Outline

1. **Why** water productivity atlas (WP Atlas)?
2. **What** does it contain?
3. **How** can it be used?
4. Demonstration (if time permits)
Why Water Productivity Atlas?

• Support unraveling the water-food-energy-environment nexus

• What is the WFEE nexus?
  ✓ Increased food/crop production but large groundwater depletion and energy use
  ✓ Inadequate nutritional supply but large groundwater depletion and energy use
  ✓ Low crop production but inadequate energy supply for groundwater use
What is Water Productivity Atlas?

• WP Atlas is an interactive web platform developed in R Shiny Web Framework
• Shows the spatial/temporal variations of WP and water footprint (WFP) indicators?
  • Shows current gaps and potential increase in WP/WFP
• Compare WP/WFP of different locations and crops
• Identify locations with severe nexus
• Develop scenarios to reduce the nexus and enhance benefits
  ✓ Reduce yield gap
  ✓ Reduce the evaporation losses
  ✓ Diversify crops to increase value and reduce consumptive water use (crop ET)
Introduction
The Water Productivity (WP) Atlas, an online tool, is a one-stop solution that can visualize and analyze the trends of WP and water footprints (WFP), assess their linkages, and the implications on the water-food-energy (WFE) nexus. It shows physical, economic, nutritional, and energy WP trends of crops, cropping, or agricultural production system. Furthermore, WFP includes green and blue WFPs.

Crops - cereals (rice, wheat, maize, barley, bajra, ragi, jowar), pulses, oil crops, fruits, vegetables, roots and tubers, spices, sugar cane, cotton, etc.

Cropping systems - rice-wheat, rice-rice, maize-wheat, cotton-wheat, etc., and agricultural production system has crop-milk production.

Agricultural production system - crop-milk production.

WP Atlas has three components: Trends, Comparisons, and Scenarios.
Water Productivity

• Physical Water Productivity (PWP)
  – Production per unit of consumptive water use
  – Water use is total consumptive water use
  – Expressed in kgm⁻³

• Economic Water Productivity (EWP)
  – Value of production per unit of CWU
  – Expressed in $m⁻³

• Nutritional Water Productivity (NWP)
  – Nutritional supply per unit of water use.
  – Expressed in Caloriesm⁻³, Proteinsm⁻³, Fatm⁻³.
  – NWP = PWP * conversion ratio
  – Conversion ratio = Nutrition per kg of production

• Water footprints
  – Blue, Green, total

• The Nexus
Spatial variation of WP
- 28 major States & Union territories
- 596 districts
- River basins (38)/Sub river basins (94)

Trends (22 years) between 1999 and 2020

Crops (32) or cropping systems (3)
- cereals, pulses, oil crops, roots and tubers, fruits, vegetables, sugar, cotton, fodder
- Rice-wheat, rice-rice, maize-wheat

Indicators (5 WP, 6WFP)
- Water productivity or Water footprints
Total CWU

• **CWU = Crop Eta = crop coefficient x Sum of PET in crop growth periods**

• In Rainfed areas,
  • **Total CWU = CWU from rainfall = Effective rainfall**
  • USDA method for estimating Effective rainfall

• In irrigated areas,
  • **Total CWU = CWU from Irrigation + CWU from rainfall**
  • Assumed to meet total irrigation CWU
Physical WP of cereals across districts

Temporal variation

Cereals Total PWP (Kgm⁻³)
- [0.12, 0.46]
- (0.46, 0.59)
- (0.59, 0.74)
- (0.74, 2.04)
- <0.1

Statistical analysis

Effect of the other factors
PWP of cereals across districts in the GRB

Temporal variation

Cereals Total PWP (Km²)

- [0.22, 0.53]
- (0.53, 0.69)
- (0.69, 0.82)
- (0.82, 1.65)
- <0.1

Year(s)

2015
2018

Effect of the other factors

- PWP
- Yield
- Area
- CWU
Physical WP of cereals across River Basins

Temporal variation

2015

Cereals Total PWP (Kgm⁻³)
- [0.16, 0.47]
- (0.47, 0.56]
- (0.56, 0.69]
- (0.69, 1.31]

Statistical analysis

Effect of the other factors

Production system
Crop
Crop
Cereal's Total

Year(s)
2015
Update
WP of cereals across sub-river basins in the GRB

Temporal variation

Cereals Total PWP (Kgm⁻³)
- [0.49, 0.57]
- (0.57, 0.71]
- (0.71, 0.8]
- (0.8, 0.94]

Statistical analysis

Effect of the other factors
Physical WP of cereals in the Ganges

Factors of PWP

INITIATIVE ON NEXUS Gains
How does nexus change under different scenarios?

- Scenarios
  - Increasing PWP with no increase in CWU
    - reduce non-beneficial evaporation
  - Increasing PWP with supplemental irrigation/CWU
  - Increasing EWP with changing cropping patterns
    - Reduce water-intensive cropped area
    - Increase high-value cropped areas
    - Shift cropping systems
Thank you

Contact: u.amarasinghe@cgiar.org

Video: WP Atlas Demonstration
prepared by Madhusha Perera
Introduction

The Water Productivity (WP) Atlas, an online tool, is a one-stop solution that can visualize and analyze the trends of WP and water footprints (WFP), assess their linkages, and the implications on the water-food-energy (WFE) nexus. It shows physical, economic, nutritional, and energy WP trends of crops, cropping, or agricultural production system. Furthermore, WFP includes green and blue WFPs.

**Crops** - cereals (rice, wheat, maize, barley, bajra, ragi, jowar), pulses, oil crops, fruits, vegetables, roots and tubers, spices, sugar cane, cotton, etc.

**Cropping systems** - rice-wheat, rice-rice, maize-wheat, cotton-wheat, etc., and agricultural production system has crop-milk production.

**Agricultural production system** - crop-milk production.

WP Atlas has three components: Trends, Comparisons, and Scenarios.

---

**Trends**

TRENDS can visualize the spatial and temporal variations of crop WP of administrative units, such as districts, states, countries, and river basins and between 1999 to 2020.

---

**Comparision**

COMPARISONS allow to choose and compare WP indicators of different administrative units, river basins, or countries in different years.

---

**Scenarios**

Scenarios can analyze the implications on WFE nexus by improving the WP of crops, crop diversification, etc.

To be developed...