3. Water availability and yield

Irrigation norm usually (under normal provision by other inputs) is calculated for high yield. Based on cotton irrigation experimental data processing in various physical-geographic conditions of Central Asia by V.R.Shreder (1977), relationship between cotton yield and irrigation norm $Y_{факт}/Y_{max}=f(M_{факт}/M_{max})$ has been received, similar relationship is obtained by G.H.Khasanhanova (1999) for maize (for grain) and alfalfa. Based on these relationships, we have built own relationship between yield losses and water availability (fig.2). Yield reduction can be predicted depending on water availability.

Since relative values are used in these relationships, it is necessary to assess total crop evaporation with regard for specific soil structure and meteorological parameters within selected period (month, decade, day). To assess total evaporation from cotton field ET_{cotton} within III hydromodulus region (light and medium loam under deep ground water) V.R.Shreder (1977) close link has been found (R^2=0.91) between total evaporation (evapotranspiration) and evaporativity (fig.3):

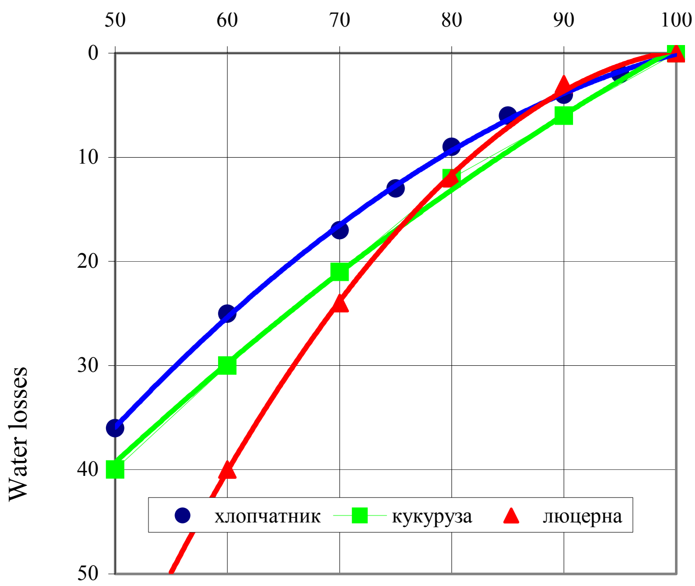

Рис. 2 | Yield losses dependence on water availability

$$ET_{cotton} = \frac{E_0^{1.58}}{31.62} \qquad (2)$$

where

ET_{cotton} - total evaporation, mm/month;

E_o - evaporativity (almost equal to reference crop total evaporation ET_o), mm/month

In order to use ET_o average daily values, this link is transformed in polinome of second degree:

$$ET_{cot\,ton} = 0.107 * E_0^2 + 0.0208 * E_0 \quad (3)$$

where

ET_{cotton} - total evaporation, mm/day;

E_o - evaporativity (almost equal to reference crop total evaporation), mm/day.

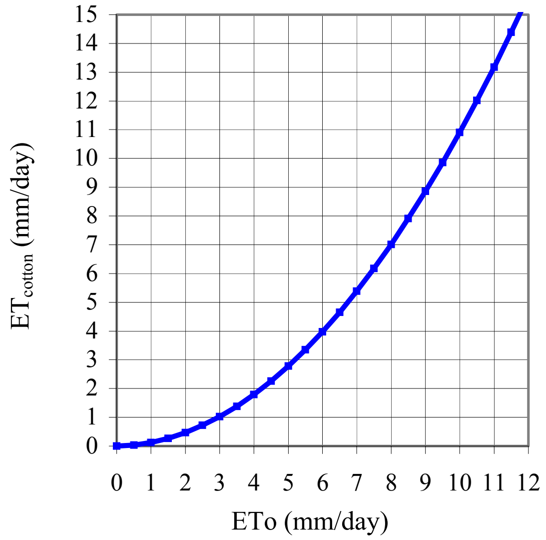

Рис. 3 | Relationship between cotton and reference crop evapotranspiration (evaporativity) – III hydromodulus region

Crop (cotton) coefficient K'_{cotton} is relationship between given and reference crop evapotranspiration:

$$K'_{cot\,ton} = \frac{ET_{cot\,ton}}{E_o} \quad (4)$$

In order to compare crop water consumption for soils with different water-physical properties, V.R.Shreder (1977) suggested to use values increase coefficient calculated for III hydromodulus region (Table 2).

Table 2 | Values increase coefficient calculated for III hydromodulus region

No	Soil structure	Values increase coefficient calculated for III hydromodulus region
I	Thick (>1 m) sandy; thin (0.2–0.5 m) loamy on sandy-gravel and sandy loam on gypsum	1.14
II	Thick sandy loam; medium (0.5-1.0 m) loamy суглинистые on sandy-gravel and gypsum	1.10
III	Light and medium loamy (silty); loamy, lighter to bottom	1.00
IV	Medium loamy (dense) and heavy loamy; loamy, heavier to bottom	0.86
V	Clayey; stratified with clay	0.75

Approximate relationship $K'_{cotton}=f(E_0)$ for soils of various structure is presented on Fig. 4.

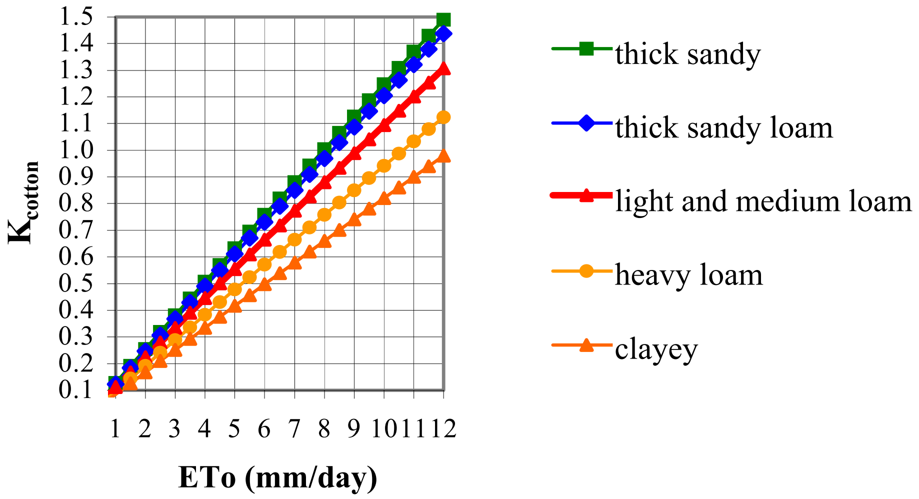

Fig. 4 | Relation between $K_{cotton}= f(ET_o)$ for soils of different structure

Using relationship $K'_{cotton}=f(E_o)$ and actual evaporativity data (weather station "Fergana") cotton consumption for III hydromodulus region can be assessed for the period 1952-2002 necessary for high yield receiving (Fig. 5).

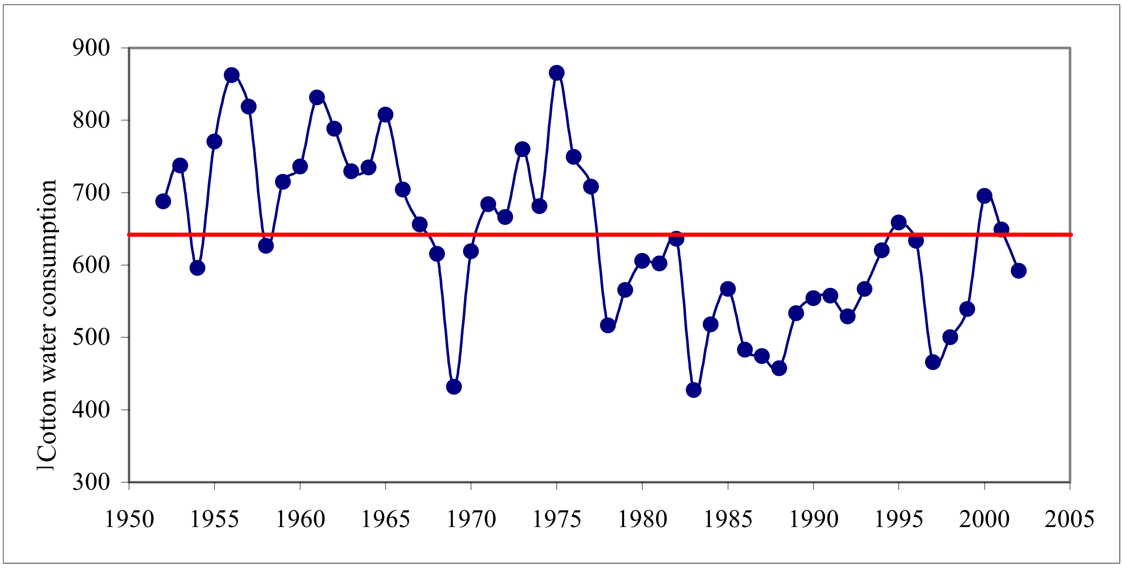

Fig. 5 | Cotton water consumption in III hydromodulus region compared with average for the period 1952-2002

Since usual water use planning practice is based on average long-term norm, under predicted river water availability reduction and crop water consumption exceeding average long-term irrigation norm impact of water availability on crop yield will increase. It is particularly true for saline and subjected to salinization lands. It can be mitigated by winter and early-spring leaching combined with moisture recharge. It is expedient also because of flow power mode when in winter there is more water than during growing period.