity and thus sustainable.

This research also investigated the effect of daily variation in both soil moisture and soil salinity on crop yield for vegetable crops, grown in identical soil structure during both the summer and winter periods. Alternative irrigation strategies were considered to evaluate whether sprinkler irrigation regimes can be modified to manage effective reduction of soil water salinity during the summer period to avoid loss of production or crop failure.

Data-logging equipment used to record soil moisture in the profile and water from rainfall and sprinkler irrigation provided indicative results. These records are supported by an adjacent online, real-time agricultural weather station and in situ tipping bucket rain gauges.

The results could modify reticulation regimes and enhance sustainability of both vegetable crops and the underlying aquifer resource.

## DECLARATION OF ORIGINALITY

All the work and materials contained in this thesis are my own. To the best of my knowledge, any material that has been previously published or written by others has been duly referenced in the text. None of the work and material presented here has been previously submitted for the award of any other degree or diploma in any university or other institution.



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Eric Law

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To my little bird Georgia Wren, hopefully you can look at this in years to come and know it's never too late to try something new.

## ABBREVIATIONS

$\theta$	soil moisture content
$m_{dry}$	dry soil weight
$m_{wet}$	wet soil weight
ASL	atmospheric surface layer
BOM	Bureau of Meteorology (Australia)
BREB	Bowen ratio-energy balance
dS/m	decisiemens per metre
DAFWA	Department of Agriculture and Food Western Australia
EC1:5	electrical conductivity of a soil suspension at a ratio of 1:5
EC	electrical conductivity
EC <sub>se</sub>	electric conductivity of a saturated paste
EC <sub>sw</sub>	electrical conductivity of soil water
$E_p$	pan evaporation
ET	evapotranspiration
ET <sub>0</sub>	reference evapotranspiration
IBRA	Interim Biogeographic Regionalisation for Australia
kPa	kilopascal
PIRSA	Primary Industries and Regions South Australia
ppm	parts per million
S/m	siemens per metre
TDR	time-domain reflectometry



TDS	total dissolved solids
$\theta_g$	gravimetric soil water content