Using 100 Years of Gunnedah Rainfall Records to Investigate the Role of Pasture in Reducing Water Table Recharge

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Dryland salinity is now a recognised problem in northern NSW. Recent predictions that 50,000 ha of the rich Liverpool Plains could become non-productive in the next 10 years with the area increasing to >100,000 ha within 20 years (Hamilton, 1992). This has caused advisers and farmers to re-assess the appropriateness of the crop and pasture rotations currently recommended in the region

Experience in southern NSW and northern Victorian suggests that more pastures are needed in our farming systems to minimise recharge of the ground water. However, in northern NSW where soils hold a lot more water in the rooting zone and the summer dominant rainfall is more erratic, ground water recharge is probably episodic, occurring only in a few very wet seasons. Under these conditions, it might not matter whether you have pasture, trees or fallow because in a normal season the soil will hold all the moisture and in erratic wet years, there will be so much water some will enter the ground water regardless of the vegetal cover present.

METHOD

To compare the likely ground water recharge of different forms of land-use on the Liverpool plains the cropping system model PERFECT developed by Queensland DPI was used. This model provides both average figures and frequency distributions (Littleboy *et al.*, 1991). In the summer dominant rainfall zone the variability is as important as the average. The computer model was used to simulate the daily soil moisture balance for 100 years of daily Gunnedah rainfall from 1889 to 1988 on a black earth and a red brown earth. The available soil water for the two soils was set at 150 mm/m and 112 mm/m respectively, maximum drainage rates were 0.5 mm/day and 6 mm/day.

For both soil types the standard rotation of wheat - fallow - sorghum - fallow - wheat was compared with opportunity cropping and lucerne-based pasture. Using the paddock sequence and rainfall data, a daily moisture budget was calculated for each of the 100 year runs. From this moisture budget the daily water use, runoff and deep drainage were calculated. The model planted an opportunity crop if there was adequate soil moisture (75 mm/m) during the planting window for wheat, sorghum or sunflowers. The potential water use of the lucerne pasture was based on an annual growth curve.

RESULTS AND DISCUSSION

The results from the PERFECT model are best used as comparisons between different paddock sequences as the numbers are generated by simulation rather than measurement. The water budgets for the different sequences are presented in Table 1. As mentioned earlier, the erratic rainfall makes the variability as important as the average. Figures 1 and 2 show that even with opportunity cropping there will be significant recharge in wetter years. In contrast, the lucerne-based pasture will only contribute small amounts even in wet years.

Table 1: The annual water budget for the standard rotation of wheat - sorghum - wheat, opportunity cropping and pasture on the black earth (BLE) and the red brown earth (RBE). The percentages are the proportion of annual rainfall 608mm in water use, runoff and drainage.

Paddock sequence	Water use + soil evap. (mm)		Runoff (mm)		Drainage (mm)	
BLE Wh So W	511	84%	58	9.5%	39	6.5%
BLE Opp crop	557	92%	39	6.5%	12	1.5%
BLE Pasture	597	98%	10.5	1.8%	0.5	0.2%
RBE WH So Wh	499	82%	23	4%	86	14%
RBE Opp Crop	542	89%	18	3%	48	8%
RBE Pasture	595	98%	7.5	1.1%	5.5	0.9%

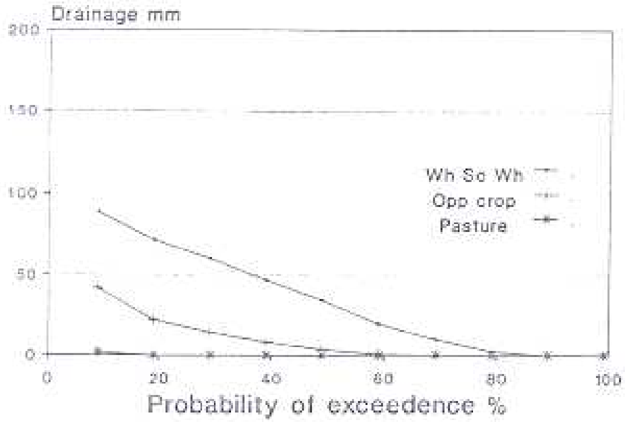

Figure 1: The probability of exceeding annual drainage for wheat/sorghum/wheat, opportunity cropping and lucerne based pasture on a black earth at Gunnedah.

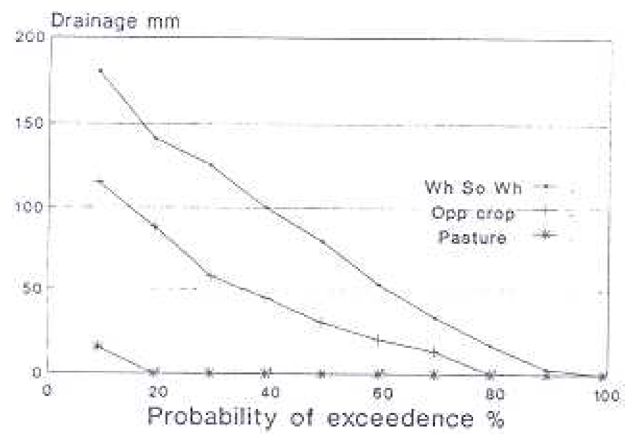

Figure 2: The probability of exceeding annual drainage for wheat/sorghum/wheat, opportunity cropping and lucerne based pasture on a red brown earth at Gunnedah.

As an example, interpret Figure 2 as follows: take the 10% point on the bottom axis. In the wettest one year in ten there will be more than 20 mm drainage from pastures, 115 mm from opportunity cropping and 180 mm from the long fallow sequence. These figures show that in the driest 80% of years, there will be negligible drainage from pastures. The difference between soil types is dramatic and is due to the faster drainage and poorer water storage per cm of soil in the red brown earth.

The PERFECT model only considers a single point, hence will not account for flooding or lateral movement of water. The simulated numbers should only be used as a guide, there is a project conducted by Department of Conservation and Land Management under way which is measuring the water balance on a number of paddocks on the Liverpool plains. In addition the University of New England is investigating the economic consequences of a transition to pastures and the Murray Darling Basin is studying the economics of land use across the basin. These simulation runs from the PERFECT model provide some background to these studies.

CONCLUSION

This exercise supports the assertion that sustainable farming on the Liverpool plains will require a significant pasture component. Because a perennial pasture is always using some of the soil moisture, there is a buffer for the storm rains. This contrasts with cropping where there is often a full profile of moisture with nothing growing or only seedlings present.

ACKNOWLEDGMENT

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REFERENCES

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