Woburn Forest Growers

To support Woburn Forest Growers in understanding the reliability of their recently installed rainwater harvesting system and the potential of increased storage capacity to reduce mains water use.

Business profile

Location	Flitwick, Central Bedfordshire
Main irrigated production system	Bedding plants, pot plants
Existing RWH system	Yes

Helping to improve decision-making regarding RWH reliability

Using data collected from Woburn Forest (Table 1), the RWH tool was set up and used to simulate daily irrigation demand taking into account the business location, production systems, protected area (polytunnel and greenhouse) characteristics and the existing rainwater harvesting system. The tool uses a daily time-step water balance model to estimate how much rainfall runoff can be usefully collected and stored, and then what proportion of seasonal irrigation demand can be met from rainwater runoff.

Table 1 Key input data for RWH tool.

Key component	Values
1. Rainwater harvesting configuration and hydrology	
Rainwater harvesting area (ha)	0.2 (66% of irrigated area)
Runoff efficiency (%)	100
Rainfall threshold for runoff production (mm)	0.5
Start and end dates for rainwater collection (months)	January-December
2. Plant water requirements and irrigation demand	
Type	Bedding plants
Irrigated area (ha)	0.3
Effective cropping area (%)	100
Timing of irrigation demand (months)	February-June
Evapotranspiration (ET) adjustment (%)	83%
Irrigation drainage/runoff fraction (%)	15
Emergency irrigation supply from RWH storage	24 hours
3. Storage capacity	
RWH storage capacity (m^3)	50

Using the RWH tool to assess annual irrigation demand and rainwater harvested from polytunnels

Figure 1 shows the annual model output for current RWH at Woburn Forest Growers, including the volume of rainwater that could be usefully collected [**black line**], the gross irrigation water demand (including drainage / runoff losses) [**red line**], and the volume of harvested rainwater used to meet irrigation demand [**blue shaded area**]. The simulated gross irrigation demand is around 700-900 m^3/yr of which 300-700 m^3/yr is met from alternative water sources (mains water). The site appears to have the potential to utilise more rainwater as the irrigation used from storage [**blue shaded area**] is currently much lower than potential harvestable rainwater [**black line**].

However, Figure 2 shows that much of the harvestable rainfall falls outside the main irrigation period which ends in June and so, once the storage tank has refilled, is lost to overflows [**medium blue**]. Due to the limited storage capacity of the current tank, of which around 1/3 is kept as emergency storage, the usable tank storage is regularly used up so that the use of rainwater [**light green bars**] to meet irrigation needs is then dependent on rainfall events.

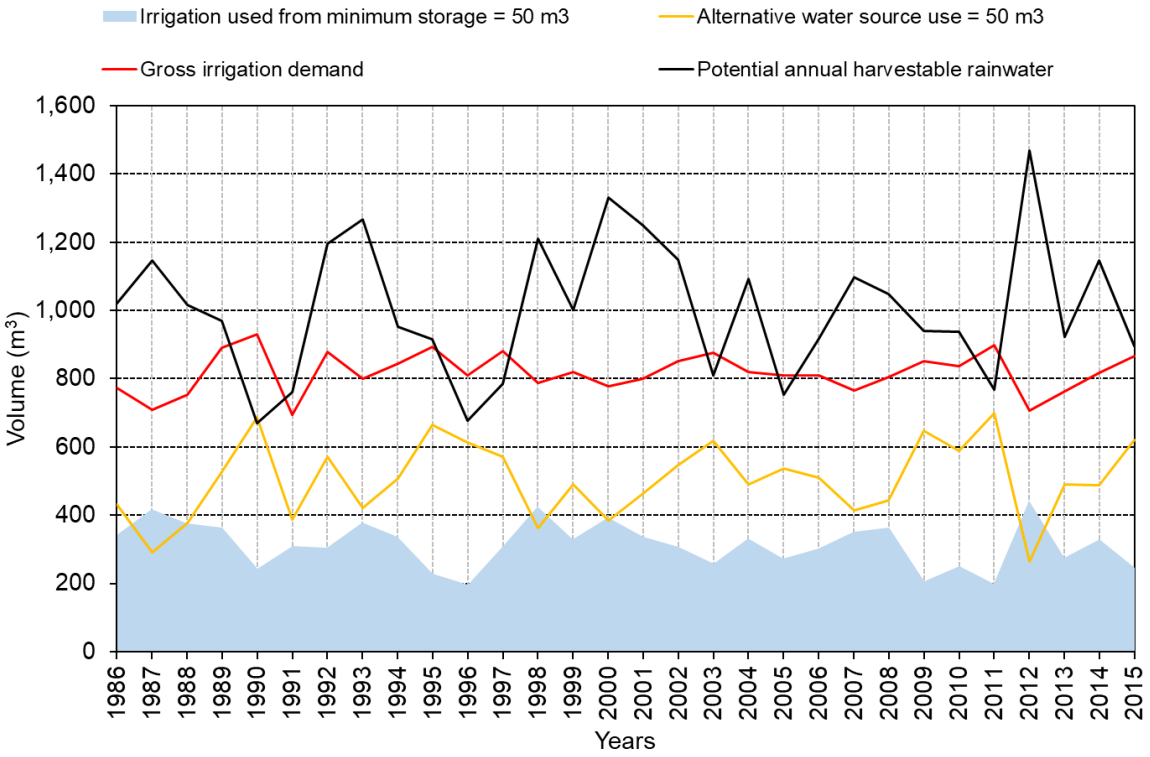


Figure 1 Annual RWH summary analysis for Woburn Forest Growers (current).

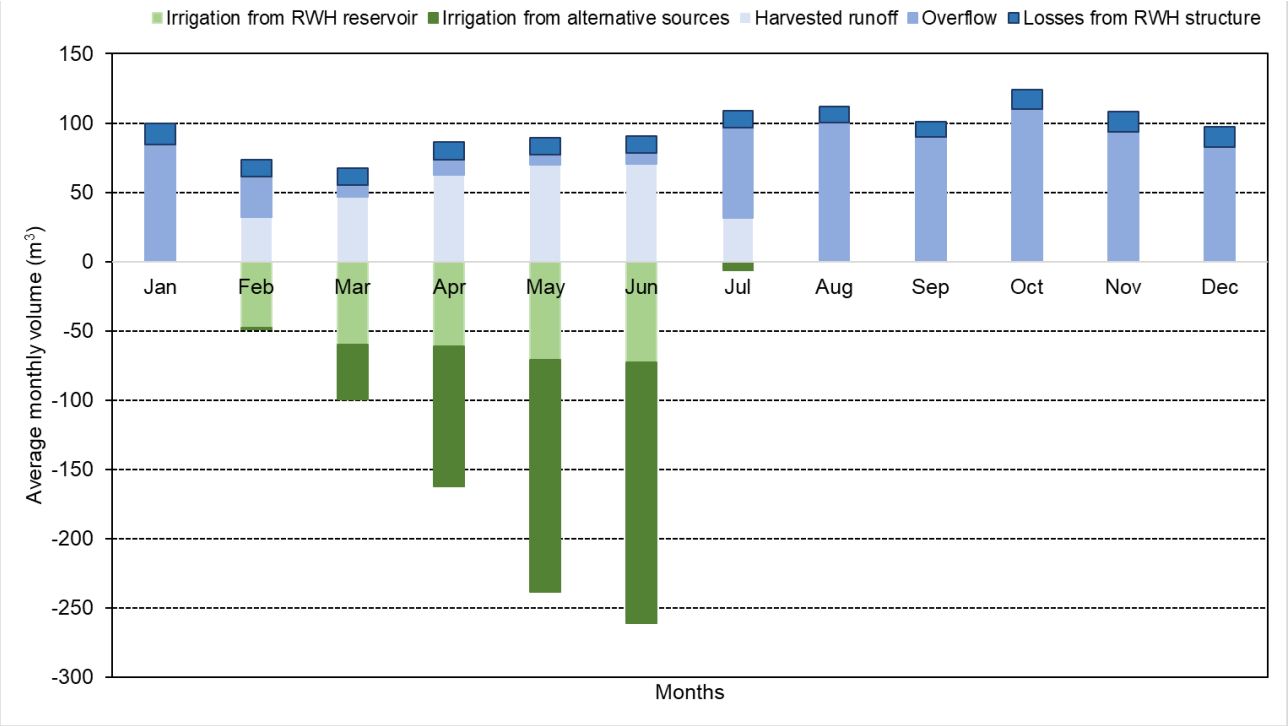


Figure 2 Monthly average water balance using RWH tool (current)

RWH performance metrics

Two RWH performance metrics were calculated across the distribution of modelled years for the current (50m^3) and potential future (100 and 150 m^3) storage capacities. The irrigation deficit (Figure 2) is the volumetric demand not met by the available water supply from harvested rainwater. The water saving efficiency (Figure 3) is the percentage of the total amount of irrigation water demanded that is supplied from the RWH system.

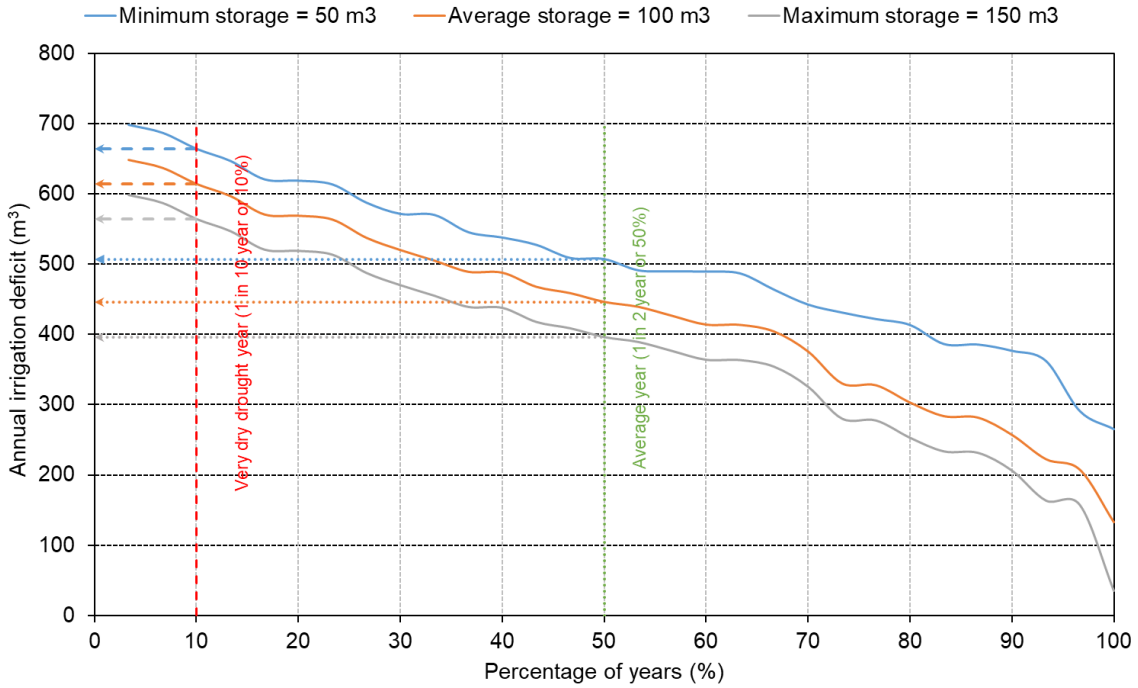


Figure 3 Annual irrigation deficit for current (50m^3) and potential future storage capacities

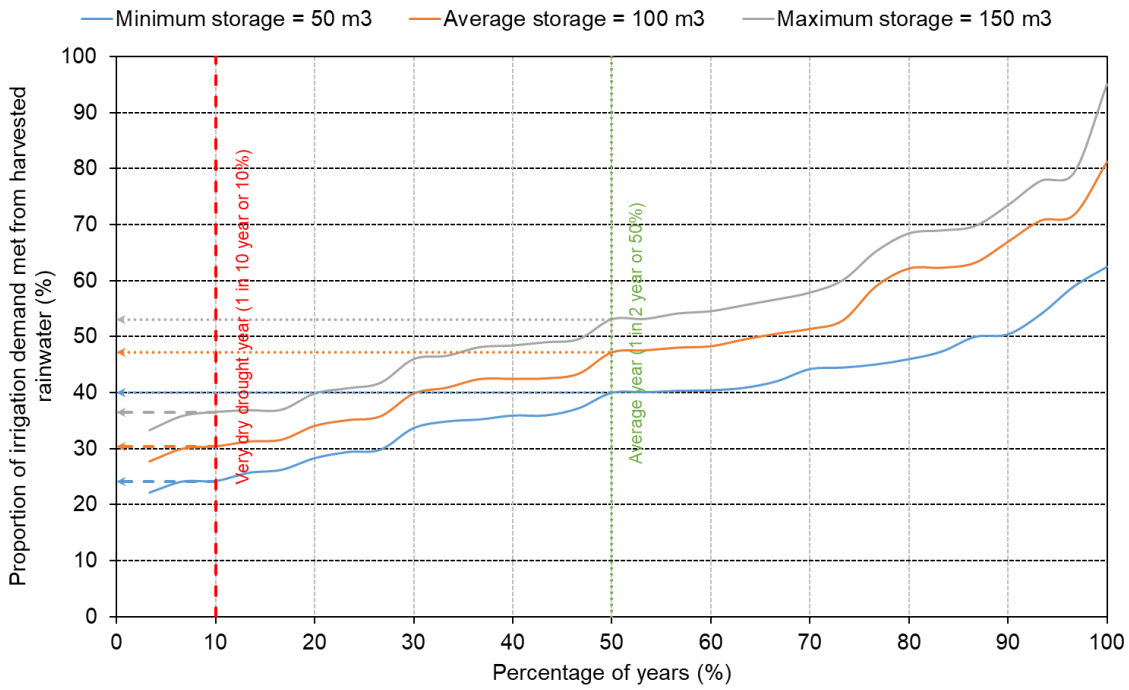


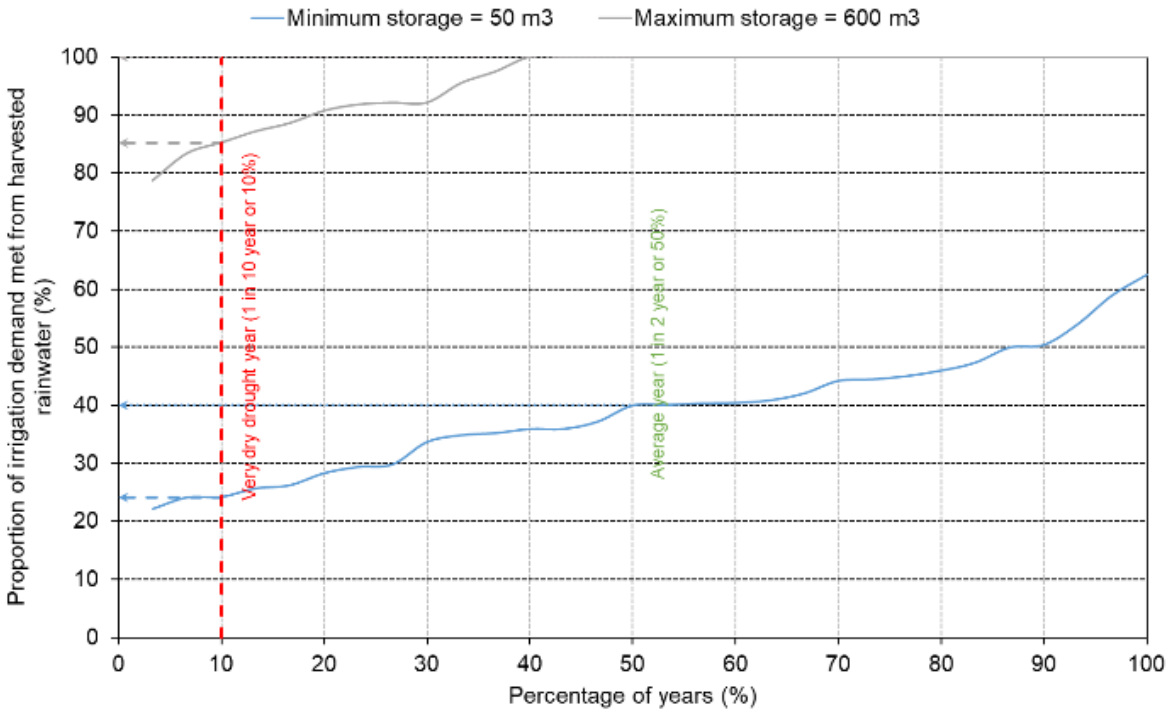
Figure 4 Water saving efficiency for current and future storage capacities

The figures suggest that, if the distribution of annual harvestable rainwater from the RWH system follows the 30-year historical weather data, tripling of storage tank capacity to 150m^3 makes relatively small beneficial changes to both the RWH irrigation deficit (Fig. 3) and the percentage of the total amount of irrigation water demanded supplied from the RWH system (Fig 4). The small benefit arises directly from the greater stored volume at the beginning of the system – in drier than average years, there is rarely sufficient daily rainfall during the irrigation period to cause the current storage tank to overflow and hence little in-season additional benefit from the larger storage tank.

Key implications for RWH at Woburn Forest Growers

The performance of the current rainwater harvesting area is limited by the combination of the rainwater harvesting area (66% of the irrigated area), the low rainfall in the area and the current storage tank capacity. However, the limited ability to fully refill the current tank during the irrigation season in most years means that the volumetric irrigation supply benefits of increases in storage capacity are limited to the increase in storage capacity i.e. adding an additional 50m^3 tank would reduce annual mains water use by around 50m^3 in most years.

The tool suggests that significantly increasing the water saving efficiency to reach 100% in most years would require the installation of a small reservoir of around 600m^3 (Figure 3a), although it would not eliminate mains water use in dry years - the use of mains water would decrease to less than 200m^3 in a very dry (1 in 10) year (compared to an estimated 700 m^3 currently). Harvesting runoff off the polytunnel would decrease the necessary reservoir storage volume to around 500m^3.


Minimum storage = 50 m3
Maximum storage = 600 m3
Proportion of irrigation demand met from harvested rainwater (%)
Percentage of years (%)
Very dry drought year (1 in 10 year or 10%)
Average year (1 in 2 year or 50%)
0
10
20
30
40
50
60
70
80
90
100