Integrating Farmers' Practices and Perceptions into Crop Modeling

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1. Introduction

- Low water use efficiency is a challenge to crop production in rainfed systems.

- Water is getting continuously scarce due to:
  - increased demand and,
  - shrinking availability induced mainly by climate change.

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- As agriculture is the major consumer of water, improving CWP is among the ways of overcoming the challenge.

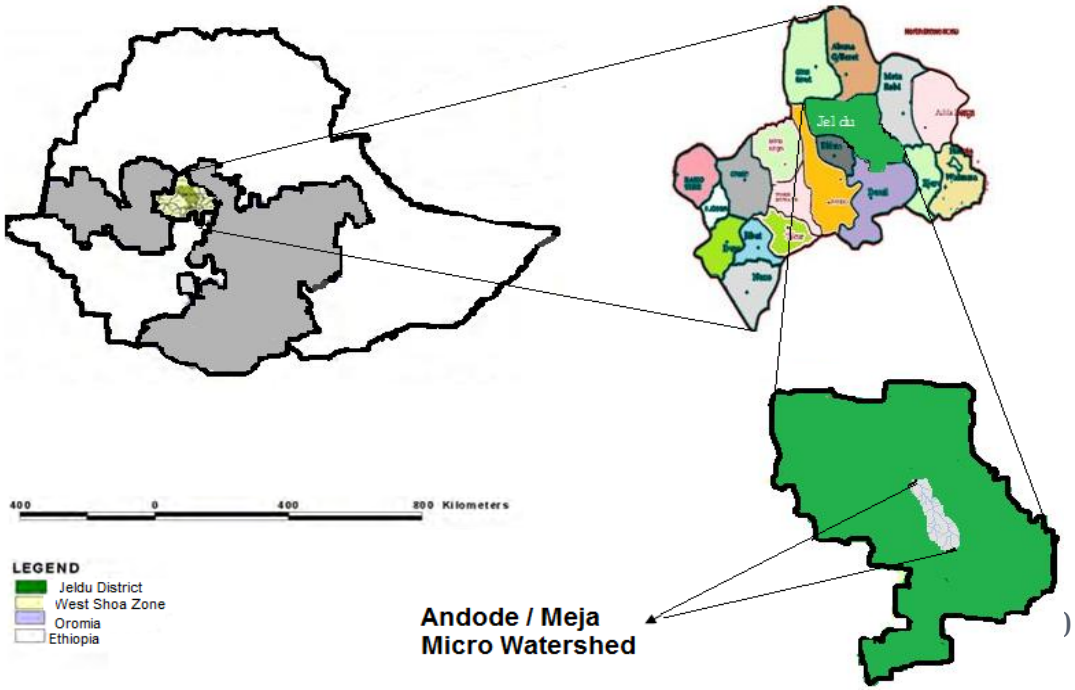
- The major objective of this study is, therefore,

  - to estimate WP of major crops grown under rainfed system through indigenous knowledge of farmers.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

- The study watershed was situated in Jeldu district
- 114 km far from Addis Ababa
- Located b/n 9° 02' 47" to 9° 15' 00" N latitude and 38° 05' 00" to 38° 12' 16" E longitude.



2.2 Data Collection Methods

- Farmers' practices and perceptions were understood through:
  - ✓ HHS and personal communications,
  - ✓ Focus group discussion,
  - ✓ Informal surveys and,
  - ✓ Personal Observations.

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- Representative crop fields were randomly selected;
- Agronomic practices implemented were monitored.
- BM and GY or TY of each crop was determined using a quadrate sampling method.
- CWR was simulated using CROPWAT model.
- From CWR average WC by each crop was calculated.
- Both PWP (kg/m3) and EWP (birr/m3) were determined at harvest.

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- WC = ETC – IR

- $CWP = \frac{\text{Crop Product (kg/ha)}}{\text{WC (m3)}}$

3. Results

Based on the farmers' practices and perception the following results were obtained :

3.1 Local Classification System of Agro-ecology

Table 1: Indicators of local agro-ecology			
Landscape Position	**Local Indicators**		
	Natural Vegetation	**Dominant crops**	**Atmo. Temp. condn**
Upper Zone	Qerero/ *Amionguria altussimal* Koso/*Hagenia abyssinica* Cedar/*Juniperous procera* Olive /*Olea erpaea . . . etc*	Barley, Potato, Enset & Wheat	Cold - Very cold
Middle Zone	Shola/*Ficus Sp.*, Zigba/*Podocarpus gracilior* Broad-leaved corton/*Croton macrostachys . . . etc.*	Wheat, Teff & Sorghum	Warm - Cool
Lower Zone	Wanza/*Cordia abyssinica* Warka and,Acacia tress. . . etc.	Maize, Teff, Sorghum & Niger Seed, etc	Very hot - Hot

3.2 Major Crops

Table 2: Common crop types grown across the three landscape positions.

Landscape position	Major Crops	Elevation (m asl)
Upper Zone	Barley, Potato and Wheat	2700 - 3200
Middle Zone	Wheat, Teff and Sorghum	2300 - 2700
Lower Zone	Maize, Teff and Sorghum	< 2300

Source: HHS and Field observation, 2011.

3.3 Agronomic Practices

i. Crop Rotation:

Used as a best mechanism (91%):

- ✓to maintain soil fertility,
- ✓weed and disease control,
- ✓reduce soil erosion and enhance crop yield.

Followed different pattern across the three agro-ecological zones.

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- Barley => Fallow => Barley . . . . Upper Zone.
- Wheat => Teff => Wheat . . . . Middle Zone.
- Teff => Sorghum/Maize . . . . . Lower Zone

ii. Fallowing Land:

- Commonly practiced in the upper zone (on 28% of 15 fields or 9% of 45 fields).

iii. Tillage, Fertilizers and Seeding Rates

Table 3: Tillage frequency, fertilizers and seeding rtes across the three landscape positions

Management Practices		Landscape Positions with their major crops								
		Upper Zone			Middle Zone			Lower Zone		
		Barley	Wheat	Potato	Wheat	Teff	Sorghum	Teff	Sorghum	Maize
FR (kg/ha)	DAP	84	85	321	92	67	10	0.0	0.0	28
	UREA	0	15	177	59	49	10	0.0	0.0	6
Tillage Freq.		3.8	3.6	3.8	3.4	3.4	1.6	2.8	1.8	2.4
SR (kg/ha)		218	162	2645	216	68	23	51	19	24

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- 56% of the sampled crop fields were tilled 3 – 4 times.
- 22% 1 to 2 times and 22% tilled 2 to 3 times.
- 33% of the monitored crop fields used no fertilizers.
- 67% used at least DAP or both.

iv. Compost application:

- Very few farmers applied compost/manure to their crop fields (13% of all monitored fields).

v. Crop Variety:

- 53% of HHs used improved varieties on the monitored crop fields.
- The remaining 47% used local varieties.

vi. Weed Control:

- In addition to frequent tillage and crop rotation, 67% of the total HHs removed weeds traditionally by hand.
- Only 33% used agro-chemicals to control weeds (Barley and Wheat).

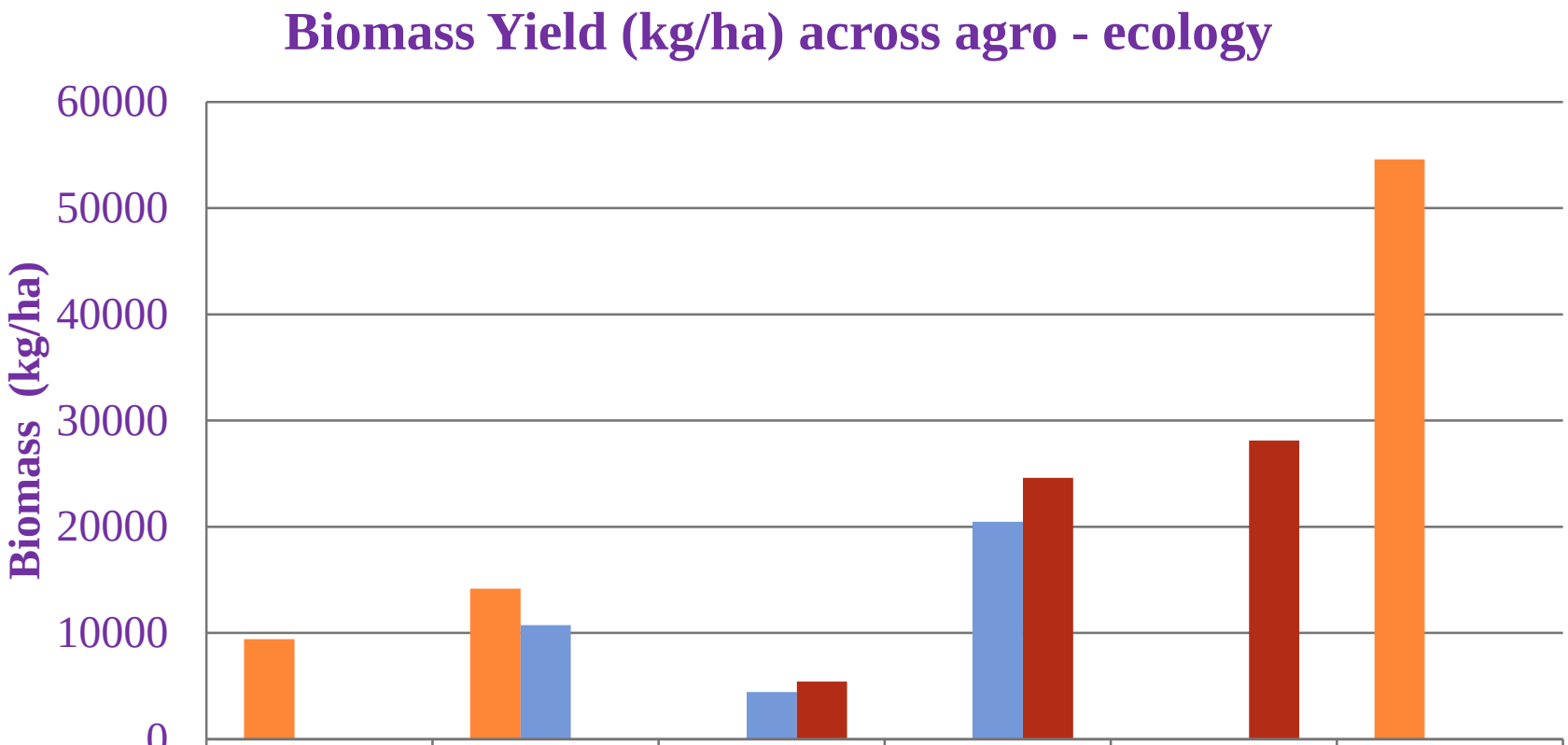
vii. Rainwater Management Practices:

- In addition to the use of improved varieties, farmers applied very limited types of RWM systems.
- The most commonly used was surface drainage (100%).
- Some farmers used:
  - cut-off drainage (6.6%),
  - deep furrows (11%) and,
  - deep tillage (22%),

viii. Cropping calendar, Methods of sowing and Harvesting:

- ✓ Planting date was determined based on the time of onset of rainfall and optimum soil moisture required by each crop types.
- ✓ Most farmers (88%) practiced traditional method of sowing.
- ✓ All sampled crops were also harvested traditionally with hand.

3.4 Crop productivity



	Barley	Wheat	Teff	Sorghum	Maize	Potato
Upper	9424	14173	0	0	0	54600
Middle	0	10735	4429	20485	0	0
Lower	0	0	5430	24601	28115	0

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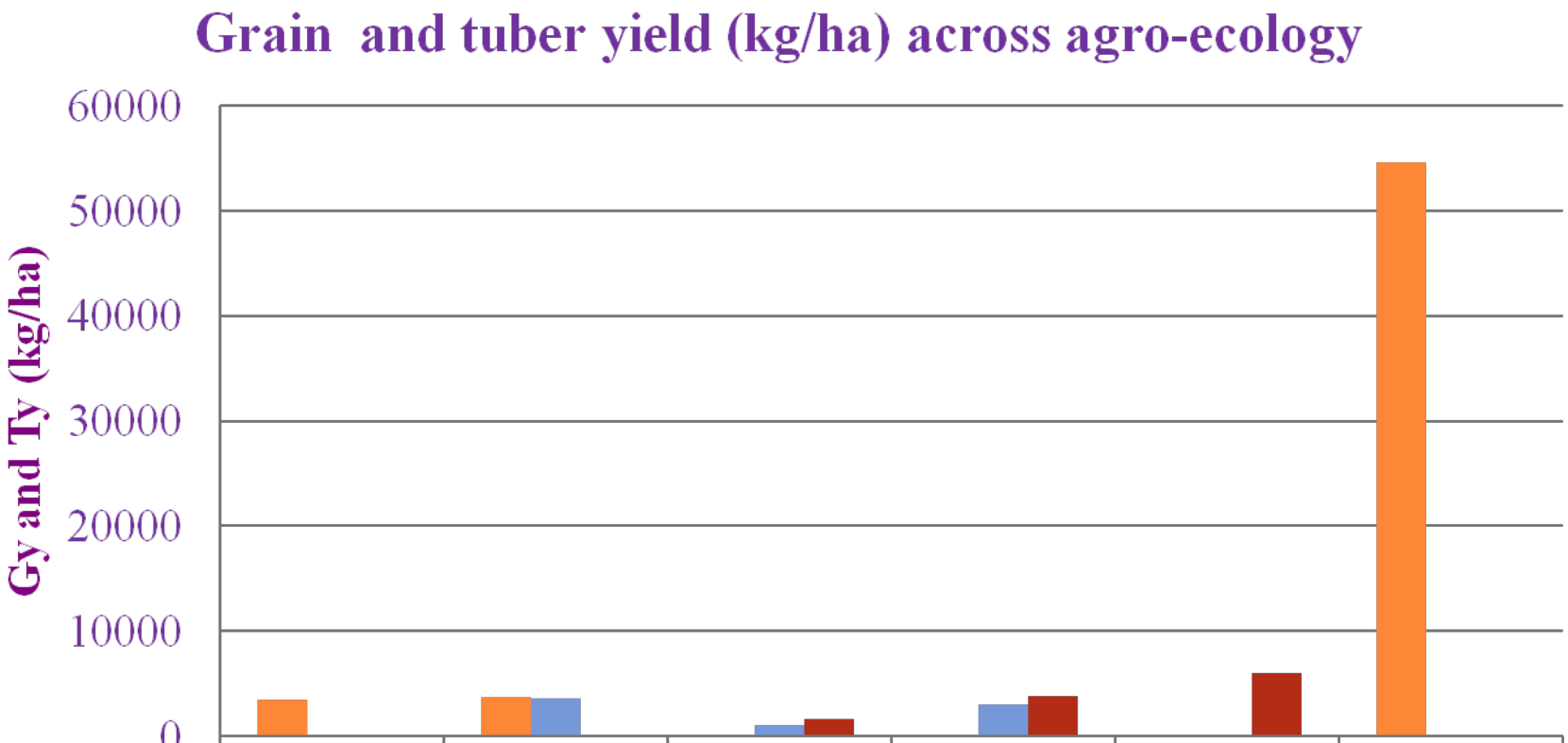
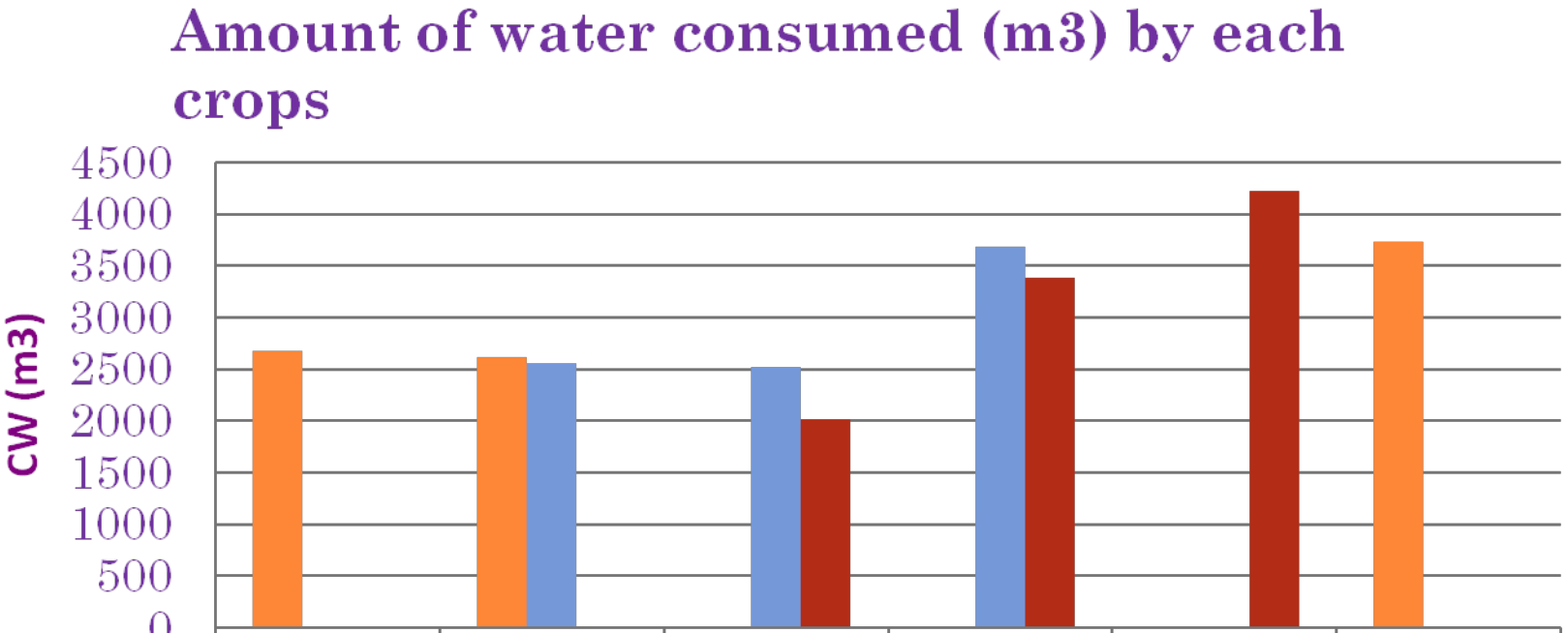


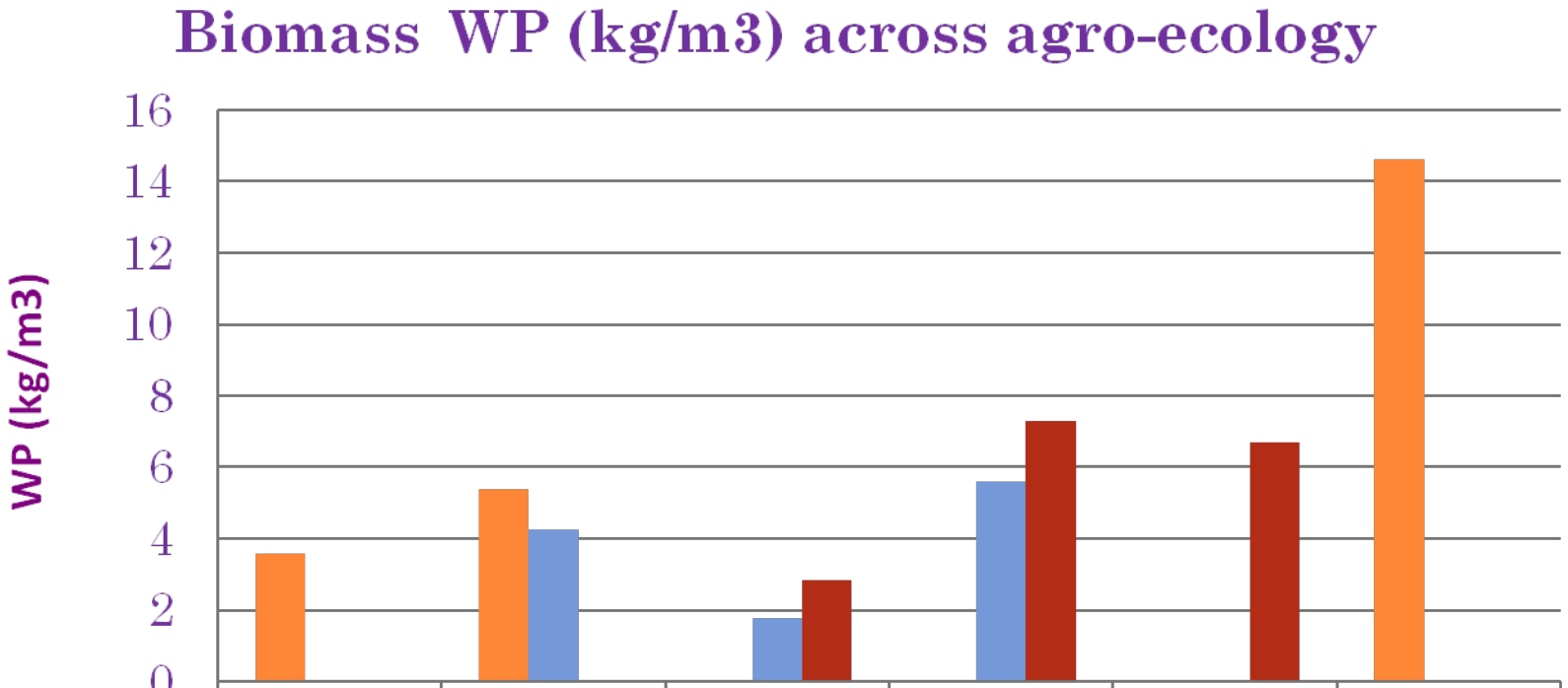
	Barley	Wheat	Teff	Sorghum	Maize	Potato
Upper	3487	3629				54600
Middle		3569	1093	3050		
Lower			1631	3802	5986	

3.5 Amount of water consumed



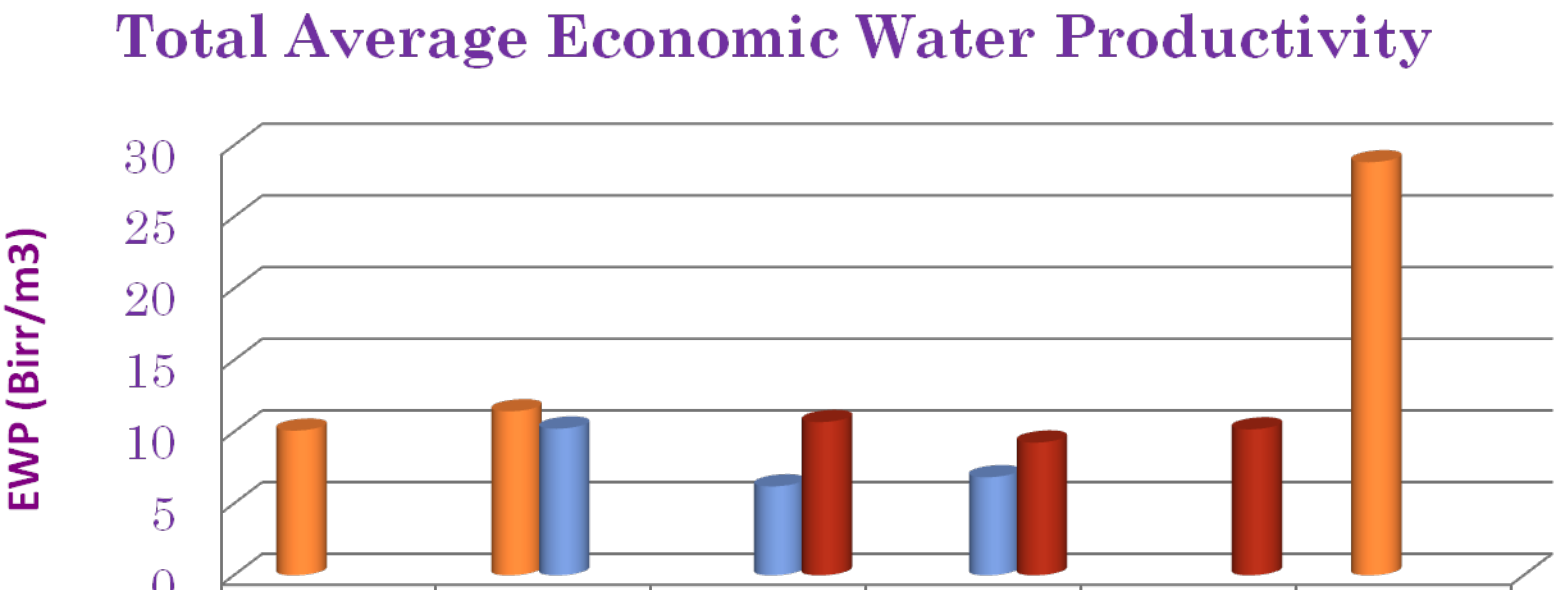
	Barley	Wheat	Teff	Sorghum	Maize	Potato
Upper	2677	2618				3733
Middle		2556	2516	3679		
Lower			2018	3378	4224	

3.6 PHYSICAL CROP WATER PRODUCTIVITY



	Barley	Wheat	Teff	Sorghum	Maize	Potato
Upper	3.57	5.38				14.61
Middle		4.26	1.78	5.59		
Lower			2.83	7.3	6.68	

3.7 ECONOMIC WATER PRODUCTIVITY



	Barley	Wheat	Teff	Sorghum	Maize	Potato
Upper	10.09	11.44				28.82
Middle		10.23	6.2	6.84		
Lower			10.69	9.26	10.18	

4. Determinant factors

- Economic WP shows variations due to:
  - difference in agro-ecology,
  - Crop types and variety,
  - Types of precursor crops used in the rotation systems and,
  - rate of inorganic fertilizers used

5. Conclusions

- Farmers used their own perception and practices to enhance crop yield and thereby improve CWP.
- They have adopted tillage and crop rotation methods, agronomic practices, and RWM practices to maximize yield from available water.

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- among the major crops the leading water consumer was maize followed by sorghum and potato.
- Potato was the most appropriate crop both in economic and physical WP in the upper zone.
- Teff had the highest local market demand from all other crops in the middle and lower zones.

Thank you for your attention!