

Water Footprints of Milk Production

A Case Study in the Moga district of Punjab, India

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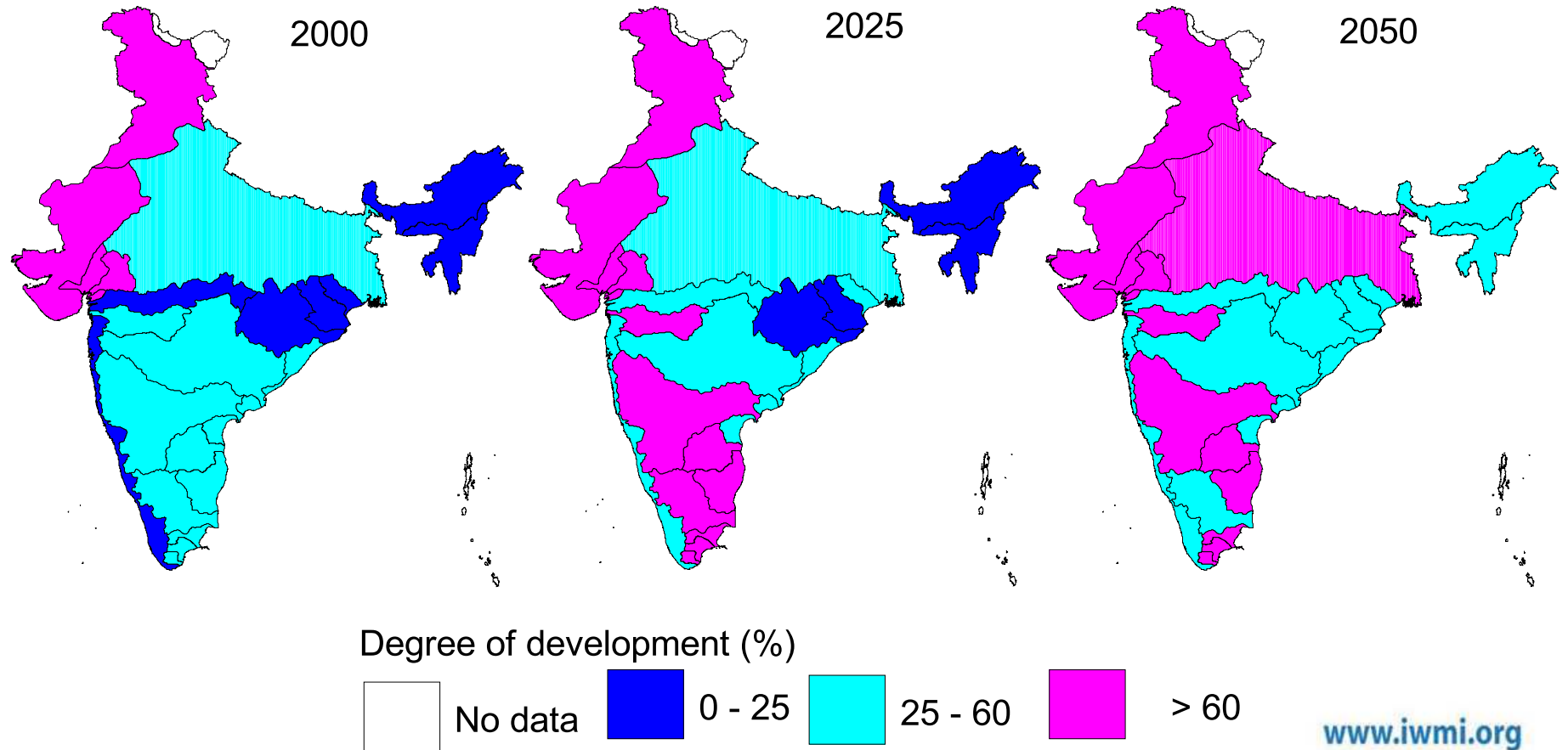
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Outline

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



1.2 Moga in a brief

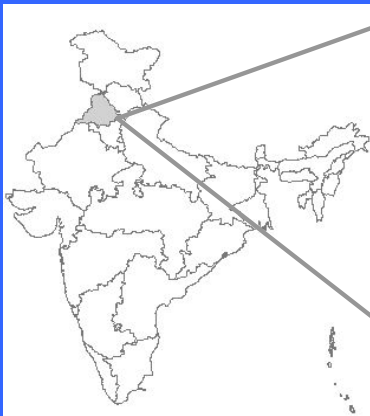
Moga blocks



Punjab districts



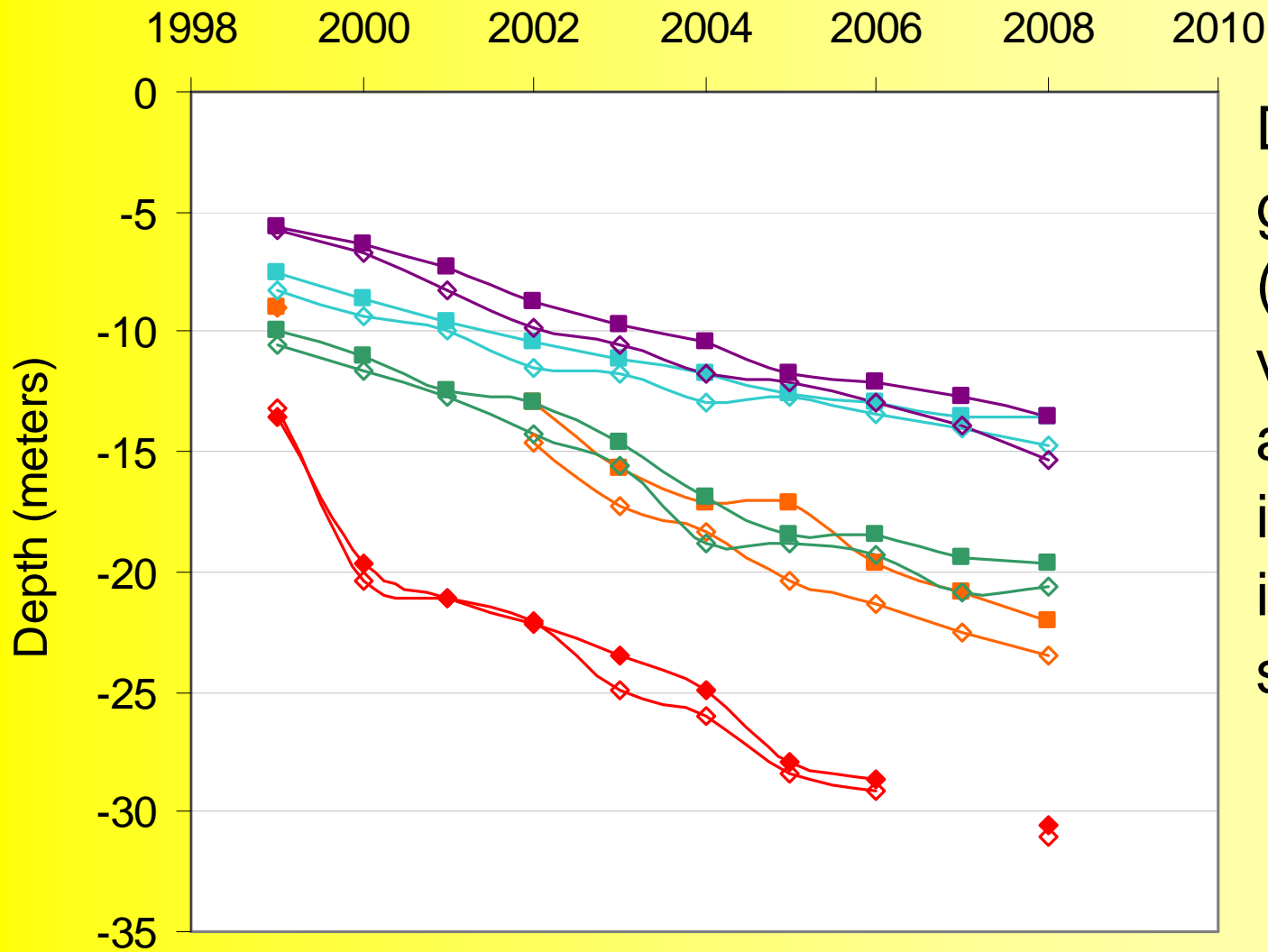
Indian states



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



2.2. 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
$WFP_{Crop} =$	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

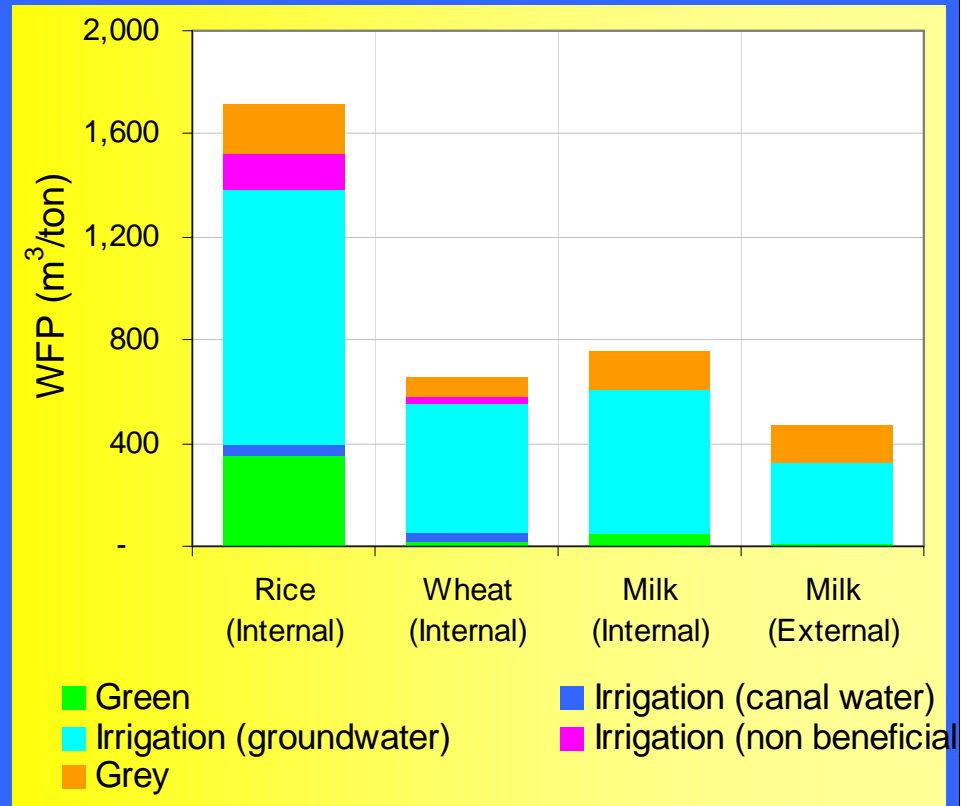
2.3 Data and methodology

- 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 (m³/ton)

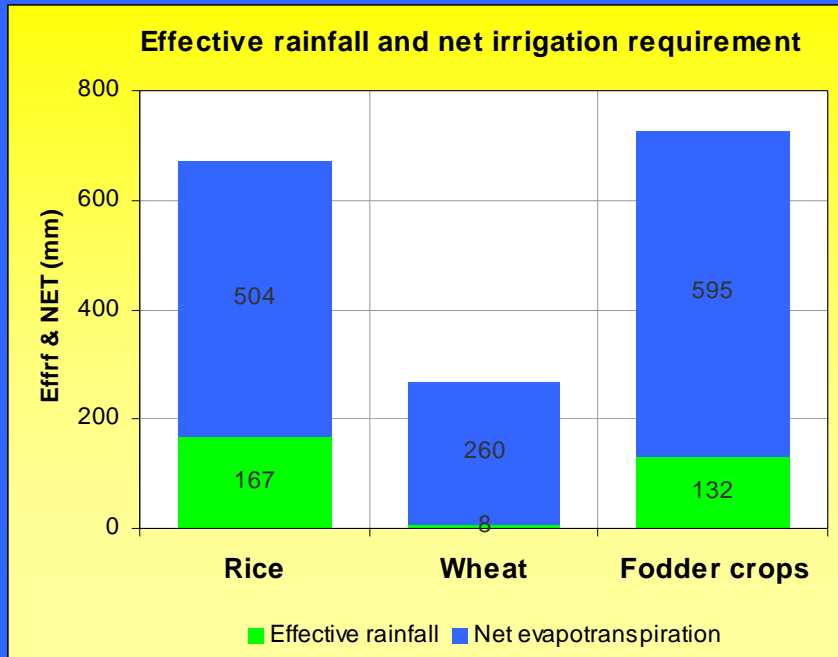
Water footprints

- Rice - 1,870 m³/ton
- Milk- 940 m³/ton
- Wheat- 554 m³/ton
- Contribution from external water footprints to milk production is 37%

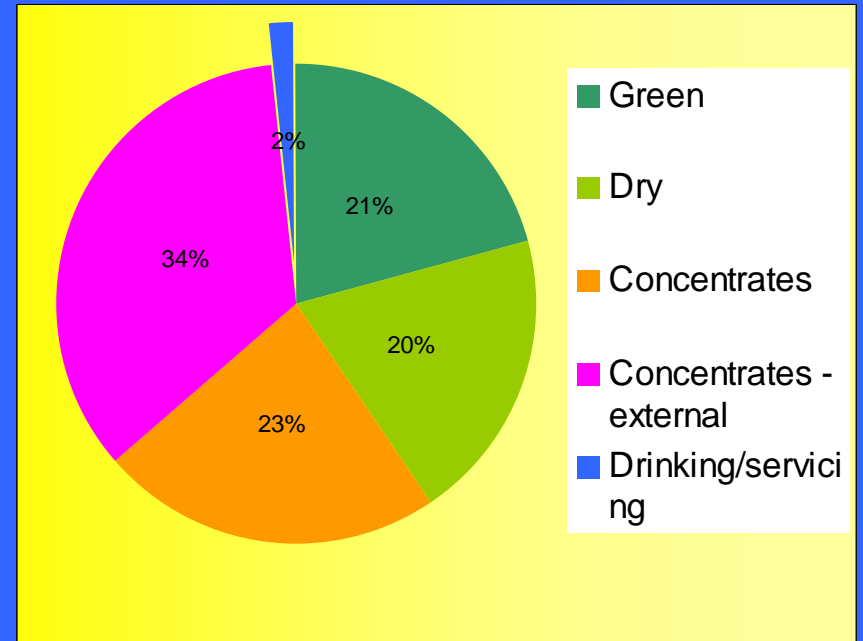


Commodity	Water Footprint (m ³ /ton)			
	Green	Irrigation		Grey
		Canal	Groundwater	
Milk	58	-	882 (94%)	143
Wheat	17	42	495 (90%)	74
Rice	346	50	984 (71%)	195

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

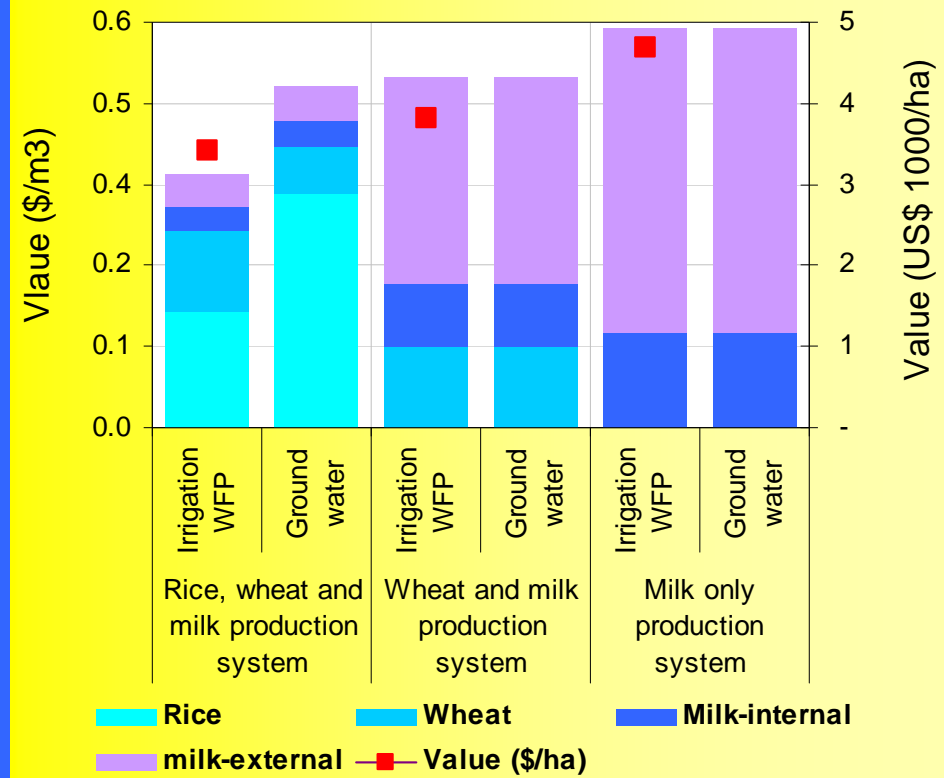
3.1 Impacts- Groundwater footprints

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

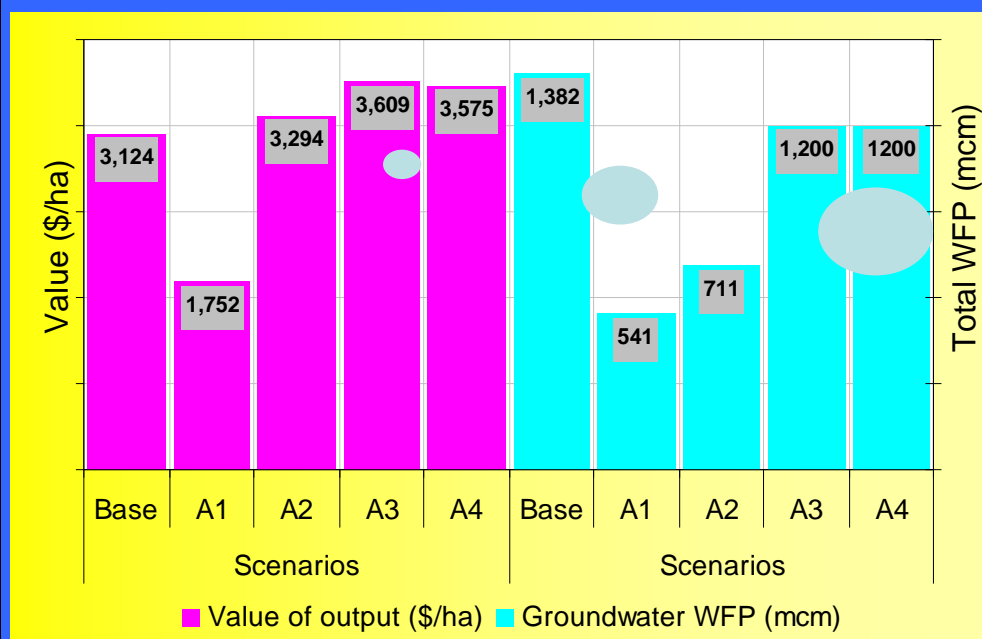
Observations

- 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

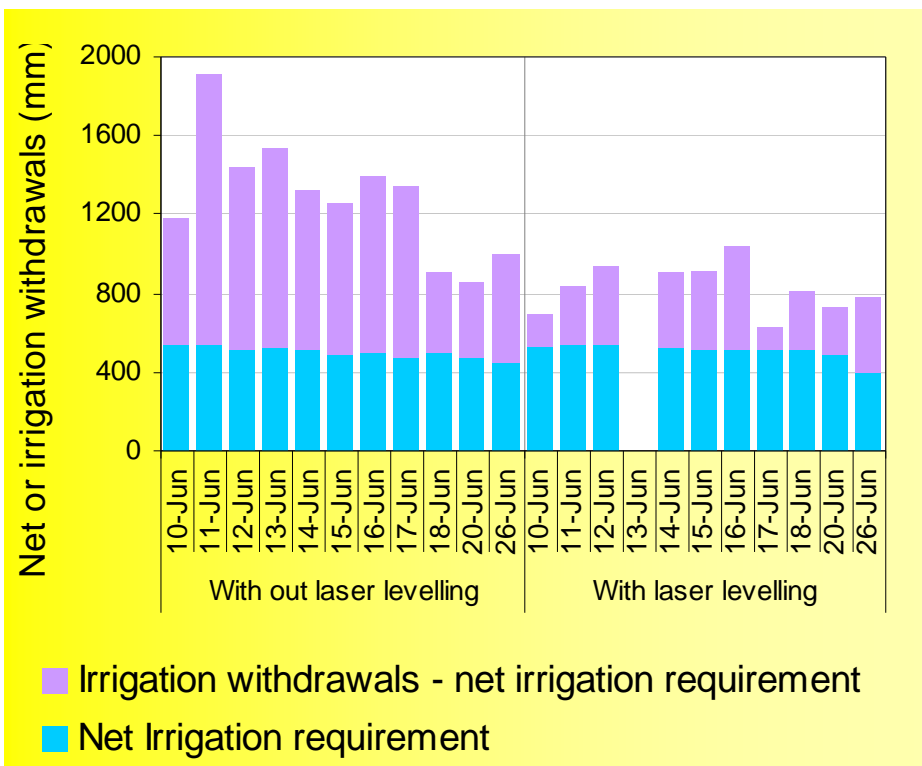
Interventions already in place in Moga

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!

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