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**Effectiveness of Established Tree and Pasture Buffer Strips in
Reducing Lateral Groundwater Movement and Nutrients from an
Effluent Disposal Area Associated with a Beef Cattle Feedlot**

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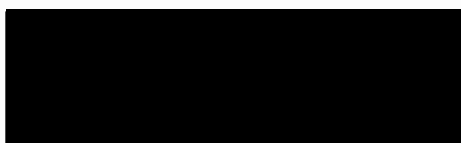
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Declaration

I declare that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I declare that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

A large black rectangular redaction box covering the signature area.

Liangmin Wang

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ABSTRACT

Vegetated buffer strips (VBSs) have been promoted as a method to control non-point sources pollution. Trees and pastures are the most common components in VBSs. The aim of this project was to determine the effectiveness of trees and improved pasture in reducing lateral groundwater movement and nutrients from an effluent irrigated disposal area associated with a beef cattle feedlot. This question is significant in the experimental site because lateral groundwater movement occurs along the A-B interface as the soil is strongly duplex with a sand loam A horizon and a heavy clay B horizon. Consequently, the soil has a significant difference in hydraulic conductivity between the A and B horizons leading to lateral movement of water above the B horizon. A field experiment was established to determine the effectiveness of tree and pasture buffer strips in reducing lateral groundwater flow and associated nutrients. The field experiment was a randomized block design with two tree species (*Eucalyptus camaldulensis* and *Casuarina cunninghamiana*), two planting densities and three replications. Improved pasture was established as controls. A glasshouse simulation experiment was also conducted to compliment to the field experiment in measuring the ability of the trees and pasture in reducing lateral nutrient movement.

The field experiment showed that both the tree species and improved pasture established successfully as VBS vegetation at the early stage (<3 years) on the Northern Tablelands area, in terms of their survival and growth rates. Water deficit and water use of the tree treatments with the two species and two densities were not significantly different, principally because the trees were not large enough to occupy the site and to dominate water relation. The longer growing period and generally larger water deficit of the improved pasture indicate that the pasture has a greater potential and advantage to be used in VBSs at least at the early stage. The trees and pasture did not exhibit significant reductions in lateral groundwater flow and nutrients through comparing the change of water table, soil water storage and groundwater chemistry. N and P accumulated and removed by pasture harvest were 189.9 and 17.0 kg ha⁻¹ respectively over the experimental period, while N and P storage in the above-

ground biomass of the trees were estimated to be 49.1 and 9.4 kg ha⁻¹ respectively. This suggests that improved pastures may take up and remove N and P more efficiently than trees at this stage provided that proper management, such as harvesting on time, is adopted.

The 11-month glasshouse experiment showed that *C. cunninghamiana* had higher growth rate in diameter and total biomass in comparison with *E. camaldulensis*. The growth of *E. camaldulensis* was more greatly affected by the density treatments than that of *C. cunninghamiana*. The evidence that *E. camaldulensis* had more roots penetrated into the soil B horizon in comparison with *C. cunninghamiana* showed that *E. camaldulensis* can more efficiently use subsurface soil water and tolerate drying environment conditions. *C. cunninghamiana* could use the surface soil moisture more efficiently than *E. camaldulensis* in terms that *C. cunninghamiana* had more fine roots in the surface soil.

The tree treatments demonstrated significantly higher capacity in retaining NO₃-N in the vegetation-soil system in comparison with bare ground. During the 'nutrient depletion period' and the 'low NO₃ addition period', tree treatments on average retained more NO₃-N than bare ground by 39.9 and 33.2%. Both tree and pasture plots significantly retained NO₃-N as NO₃-N enriched water flowed through the soil during the 'high NO₃ addition period, the trees, however, did not show a significantly greater ability in retaining lateral moving NO₃-N in comparison with pasture. The experiment also showed that the efficiency of NO₃-N removal by trees was greater when NO₃-N concentration was relatively higher in the soil.

Finally, two integrated VBS models are presented that include both tree (combination trees with deep root systems and trees with surface dominant root systems) and pasture components to integrate the advantages of both trees and pastures in removing nutrients and reducing water flow from adjacent fields.

Content

	Page
DECLARATION	I
ACKNOWLEDGEMENT	II
ABSTRACT	IV
List of Tables	XII
List of plates	XIV
List of Figures	XV
Chapter 1 Introduction	1
1.1. Contamination of inland water systems	1
1.2. Non-point source contamination	2
1.3. Vegetation-soil system as an alternative to dealing with point and non-point source pollutants	3
1.4. Potential pollution associated with feedlot effluent in Australia	5
1.5. Study aims	7
1.6. Thesis outlines	8
Chapter 2. Literature review and background	11

2.1. Introduction	11
2.2. The terminology and prime function of buffer zones	11
2.3. Mechanisms and potential role of vegetated buffer strips in removing pollutants	15
2.3.1. General principles of VBSs in removing pollutants	15
2.3.2. Sediment trapping in VBSs	17
2.3.3. Nutrient removal in VBSs	19
2.3.3.1. Surface nutrient removal	20
2.3.3.2. Subsurface nutrient removal	22
2.4. Other beneficial aspects of vegetative buffer strips	25
2.5. Design and management of VBSs	27
2.6. Status of study and practice of VBSs in Australia	32
2.7. Conclusion	35
Chapter 3. Study design and methods	37
3.1. Field experiment	37
3.1.1. Introduction	37
3.1.2. Site description	38
3.1.2.1. Climate	38
3.1.2.2. Vegetation	39
3.1.2.3. Soil properties	39
3.1.2.3.1. Physical properties	39
3.1.2.3.2. Chemical properties	42
3.1.3. Design and establishment	45
3.1.3.1. Selection of tree and grass species	45
3.1.3.2. Establishment	46
3.1.3.3. Instrumentation for monitoring soil water storage and groundwater	47
3.1.3.4. Instrumentation for surface runoff measurement	49
3.1.3.5. Effluent irrigation	50
3.1.4. Survival and growth measurement and analysis for the trees and pasture	52
3.1.5. Estimate of water use by trees and pasture	52

3.1.5.1. Soil water storage	53
3.1.5.2. Soil water deficit	54
3.1.5.3. Separation of evaporation and drainage	55
3.1.6. Estimate of the effectiveness of trees and pasture in reducing lateral groundwater flow	55
3.1.7. Estimate of the effectiveness of trees and pasture in removing nutrients	56
3.1.7.1. Nutrient removal from lateral groundwater flow	56
3.1.7.2. Estimate of changes in surface soil chemical properties	57
3.2. Glasshouse experiment	59
3.2.1. Introduction	59
3.2.2. Design and establishment	60
3.2.3. Experimental periods and nitrate application	65
3.2.4. Growth measurement of trees and grasses	66
3.2.5. Soil solution sampling and analysis	67
3.2.6. Water use measurement for the trees and pasture	68
3.3. Data analysis	68
Chapter 4. Growth and water use by trees and pasture	70
4.1. Results	70
4.1.1. The survival and growth of trees and pasture	70
4.1.1.1. Tree survival and growth	70
4.1.1.2. Pasture establishment and growth	75
4.1.2. Water use by trees and pasture	75
4.1.2.1. Soil water deficit	75
4.1.2.2. Determination of the effective rooting depth	82
4.1.2.3. Water use and water balance	89
4.2. Discussion	94
4.2.1. The survival and growth of trees and pasture	94
4.2.1.1. Tree survival	94
4.2.1.2. Tree growth	97
4.2.1.3. Pasture establishment and growth	98
4.2.1.4. Factors affecting the survival and growth of trees and pasture	98

(1) Frost and cold temperature	99
(2) Weed competition	100
(3) Damage by rabbits/hares	101
(4) Insect damage	101
(5) Waterlogging and drought	102
(6) Irrigation with effluent	103
4.2.2. Water use by trees and pasture	104
4.2.2.1. Soil water deficit	104
4.2.2.2. Determination of the effective rooting depth	106
4.2.2.3. Water use and water balance	107
4.3. Conclusion	109

Chapter 5. Effectiveness of the trees and pasture in intercepting lateral groundwater flow and nutrients **110**

5.1. Results	110
5.1.1. Evidence for lateral groundwater flow	110
5.1.2. Interception of lateral groundwater flow by the trees and pastures	113
5.1.2.1. Evidence from water table levels	113
5.1.2.2. Evidence from comparison of soil water storage	119
5.1.3. Nutrient interception by trees and pastures	124
5.1.3.1. The amount of N and P added in the experimental zone and pasture application zone in effluent and fertilisers	124
5.1.3.2. Evidence from monitoring groundwater quality	125
5.1.4. Change of surface soil chemical properties	135
5.2. Discussion	137
5.2.1. Lateral groundwater interception by trees and pastures	137
5.2.2. Nutrient interception by trees and pastures	140
5.2.3. Nutrient relations between vegetation, soil and groundwater	143
5.2.3.1. Comparative N and P balance for the tree and pasture treatments in the experimental zone	144
5.2.3.2. Nutrient relations between vegetation, soil and groundwater	149
5.3. Conclusion	151

Chapter 6. A simulation experiment on the effectiveness of trees and pasture in reducing lateral nutrient movement	153
6.1. Results	153
6.1.1. Growth responses of trees and grasses	153
6.1.1.1. Tree growth	153
6.1.1.2. Above and below ground biomass	158
6.1.1.3. Nitrogen and phosphorus accumulation in trees and grasses	160
6.1.2. Nutrient removal by trees and pastures from lateral groundwater flow	162
6.1.2.1. Evidence from the ‘soil nutrient depletion period’	162
6.1.2.2. Evidence from the ‘low NO ₃ -N addition period’	172
6.1.2.3. Evidence from the ‘high NO ₃ -N addition period’	174
6.1.2.4. Summary of the experiment	174
6.1.3. Comparison of water use by trees and pasture	179
6.2. Discussion	180
6.2.1. Growth responses of trees and pasture	180
6.2.2. Nutrient removal in soil solution by trees and pasture	182
6.2.3. Water use by trees and pasture	185
6.3. Conclusion	186
Chapter 7. General discussion and conclusion	187
7.1. The perspective of using the two tree species as components in VBS on the Northern Tablelands	188
7.2. Tree vs. grass vegetative buffer strips	190
7.3. The main mechanisms involved in NO ₂ -N removal from lateral moving groundwater by VBSs	193
7.4. Design of VBSs for the Northern Tablelands	195
7.4.1. Requirements for design of VBSs	195
7.4.2. Specific factors influencing the design and installation of VBSs on the Northern Tablelands	196

7.4.3. Two integrated VBS models for Northern Tablelands	
7.4.3.1. Model 1: a tree zone combined with a pasture zone	197
7.4.3.2. Model 2: a tree zone with pasture understorey layer	200
7.5. Limitations associated with this study and the question that needs further research	203
7.6. Conclusion	204
References	207

List of Tables

	Page
 Chapter 3	
Table 3.1. Soil physical properties of the experimental site at Tullimba, NSW	42
Table 3.2. Soil chemical properties of the experimental site at Tullimba, NSW	44
Table 3.3. The typical chemical composition of the irrigation effluent	51
Table 3.4. The experimental stages and periods for the glasshouse experiment	66
 Chapter 4	
Table 4.1. Water balance (mm) of the tree plantation and pasture from 25/9/1997 to 31/3/1998	94
Table 4.2. Comparison of survival and growth for <i>E. camaldulensis</i> and <i>C. cunninghamiana</i> from different experiments in Australia	96
 Chapter 5	
Table 5.1. The amount of N and P added to the experimental zone and the pasture application zone from December 15, 1996 to September 25, 1997	125
Table 5.2. Comparison of soil chemical properties between trees and pastures	136
Table 5.3. Comparison of the changes in soil chemical properties for the tree and pasture treatments in the experiment site, and the pasture application zone	137
Table 5.4. Soil N budget for the Pasture application zone and the experimental zone during the period between July 1995 and March 1998	148
Table 5.5. Soil P budget for the Pasture application zone and the experimental zone during the period between July 1995 and March 1998	149

Chapter 6

Table 6.1. Analysis of variances for the effect of treatments on tree height growth	155
Table 6.2. Analysis of variances for the effects of treatments on tree diameter growth	156
Table 6.3. Biomass (g plot^{-1}) of the trees growing in glasshouse	160
Table 6.4. Mean concentration of N and P in the tissue of <i>Eucalyptus camaldulensis</i> , <i>Casuarina cunninghamiana</i> and pasture in the glasshouse experiment	161
Table 6.5. Comparison of total biomass, and N and P stored in the above- and below-ground biomass for trees and pastures in the glasshouse experiment	162
Table 6.6. Levels of significance from the analysis of variances for the effect of treatments on $\text{NO}_3\text{-N}$ concentration in soil solution between the tree treatments over the 'soil nutrient depletion period', 'low $\text{NO}_3\text{-N}$ addition period' and 'high $\text{NO}_3\text{-N}$ addition period	166
Table 6.7. The efficiency of trees in removing $\text{NO}_3\text{-N}$ from soil solution in comparison with pastures and bare ground in the glasshouse experiment	178

List of Plates

	Between pages
Plate 1. Showing the marked difference in texture between the soil A- and B-horizon in the experimental site at Tullimb. A- horizon is a sandy clay loam and B-horizon is light-medium to medium clay	41/42
Plate 2a. Showing the established experimental site at Tullimba. Planted trees were protected with milk cartons around them. Observation wells (each instrument station including 3 wells) were established above, within and below the experimental zone.	46/47
Plate 2b. The trees (<i>E. camaldulensis</i> and <i>C. cunninghamiana</i>) and pastures in late November 1997 (in the third growing season).	46/47
Plate 3a. Showing the deep root system of <i>E. camaldulensis</i> .	158/159
Plate 3b. Showing the surface dominant root system of <i>C. cunninghamiana</i> .	158/159

List of Figures

	Page
Chapter 1	
Figure 1.1. The location of Tullimba, west of Armidale, NSW	9
Figure 1.2. Tullimba beef cattle feedlot, showing the effluent disposal area and the experimental site	10
Chapter 2	
Figure 2.1. Three zoned riparian zone system	31
Chapter 3	
Figure 3.1. Topographic relief of the experimental site at Tullimba, NSW	40
Figure 3.2. Field experimental layout at Tullimba	41
Figure 3.3. Locations of instrument stations for the field experiment at Tullimba, NSW	48
Figure 3.4. The observation wells and neutron probe access tubes at an instrument station	49
Figure 3.5. Schematic representation of the glasshouse experiment	61
Figure 3.6. The glasshouse experiment layout	64
Chapter 4	
Figure 4.1. Height growth of <i>Eucalyptus camaldulensis</i> and <i>Casuarina cunninghamiana</i> during 29 months since planted	72
Figure 4.2. The effect of tree species and density treatments on (a) average height, (b) crown cover and (c) basal area	74

Figure 4.3. The dynamics of soil water deficit of the tree and pasture plots during the period from September 1996 to March 1998	77
Figure 4.4. Comparison of the soil water extraction patterns for trees and pasture at four different depths in the soil profile	79
Figure 4.5. Water extraction patterns for the tree treatments	80
Figure 4.6. Water content against time at selected measuring depths for all the 15 tree and pasture plots to determine the effective rooting depth	83
Figure 4.7. Change of soil water content for the tree and pasture treatments at the depths of 120 cm, 100 cm and 80 cm from October 10 to December 4, 1997	88
Figure 4.8. Seasonal patterns of daily water use for the tree and pasture treatments	90
Figure 4.9. Comparison of water use for the trees and pasture during the 13 fortnights since September 25, 1997 (third growing season)	92
Figure 4.10. Mean cumulative water use by the trees and pastures over 13 fortnights since September 25, 1997 (third growing season)	93

Chapter 5

Figure 5.1. Change in number of observation wells (shallow, medium and deep) with groundwater for the instrument stations above, within and below the experimental zone during 67 days since February 6, 1997 as results of rainfall and irrigation	112
Figure 5.2. Comparison of water table levels for the three zones: above experimental zone, within experimental zone and below experimental zone during 67 days since February 6, 1997	114
Figure 5.3. Comparison of water table levels for the tree and pasture plots, and between the tree treatments	115
Figure 5.4. Comparison of water table levels for the three zones: above experimental zone, within experimental zone and below experimental zone during 196 days since September 25, 1997	117
Figure 5.5. Comparison of water table levels for the tree and pasture treatments during 196 days from September 25, 1997	118

Figure 5.6. Comparison of soil water storage for the three zones: above experimental zone, within experimental zone and below experimental zone during the period from September 1997 to March 1998	121
Figure 5.7. Comparison of soil water storage for the tree and pasture plots during the period from September 1997 to March 1998	122
Figure 5.8. Comparison of soil water storage between the tree treatments during the period from September 1997 to March 1998	123
Figure 5.9. Comparison of chemical changes in the groundwater from the deep observation wells for the pasture application zone and the zones above, within and below the experimental site	127
Figure 5.10. Comparison of chemical changes in the groundwater from the shallow observation wells for the pasture application zone and the zones of above, within and below the experimental site	128
Figure 5.11. Comparison of chemical changes in the groundwater from the shallow and deep observation wells for the pasture application zone and the zones of above, within and below the experimental site	130
Figure 5.12. Comparison of chemical changes in the groundwater from the deep observation wells for trees and pastures	131
Figure 5.13. Comparison of chemical changes in the groundwater from the deep observation wells between the tree treatments	132
Figure 5.14. Comparison of chemical changes in the groundwater from the shallow observation wells for trees and pastures	133
Figure 5.15. Comparison of chemical changes of the groundwater from the shallow observation wells between the tree treatments	134
Figure 5.16. A schematic model of soil nutrient balance for the experimental zone and the pasture application zone at Tullimba	147

Chapter 6

Figure 6.1. The effect of species and density treatments on tree height growth in the glasshouse experiment	154
Figure 6.2. The effect of species and density treatments on tree diameter growth in the glasshouse experiment	157

Figure 6.3. Comparison of biomass for trees and pastures in the glasshouse experiment	156
Figure 6.4. Comparison of NO ₃ -N concentration in soil solution between (a) the tree treatment and bare ground control, and (b) among the tree treatments over the 'soil nutrient depletion period'	164
Figure 6.5. Comparison of NO ₃ -N concentration in soil solution at (a) A-B interface and (b) B horizon for the tree treatments and bare ground control over the 'soil nutrient depletion period'	165
Figure 6.6. Comparison of PO ₄ -P concentration in soil solution between (a) the tree treatment and bare ground control and (b) among the tree treatments over the 'soil nutrient depletion period'	168
Figure 6.7. Comparison of PO ₄ -P concentration in soil solution at (a) the soil A-B interface and (b) in the B horizon for the tree treatments and bare ground control over the 'soil nutrient depletion period'	169
Figure 6.8. Comparison of EC values in soil solution for the tree treatments and bare ground control over the 'soil nutrient depletion period'	170
Figure 6.9. Comparison of pH values in soil solution for the tree treatments and bare ground control over the 'soil nutrient depletion period'	171
Figure 6.10. The effect of tree treatments on NO ₃ -N concentration in lateral (a) A-B interface flow and (b) B horizon flow compared with bare ground control during the 'low NO ₃ -N addition period'	173
Figure 6.11. Effects of trees and pastures on NO ₃ -N concentration in lateral A-B interface flow and B horizon flow during the 'high NO ₃ -N addition period'	176
Figure 6.12. Comparison of the efficiency of tree zone in NO ₃ -N removal (a) for the A-B interface flow and (b) the B horizon flow during the low and high NO ₃ -N addition periods	177
Figure 6.13. Comparison of water use between the tree and pasture treatments during the 4 weeks since April 1, 1998	179

Chapter 7

Figure 7.1. Integrated VBS model 1 for use on the Northern Tablelands,

NSW by designing a tree zone using trees with deep root systems
and the trees with surface dominant root systems, combined with
a improved pastures zone

201

Figure 7.2. Integrated VBS model 2 for use on the Northern Tablelands,
NSW by interplanting the trees with deep root systems, the trees
with surface dominant root systems and improved pastures

202