Integrating agricultural water use with the global water budget

MalinFalkenmark&Johan Rockström

SIWI and Stockholm Resilience Center

Concerns

* climate change + popul growth

--> food supply problems

* water in dominating mental image

= irrigation focused

--> severe river depletion + groundw overexploit

closing basins = 1.4 bln people

---> WHAT ARE THE OPTIONS?

M.Falkenmark, SIWI and
Stockholm Resilience Center

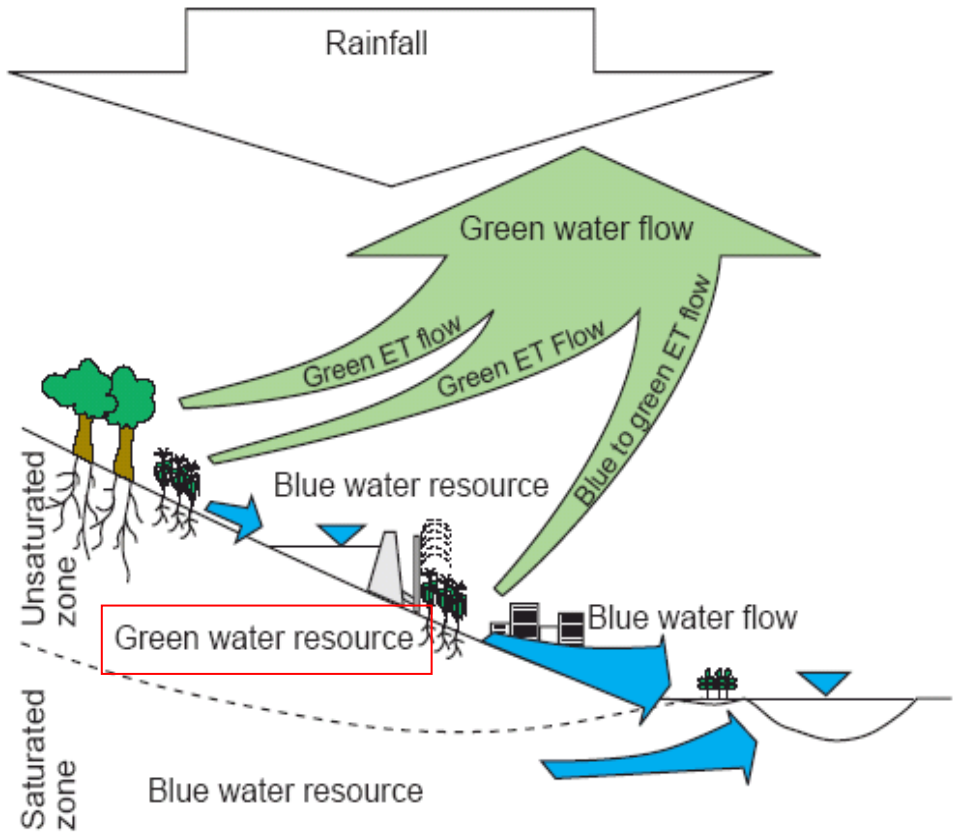
Crops feed on soil moisture

Water resource = rain

→two types of water

***green water in the soil**

***blue water in rivers and aquifers**



M.Falkenmark, SIWI and
Stockholm Resilience Center

Aim and method

Aim:

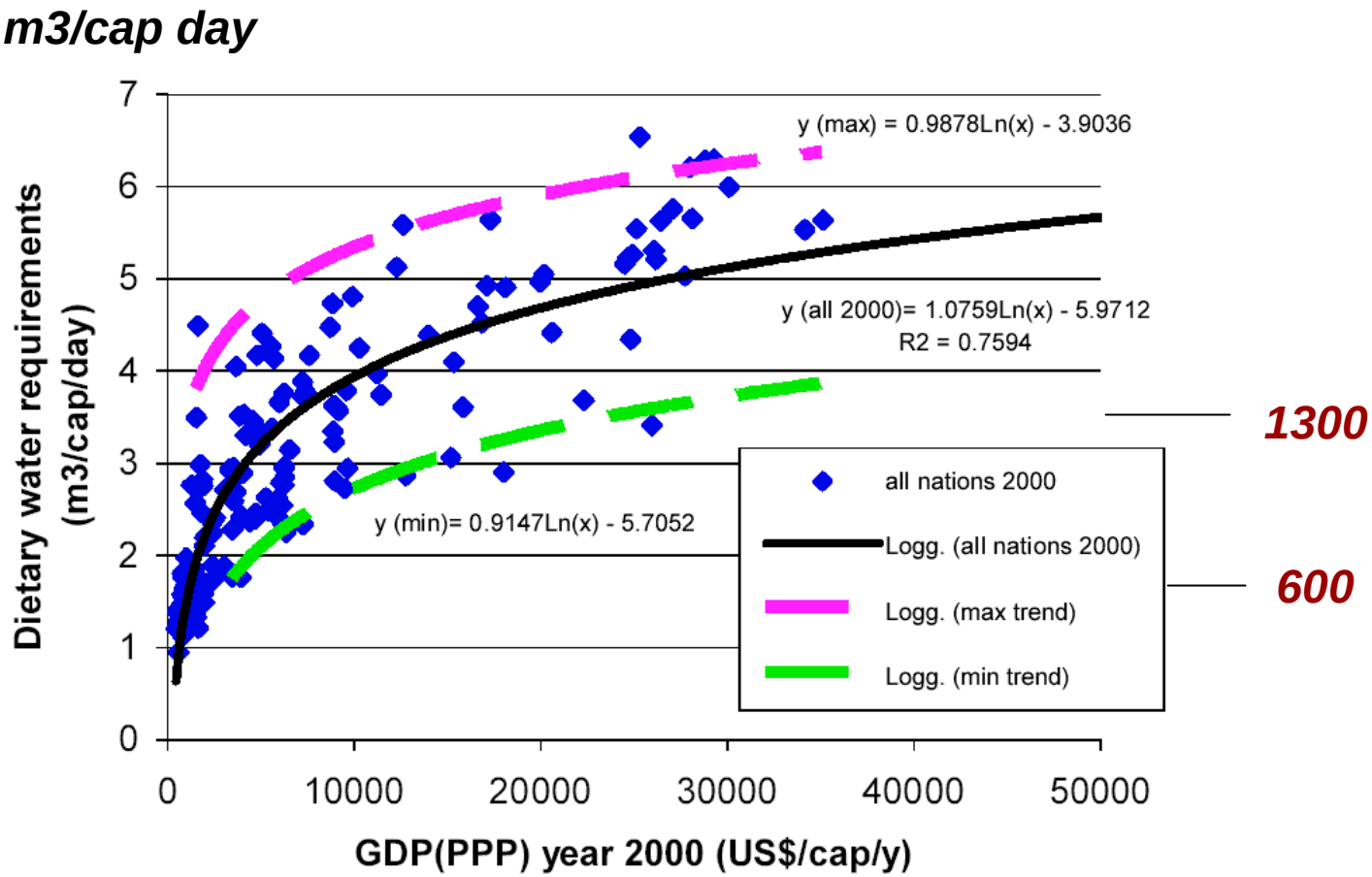
* put future food water requirements in a global perspective
* categorize countries for water shortages

Method

* pixel-based global modeling 2050
  = LPJ-model+climate change+population growth A2
  – current water productivity
* food selfsufficiency as politically preferred policy
* standard diet 3000 kcal/p d (FAO 2030) --> 1300 m3/p yr
  also mini-diet 600 m3/p yr

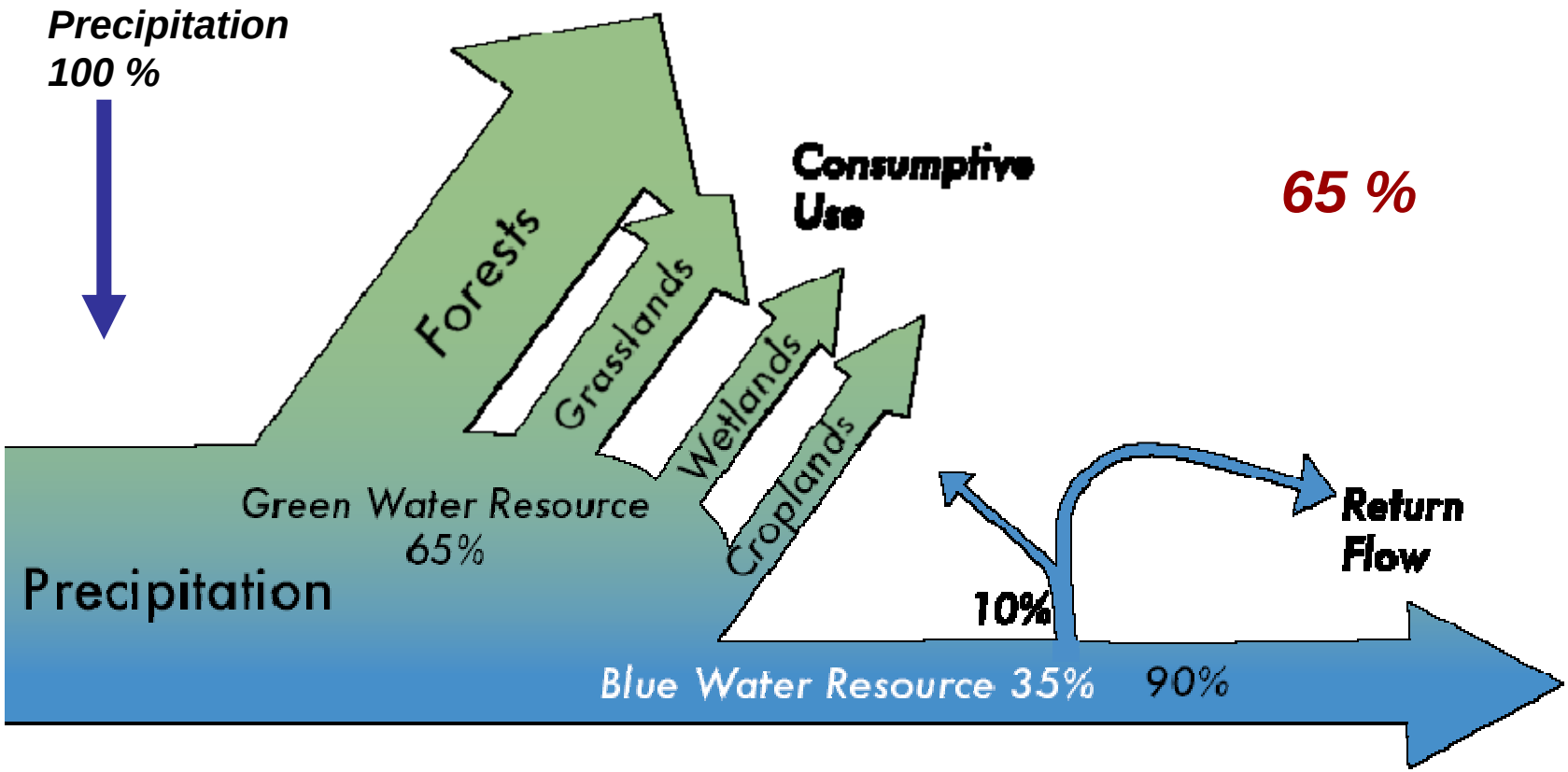
M.Falkenmark, SIWI and
Stockholm Resilience Center

Food water requirements vs income



M.Falkenmark, SIWI and
Stockholm Resilience Center

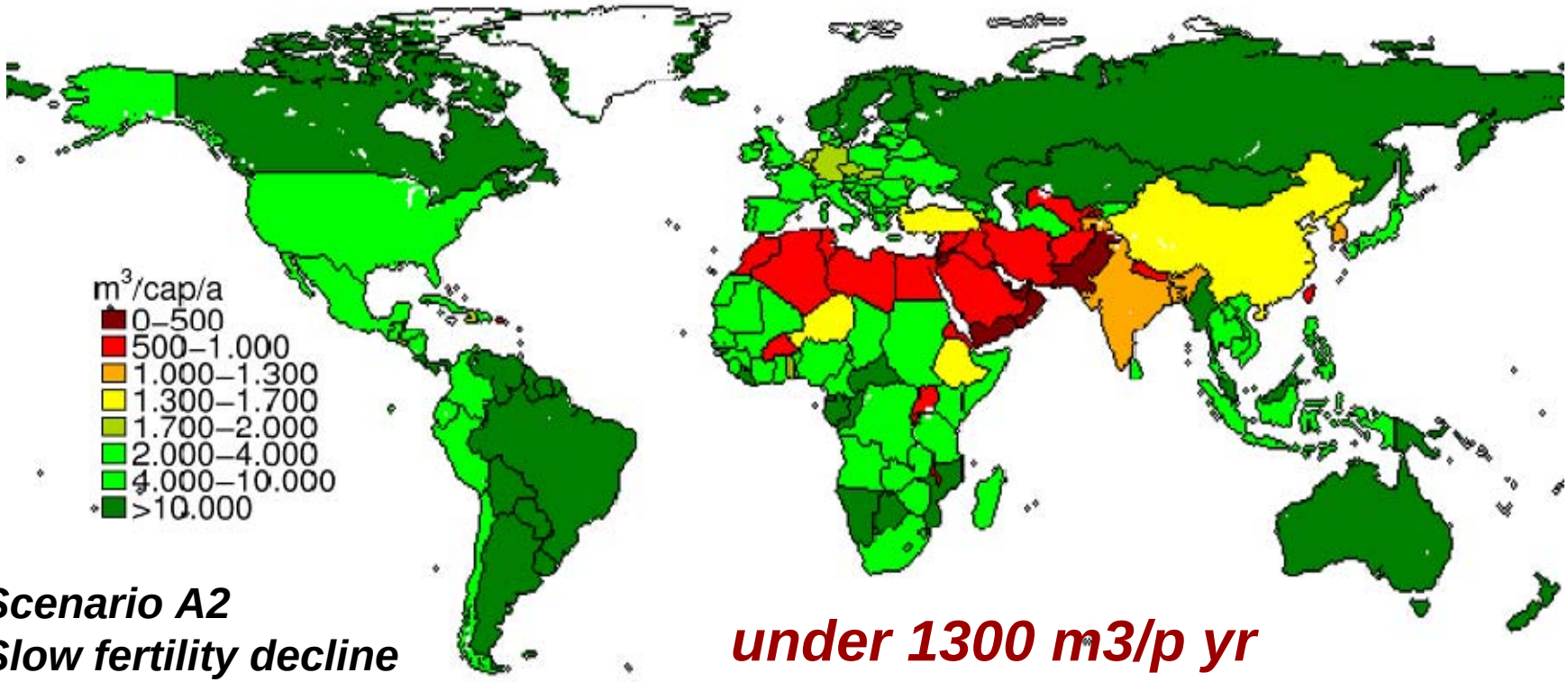
Global water budget



M.Falkenmark, SIWI and
Stockholm Resilience Center

2050: Total water availability

Blue + green water

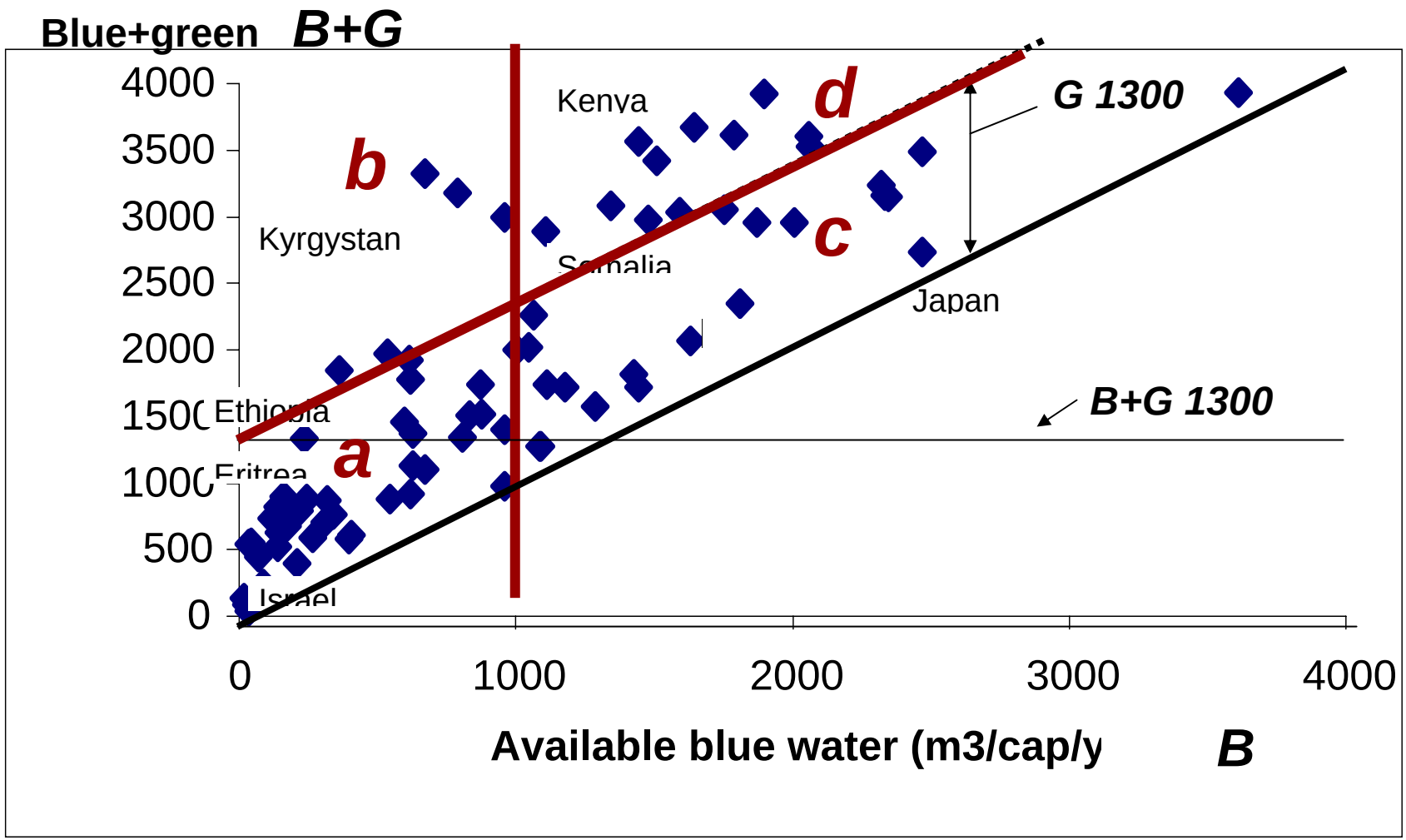


Scenario A2
Slow fertility decline

under 1300 m3/p yr
= red + orange

M.Falkenmark, SIWI and
Stockholm Resilience Center

Blue water may be inaccessible
due to chronic water shortage



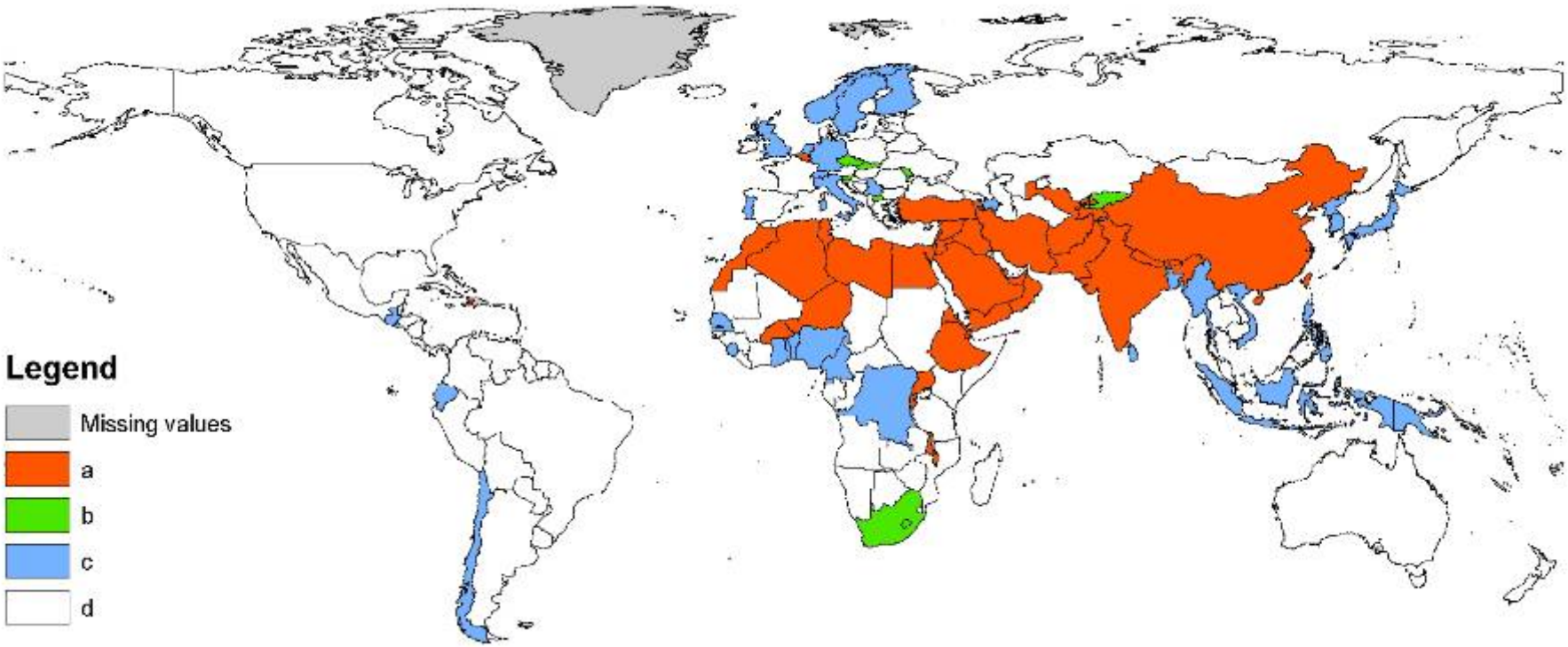
M.Falkenmark, SIWI and
Stockholm Resilience Center

Water scarcity combinations 2050

GREEN ---------- *BLUE*	**Green shortage** **<1300m3/ p yr**	**Green freedom** **>1300m3/ p yr**
Blue shortage **<1000m3/ p yr**	a **Iran ,Pak,Jordan Eg,Eth, India, China**	b **Kyrg, Czeckosl, Les, S Afr**
Blue freedom **>1000m3/ p yr**	c **Jap,Bangl,N+SKor, Nga. To,**	d **Zimb,Ghana , Ang,Botsw, Chad ,Ke,Mali,Namib, Sud, Ta,Za,Zimb**

M.Falkenmark, SIWI and
Stockholm Resilience Center

Green/blue water shortage by 2050



M.Falkenmark, SIWI and
Stockholm Resilience Center

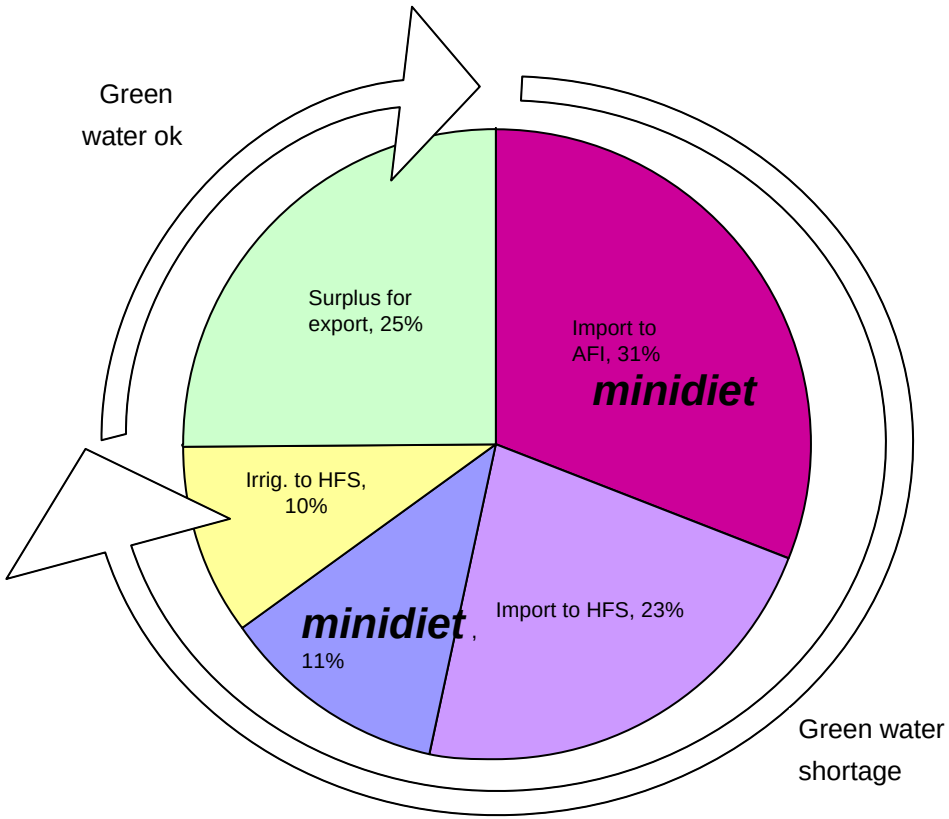
Global food supply 2050

food export

b + d

irrigation possible

c



food import

a

M.Falkenmark, SIWI and Stockholm Resilience Center

Policy implications

GREEN / *BLUE*	**Green shortage** <1300m3/pyr	**Green freedom** >1300m3/pyr
Blue shortage <1000m3/pyr	a **53 % of world pop** * **horisontal expansion** • **radical water productivity increase** * **FOOD IMPORT**	b * **upgrading rainfed agric**
Blue freedom >1000m3/pyr	c **21% of world pop** * **irrigation**	d * **rainfed agric** * **irrigation** * **FOOD EXPORT**

Conclusions

- **popul growth disastrous --> 53 % of pop into food import dependence**
- **only 21 % of world popul in irrigable countries**
  (except for river depletion phenom)
- **hot spot region = ribbon Morocco -> China**
- **green water has to be better used**
  --> drought resilient rainfed agric by developing soil/water integration
- **prepare water rich regions for food export**

M.Falkenmark, SIWI and
Stockholm Resilience Center