# Appendix 6. Proforma calculation sheets (for photocopying)

## Calculation Sheet: Water 1 – Past crop performance

### Enter rainfall for your site (available from own records or Australian Rainman)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| wettest 20%* | | | | | | | | | | | | |
| average | | | | | | | | | | | | |
| driest 20%+ | | | | | | | | | | | | |

* the wettest one season in five (20% of seasons) or *in 20% of years rainfall will exceed ……..?*
+ the driest one season in five (20% of seasons) or *in 80% of years rainfall will exceed ……..?*

### 1.1. Rainfall stored during fallow

When does the fallow normally start and finish?

Month the fallow starts: _____

Month the fallow ends: _____

Total fallow rainfall = _____ mm

**Water stored over the fallow** = Fallow rainfall x % of rainfall stored (suggest 20%,

= _____ mm x _____% see Table 3.1)

= _____ mm

### 1.2. Water supply from in-crop rainfall

When do you normally plant and harvest?

Month of planting: _____

Month of turning*: _____

**Total in-crop rainfall** = _____ mm

**Total water** supply = Water stored over fallow + in-crop rain

= _____ mm + _____ mm

= _____ mm

### 1.3. Yield produced from each mm of water (WUE)

**Water use efficiency** $= \dfrac{\text{Crop yield (kg/ha)}}{\text{(Total water supply – 100)}}$

$= \dfrac{\text{kg/ha}}{\text{mm – 100}}$

= _____ kg of yield/ha/mm of water

* Turning = physiological maturity — when the crop stops accumulating more yield.

## Calculation Sheet: Water 2 – Estimating available fallow moisture – using a push probe

**Water available to plants** = Depth of wet soil x water available/cm of wet soil*

**(Plant Available Water)** = _____ cm x _____ mm of water/cm of soil depth

Available stored water = _____ mm of water

* this is described as the Plant Available Water Capacity. PAWC values for some soils are listed in Table 3.2

## Calculation sheet: Water 3 – Estimating available fallow moisture – using a soil corer

| Depth interval (cm) | Layer thickness (cm) | Bulk[1] density (g/cm$^3$) | Crop[1] lower limit (%) | Wet weight [2] (g) | Dry weight.[2] (g) | Gravimetric water[3] (%) | Volumetric water (%) | Available water (mm) |
|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f (d-e)/e x100 | g f x b | h (g-c) x a/10 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | Total available water | |

[1] Input from Module 5 for specific soil type and location - lower limit is in volumetric measure
[2] Input from field data
[3] Calculate from (d-e)/e if d and e are net weights; use (d-e)/(e-tare) if gross weights

## Calculation sheet: Water 4 – Calculating expected yield from available soil water and forecast rainfall

### 2.2. Rainfall expected while crop is growing

(Enter rainfall for your site from own records or Australian Rainman)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| wettest 20%* | | | | | | | | | | | | |
| average | | | | | | | | | | | | |
| driest 20%+ | | | | | | | | | | | | |

* the wettest one season in five (20% of seasons) or *in 20% of years rainfall will exceed …….?*
+ the driest one season in five (20% of seasons) or *in 80% of years rainfall will exceed ……..?*

**Period of crop water use**

month of planting = _____

month of turning = _____

(physiological maturity or when the crop stops accumulating more yield)

**Estimated in-crop rainfall for period**

= _____ mm

### 2.3. Total water supply expected for the crop

**Available water** = Soil water at planting* + Expected in-crop rain

= _____ mm + ____ mm

= _____ mm

*from Calculation Sheet: Water 2 or 3

This calculation can be repeated for average, wet and dry years.

### 2.4. Yield expected this season

**Expected Yield = Water Use Efficiency x (water supply – 100)**

(WUE from Table 3.4 or from your own calculation of past paddock performance)

= _____ kg/ha/mm x _____mm

= _____ kg/ha ÷ 1000

**Expected yield = _____ t/ha**

## Calculation sheet: Water 5 – What happened this season?

### 3.1. How much water did the crop use?

**Plant available water (PAW) at planting** (from Section 2)

$PAW_{planting}$ = _____ mm

**Rain while the crop was growing** (from your own records)

In-crop rainfall = _____ mm

**Plant available water (PAW) at harvest**

$PAW_{at\ harvest}$ = _____ mm

**Amount of water used by the crop**

Water used by the crop = $PAW_{planting}$ + In-crop rain – $PAW_{harvest}$

= _____ mm + _____ mm – _____ mm

**=** _____ mm

NB: In seasons where it can be assumed that little water remains in the profile after harvest, there is no need to core to determine residual water. Set $PAW_{harvest}$ = 0.

### 3.2. How efficiently did the crop use water?

$WUE_{actual}$ = Actual crop yield (kg/ha) ÷ (Water used – 100)

= _____ kg/ha ÷ ( _____ mm – 100)

= _____ kg/ha ÷ _____ mm

= _____ kg/ha/mm

## Calculation sheet: Water 6 – How much rain was stored during the fallow?

### a. Estimation by push probe (See also Calculation Sheet: Water 2)

**Plant Available Water ($PAW_{start}$) at start of the fallow**

$PAW_{start}$ * = Depth of wet soil at start x PAW Capacity (See Table 3.2)

= _____ cm x _____ mm/cm

= _____ mm

**Plant Available Water ($PAW_{end}$) at end of the fallow**

$PAW_{end}$ = Depth of wet soil at end x PAWC (Table 3.2)

= _____ cm x _____ mm/cm

= _____ mm

### or b. Estimation by coring (at start and at end of fallow, using Sheet: Water 3)

$PAW_{start}$ * = _____ mm

$PAW_{end}$ = _____ mm

**Fallow rainfall** = _____ mm (from own records)

## How efficient was the fallow?

Fallow efficiency = (PAW stored during fallow ÷ Fallow rainfall) x 100

$$= \frac{(PAW_{end} - PAW_{start})}{\text{Fallow rainfall}} \times 100$$

$$= \frac{(\quad mm - \quad mm)}{mm} \times 100$$

$$= \frac{\quad mm}{mm} \times 100$$

Fallow efficiency = _____%

*In seasons when it can be assumed that little water remains in the profile after harvest of the previous crop, there is no need to determine PAW at the start of the fallow. Set $PAW_{start}$ at 0.

# Calculation sheet: Nitrogen 1 – Calculating the nitrogen requirement of the crop

## 5.1. Target yield

Target yield* = _____ t/ha (or bales/ha)

The expected yield will be based on the availability of water. Calculation of the total supply of water for the crop, and what that may mean to yield, has been described in a previous section.

Target protein (wheat, barley, sorghum) = _____ % protein

## 5.2. Nitrogen removed in harvested grain or cotton seed

*N removed depends on yield and protein content of grain*

N in wheat grain = Yield (t/ha) x grain protein % x 1.75
= _____ t/ha x _____ x 1.75
= _____ kg/ha

N in barley/sorghum grain = Yield (t/ha) x grain protein % x 1.60
= _____ t/ha x _____ x 1.60
= _____ kg/ha

N in cotton seed = Yield (bales/ha) x 11 kg[1]
= _____ bales/ha x 11 kg
= _____ kg/ha

**Nitrogen removed in harvest** = _____ kg/ha

[1](Ridge 1994)

## 5.3. Nitrogen needed to grow the crop

*Only about half of the available soil N ends up in harvested grain or cotton*

N needed = 2 x N removed in grain or cotton seed

= 2 x _____ kg/ha

= _____ kg/ha

*Once target yield and protein levels have been set for wheat, barley or sorghum, the nitrogen needed to grow the crop may be read off Tables 3.7 or 3.8. This avoids the need for calculations 5.2 and 5.3. (Note that figures in Tables 3.7 and 3.8 have been rounded off to nearest 5 kg.)

## Calculation sheet: Nitrogen 2 – Fertiliser requirement

### 6.1. Soil N available (from soil tests) (Use Table 3.5 as an example)

| Depth interval (cm) | Layer thickness (cm) | Bulk Density# (g/cm³) | N conc.* (mg/kg) | AvailableN (kg/ha) |
|---|---|---|---|---|
| | a | b | c | d (cxb) x a/10 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | Total available N | |

# Bulk Density data for specific soils and locations are available from Module 5 database

* Nitrogen concentration input from results of analysis.

### 6.2. Nitrogen mineralised during crop

Total available N = _____ kg/ha

. In-crop mineralisation may be estimated from Table 3.6

### 6.3. Extra nitrogen needed to achieve expected yield

The amount of extra nitrogen needed to achieve the expected yield is the difference between that required to produce the expected crop yield and what is available from the soil.

Extra N needed = N to grow crop – (N available + N mineralised in-crop)

= ____ kg/ha – ( ___ kg/ha + ___ kg/ha)

= _____ kg/ha

A positive result means extra N is needed.
A negative result means extra N is not needed from fertiliser or legume rotation. In this case, there is a surplus of nitrogen for the expected yield.