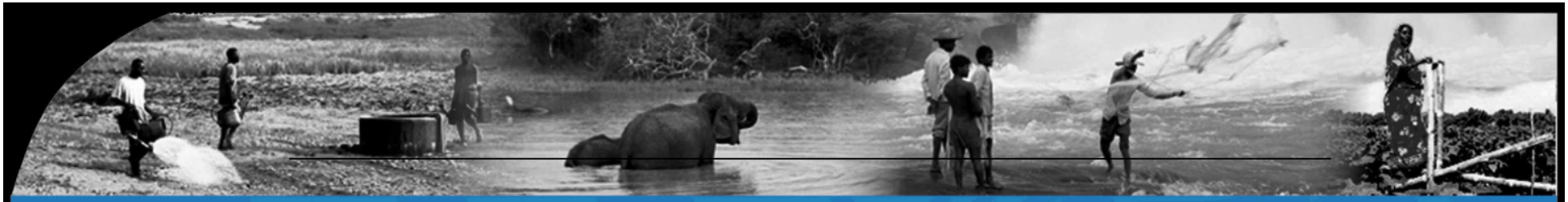


Water Footprints of Milk Production

A Case Study in the Moga district of Punjab, India

Upali Amarasinghe, Vladimir Smakhtin, Bharat Sharma and Nishadi Eriyagama

of

International Water Management Institute

Carlo Galli and Manfred Noll

of

Nestle

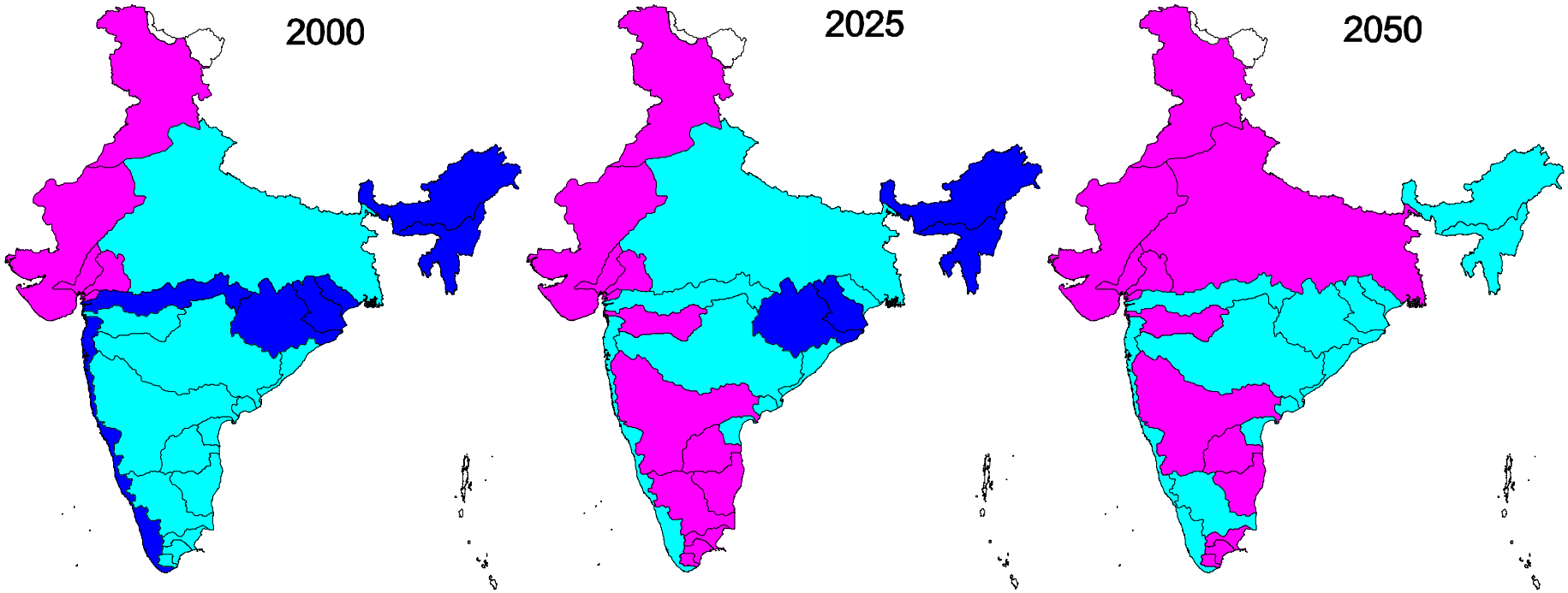
www.iwmi.org

Outline

1. Background and objectives
2. Components of milk water footprints
3. Impact of Moga water footprints
4. Reducing water footprints

1. Background

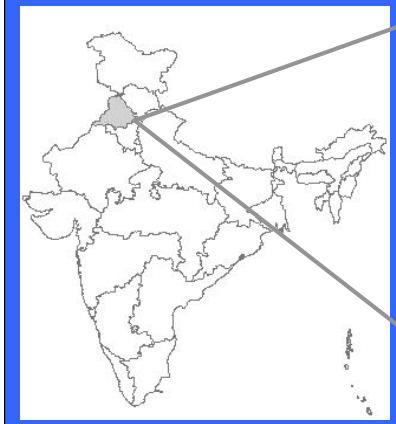
Increasing physical water scarcity



www.iwmi.org

1.2 Moga in a brief

Indian states



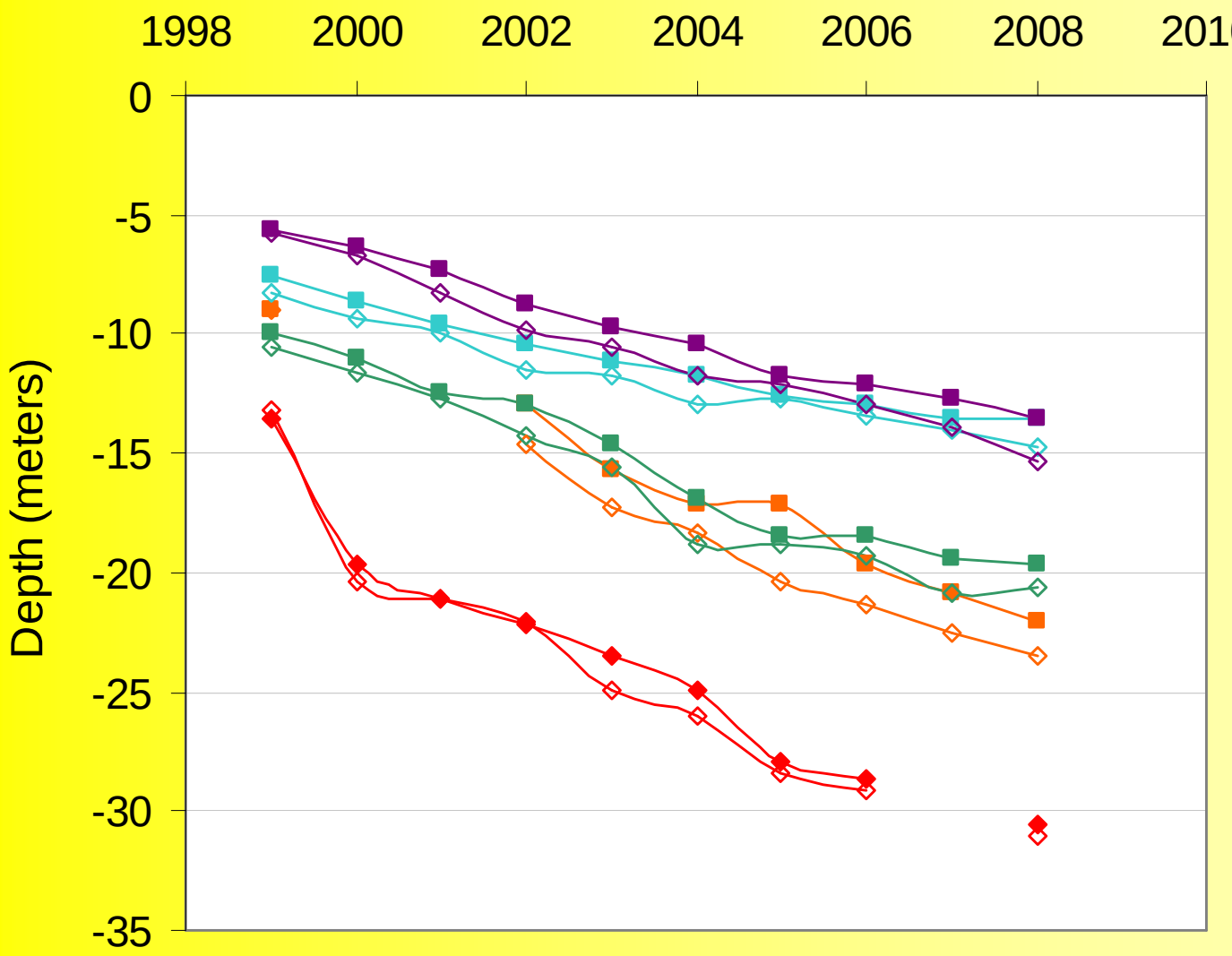
Punjab districts

Moga blocks

1.3 Moga in a brief

- 11th largest district in Punjab
- Have an arid climate - Annual rainfall 438 mm, temperature 7 - 48° C
- Population is 895,000.
- 80% live in rural areas and livelihoods depends on agriculture
- Average land holding size is 13 acres

1.4 Why Moga?



Depth to groundwater (m) in few villages before and after irrigating rice in the Kharif season

1.5 Why Moga?

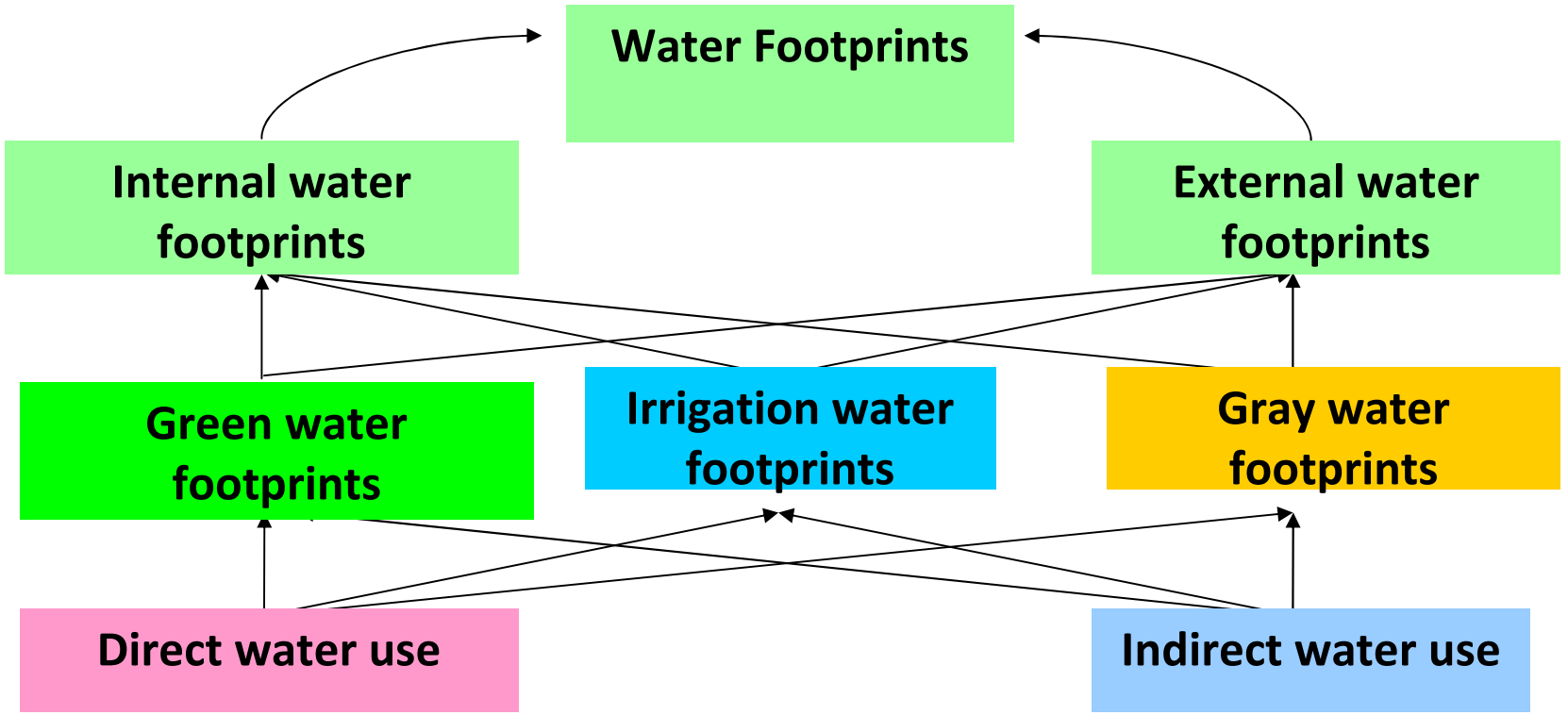
- Groundwater is the major source of irrigation and is overexploited everywhere
- At risk are sustainable agriculture production, industrial expansion, domestic water supply etc.
- Moga is one of Nestlé's Milk districts and feed production depends on groundwater

1.6 Objectives

- Assess water footprints (WFP) of milk, wheat and rice production in Moga
- Assess impacts of total WFPs and
- Find ways of reducing WFPs

2.1 Components of water footprints

WFP = the consumptive water use (Evapo-transpiration)



2.2. Components of WFPs of milk and crops

WFP			Direct water use	+	Indirect water use
WFP_{Milk} =	Green	=	na	+	CWU from soil moisture in fodder and other feed crops
	Irrigation	=	Drinking/servicing of animals	+	CWU from irrigation in fodder and other feed crops
	Grey	=	na	+	Water pollution through input use or in by products
$WFP_{Crop}{}^{1}$ =	Green	=	CWU from soil moisture in crop production	+	na
	Irrigation	=	CWU from irrigation water in crop production	+	na
	Grey	=	Water pollution from input use or in byproducts	+	na

2.3 Data and methodology

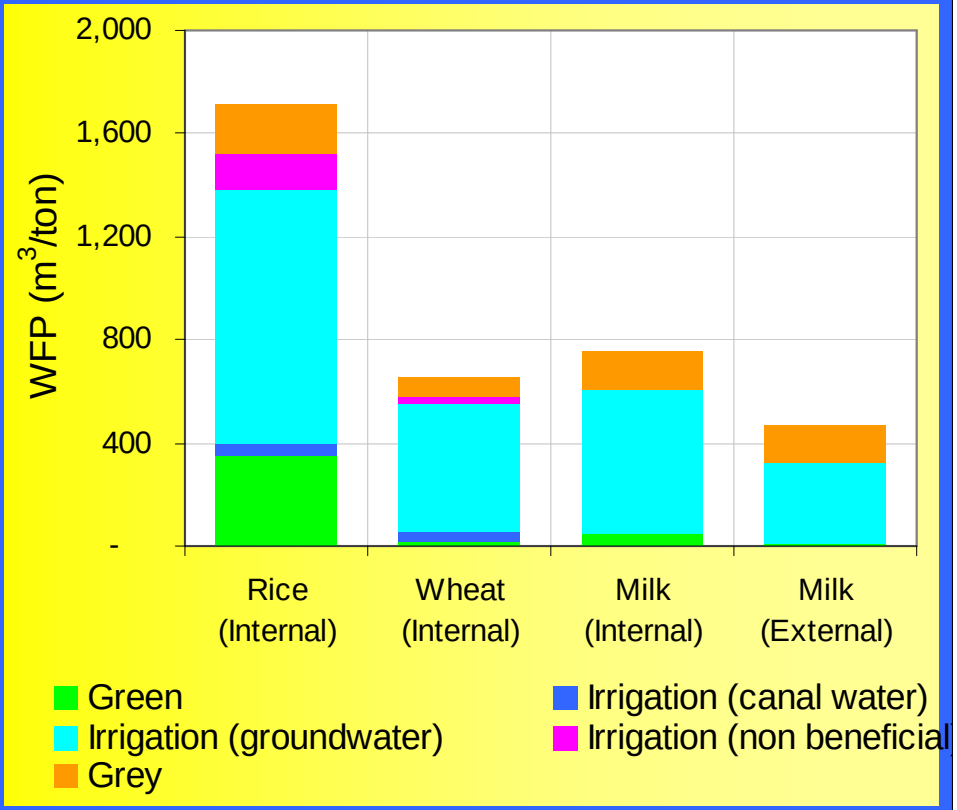
- Estimated WFPs (m^3/ton) using primary data
  - collected from a sample survey in Moga
  - Sample size of 300 farmers
- Combined with secondary data of total production to estimate total WFP (million m^3/year)
- Used production surpluses and value to assess impacts of total WFP

2.4 Water footprints of milk, wheat and rice (m^3/ton)

Water footprints

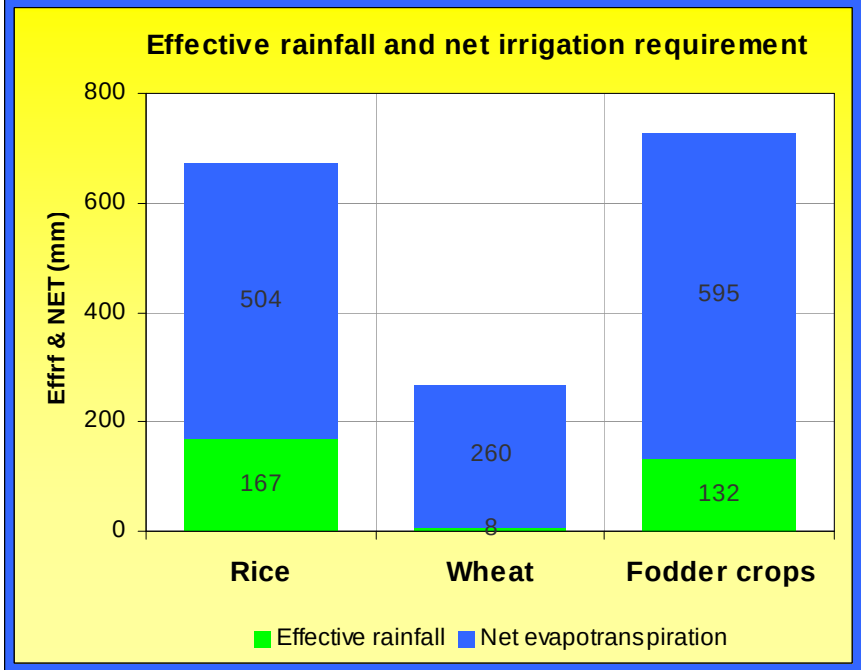
- Rice - 1,870 m^3/ton
- Milk- 940 m^3/ton
- Wheat- 554 m^3/ton

- Contribution from external water footprints to milk production is 37%

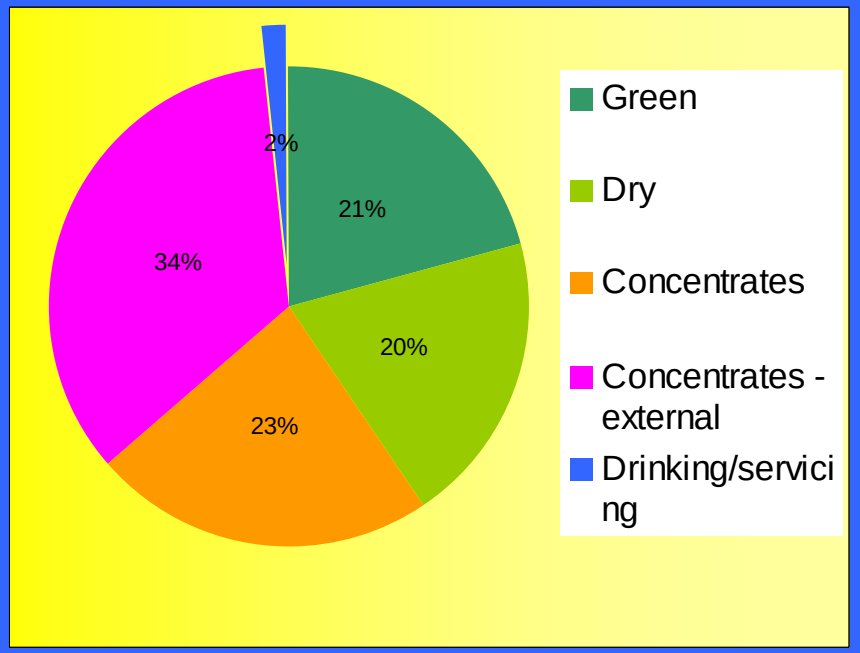


Commodity	Water Footprint (m3/ton)			
	Green	Irrigation		Grey
		Canal	Groundwater	
Milk	58	-	882 (94%)	143
Wheat	17	42	495 (90%)	74
Rice	346	50	984 (71%)	195

Crop water requirements



Composition of milk water footprints



Crop water requirements

- rice - 671mm
- Wheat – 268
- Fodder crops – 727 mm

Water footprints of milk

- Green fodder - 196 m3/ton
- Dry fodder – 184 m3/ton
- Concentrates – internal – 218 m3/ton
- Concentrates – External - 327 m3/ton
- Drinking/bathing – 15 m3/ton

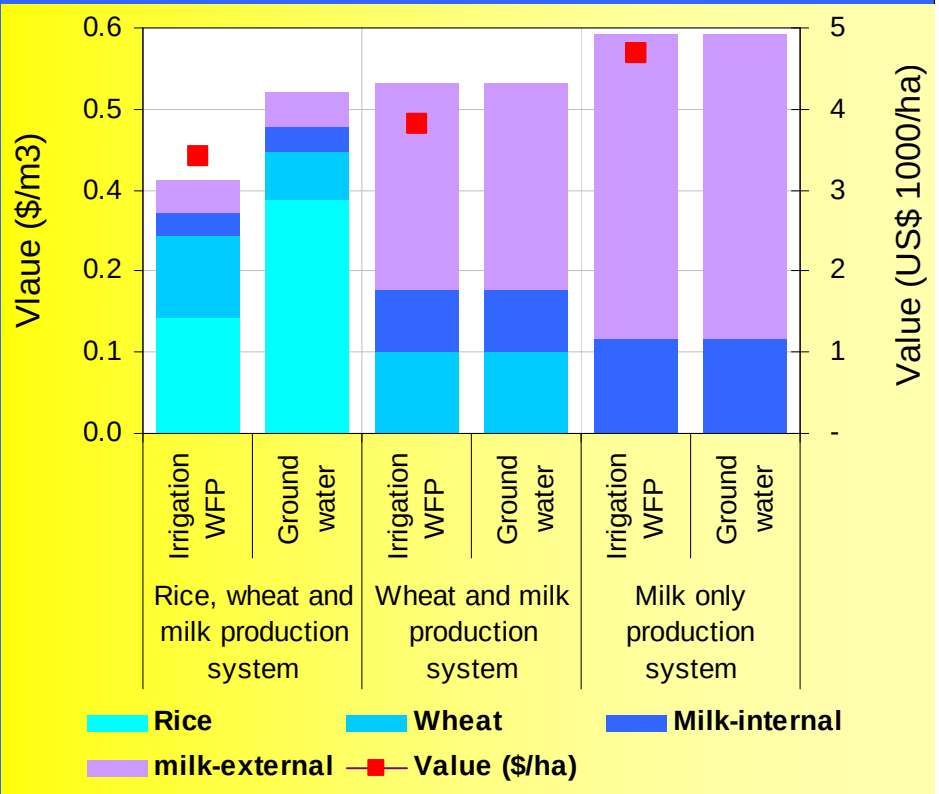
3.1 Impacts- Groundwater footprints

Commodity	Internal water footprint (million cubic meters /year)			Virtual water in production surpluses (million cubic meters/year)	
	Total	Irrigation	Groundwater	Total	Groundwater
Milk	127	113	113	72	64
Wheat	464	450	415	412	368
Rice	1,198	898	854	1,194	852
Total	1,789	1,461	1,382	1,678	1,284

- Internal groundwater footprint
  - contributes to 78% of total
  - of the exports (of 84 mcm) is more than natural recharge limits (1200 mcm/yr)
  - Needs to be reduced for sustainable agricultural production

3.2 Impacts – Virtual water contribution

- Value of output per unit of net irrigated area
  - US$ 4,221/ha in Milk only
  - US$ 3433/ha in milk-wheat
  - US$ 3081/ha in milk-wheat-rice
- High dependency of milk only outputs from virtual water



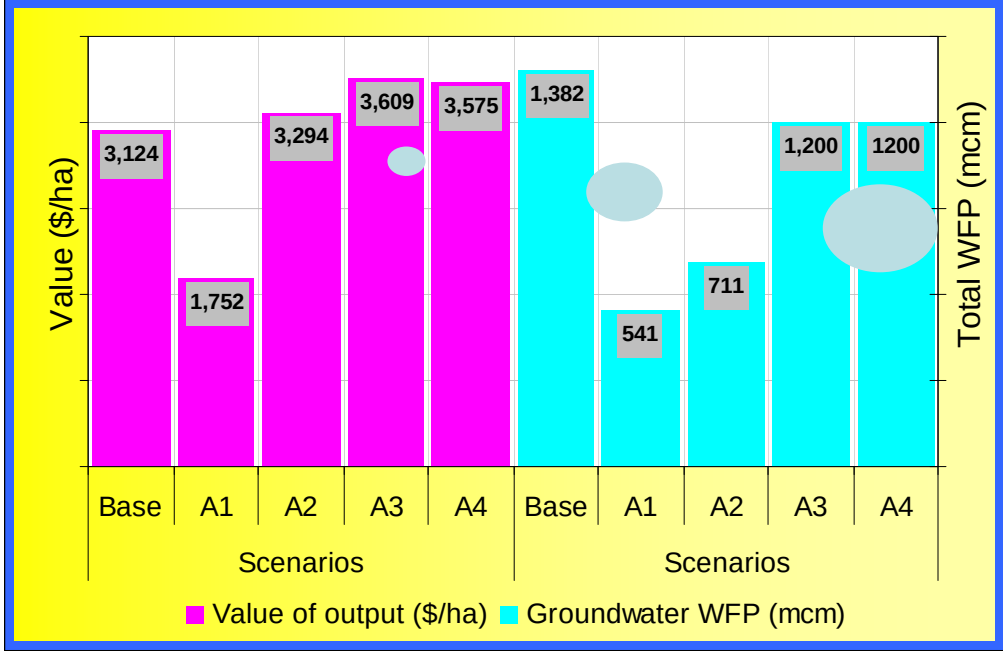
4.1 Reducing water footprints: Agriculture diversification

Observations

- Virtual groundwater content and exports of rice is large
- Milk only or wheat-milk production systems have higher value of output
- Dairy intensive production systems with less rice area offer the most benefits
- An ideal scenario is a combination of
  - Less rice area
  - More dairy animals
  - Same wheat area
  - More fodder area

4.2. Impact of Agriculture diversification

Scenario	Crop area - % of total				Number of lactating animals per 6 ha land	
	Kharif		Rabi		Crossbred cows	Buffaloes
	Rice	Fodder	Wheat	Fodder		
Base	90	10	90	10	1	3
A1	0	10	90	10	1	3
A2	0	31	90	10	8	3
A3	62	20	90	10	5	3
A4	62.5	19.9	90	10	1	7



- Scenario A3 is the optimum under current level of productivities.
- Value of output is US$480/ ha more than the base scenario

4.3. Policy recommendations for reducing WFP

1. **Diversify agriculture to dairy intensive production systems, especially for small holders**
   - Wheat-milk or Milk only is preferred
   - Value of output will increase, but
   - Virtual water imports also will increase.
   - Increase virtual trade opportunities, possibly, for rainfed areas

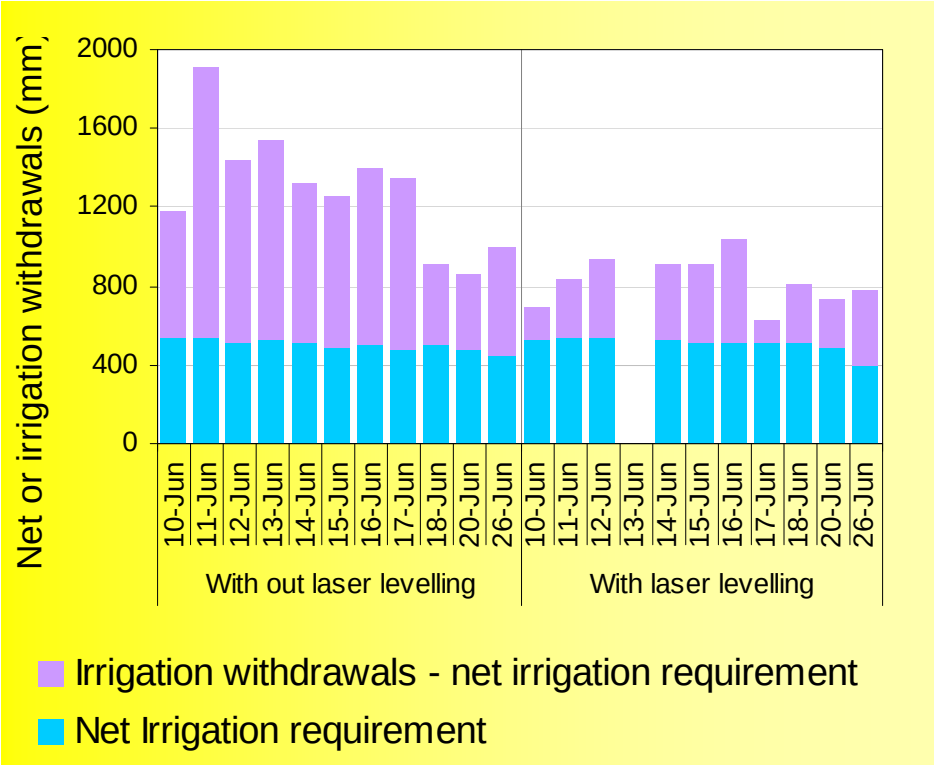
2. **Reduce rice area, increase number of lactating cross-bred cows, and increase fodder area**
   - 62% rice area, 20% fodder area in Kharif
   - 90% wheat area and 10% fodder area in Rabi
   - 5 cross-bred cows and 3 buffaloes (Total of 8 lactating animals/ 6 ha)

4.4 Policy recommendations for reducing water withdrawals

Interventions already in place in Moga

1. **Strictly adhering to delayed rice planting till June 10th**
   - Reduce ET by 9%
   - Reduce withdrawals by 141 million m3

2. **Laser land leveling in all irrigated areas**
   - Only 17% of area is laser leveled at present
   - Irrigation depth on laser level land is 124 mm



Thank you for your kind attention!

Acknowledgement:

- NESTLE India for providing financial support
- Moga and Punjab Agriculture department for data collection support
- Carlo Galli, Manfred Noll, Babarjit Bhullar of Nestle for logistical support
- Nestle Moga staff for sample survey data collection support