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Innovation Laboratory for Small Scale Irrigation meeting – EAC Ghana

09 February 2016

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ETHIOPIA

INTERVENTIONS ETHIOPIA

- GW/SW use: **manual/& motorized water lifting devices** (pulley, rope and washer, diesel pump, solar pump)
- **Irrigation management** (CWR, WFD)
- **Crops** (vegetables, fruit trees and fodder species)
- **Groundwater recharge improvement**
- **Revolving fund** (credit access)

=> From household to watershed level

GHANA

INTERVENTIONS

- **Water lifting:** motorized water lifting devices
- **Water source:** shallow wells, roof top water harvesting
- **Water application systems:** drip, overhead and water can
- **Irrigation management** (Wetting front detectors and farmer practice)
- **Crops**: vegetables: roselle, onion, tomato and fodder: pigean pea, etc.
- **Credit access**: revolving fund

TANZANIA

INTERVENTIONS IN TANZANIA

- **Water lifting technologies**: motorized pumps
- **Crops:** vegetables and rice
- **Water management:** farmers practice, drip and AWD (rice)
- **Credit access**: revolving fund



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KEY LESSONS YEAR 2 PARTNER EVALUATION ETHIOPIA

Photo curtesy: Desalegne Tadesse, IWMI

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- *Water lifting technology* preference site dependent (e.g. R&W Danghista, pulley Robit, motorized pumps Adami Tulu)
- *Crop management and performance* varies strongly between sites and within sites (farmers project ownership depending on technology and crop trade off (*Chat*))
- *Project delays* in the first season led to water shortages in some shallow wells (mainly Amhara region)
- Vegetable production *income* strongly variable among sites because of crop choice and yield per area
- *Irrigated fodder* showed potential however access to market and water shortage reduced farmers willingness to participate
- Involvement of research institutes/universities vary between sites

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CAPACITY BUILDING

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MSC. THESIS COMPLETED

1) Analysis of Technical efficiencies of small-scale irrigation technologies
2) Cost-Benefit analysis of small-scale irrigation technologies, and
3) Farmers willingness to pay and choice of smallholder water lifting irrigation technologies
4) Assessment of water demand, water and crop productivity of selected fodder varieties under small holder irrigated farming practices using wetting front detector (case studies in Lemo and Angacha areas of SNNPR)
5) Production, water use and crop coefficient development for Napier grass under small scale irrigation: the case of Robit Kebele
6) Evaluating Irrigation Technologies to Improve Crop and Water Productivity of Onion in Dangishta Watershed
7) Assessing the performance of manual water lifting technologies and soil water balance on irrigated tomato production: the case of Western Amhara sub region

MSC. THESIS ONGOING AND NEW

1) Improving Subsurface Recharge By Breaking Hardpans Through Mechanical Means (June 2016)
2) Rainfall-runoff processes in the upper Blue Nile Basin, the case of Dangishta watershed. (June 2016)
3) Optimizing irrigation scheduling to improve onion production in Danghista (June 2017)
4) Effect of irrigation scheduling on nutrient leaching under Tomato (August 2016)
5) Assessment of pesticide residue contamination and transportation in soil and water: the case of Robit Bata (December 2016)
6) Working title: Impact of ground water irrigation on household welfare: Micro econometrics approach (December 2016)

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ACTIVITIES FOR YEAR 3

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ACTIVITIES IN YEAR 3 - ETHIOPIA

1. Understanding of the effects of water lifting technologies on multi purpose and multi crop use (through field books)
2. Improving conveyance of manual water lifting technologies
3. Continuation of monitoring irrigated crop and water productivity for selected crops in the various sites
4. Capacity building of MSc. and PhD students through ILSSI on irrigation, water management, hydrological processes and watershed scale
5. Re-evaluation of the hard pan hypothesis and experiment in Robit
6. Stakeholder engagement meeting for scenario development (June?)

Technology	Number of target households being monitored				Original number of target households			
	Robit	Dangesheta	Adami-tulu	Lemo *AR*	Robit	Dangesheta	Adami-tulu	Lemo *AR*
Rope and Washer	0	**22**	1	26	13	12	6	26
Pulley	**24**	11	0	0	9	12	0	
Diesel Pump	0	0	12	0	0	0	20	
Solar Pumps				**4+2**				0
Crops grown	• Tomato • Napier	• Onion	• Cabbage • (mix veg.)	• Carrot • Cabbage • Oats/Vetch • Avocado				

ACTIVITIES YEAR 3 - GHANA

- Installation of irrigation kits, tanks and hoses and establishment of irrigation experiments and/or demonstrations with water cans
- Continuous data collection for dry season field experiments and other watershed characteristics.
- Training of farmers and extension agents in the use of WFD for irrigation
- Recruitment of 2 MPhil students
- Write research report of biophysical baseline for Ghana
- Write research report on economic evaluation of irrigation technologies
- Stakeholder engagement meeting for scenario development (July?)

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Site	Nat. Partners	Sites	Interventions:			Farmers	Students
			Technical interventions	Crops	Finance		
Bihinaayili	UDS	1	• Tank and hose • Water can • WFD	• Roselle	• Credit/ Revolving fund (protocol Dev.)	• 16	Not recruited yet (2)
Zanlerigu	UDS	1	• Tank and hose • Water can • Roof top water harvesting and use of drip irrigation • WFD	• Onion • Leafy vegetables	• Credit/ Revolving fund (protocol Dev.)	• 21	
Dimbasinia	UDS	1	• Drip (IDE kits) • Drip (UDS kits) • Water can • WFD	• Tomato	• Credit/ Revolving fund (protocol Dev.)	• 24	

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ACTIVITIES YEAR 3 - TANZANIA

- First dry season vegetable production using motorized pumps in 2 sites
- Start discharge and climatic monitoring of the watershed
- Understanding the effect of SRI at landscape level
- Partnering up with AVRDC/ Africa Rice and NAFAKA
- Stakeholder engagement meeting for scenario development (June?)

Site	Nat. Partners	Sites	Interventions:			Farmers	Students
			Technical interventions	Crops	Finance		
Rudewa	SUA	1	• Motorized pumps • (interest in WFD)	• Tomato	• Credit/ Revolving fund (group)	• 23	Not recruited yet
Mkindo	SUA	1	• Motorized pumps • SRI (AWD) • (interest in WFD)	• African Egg plant	• Credit/ Revolving fund (group)	• 16	

GENDER

Focus on gendered incentives/discentives for adopting (or disadopting) SSI technologies and practices

Some factors: labor requirements, credit access, land access, social status

Ethiopia (October, IWMI); Ghana (March, IWMI), Tanzania (February, IFPRI)

Training workshops to follow in each country adapted to context and existing levels of knowledge and organization around irrigation and gender


Thank you !

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Ethiopia

Robit	Nat. Partners	Sites	Interventions:			Farmers	Students
			Technical interventions	Crops	Finance		
Year 2- Plan	BDU, ARARI/Andasa, WOA	1	• Pulley + Tank • Rope and washer • Hard pan	• Tomato (hybrid) • Napier grass • Maize	• Credit/ Revolving fund • Saving and Credit training workshop	• 18 • 17 • 5	• 1 PhD student • 4 Msc. students
Year 2- Good	BDU is very involved		• Pulley + Tank were well received	• Tomato was successful with some farmers	• Multi-purpose coop involved from the start		• MSc. Teshager 2014/15 Eshetu Chole Memorial Award
Year 2 -Moderate	DA requesting payment on a very regular basis		• Hardpan fields do not seem to have compacted layer rather shallow soil profile	• Poor management of tomato crop EMMP hybrid/pesticide	• Credit/ Revolving fund		• Need for irrigation research capacity building • 2 MSc. students obtained a job
Year 2-Challenges	Woreda officials not very supportive		• Rope and washer failed	• Chat is main irrigated crop • Poor management/fencing • High pesticide cost			• 2 MSc. Thesis biophysical students delayed
Year 3 -Plan	Monthly payment of DA and woreda officials		• Rope and washer have been transported to Dangila and more pulleys have been acquired	• Tomato seeds bought by farmers • Hardpan plots Revisited • Multi-purpose use	• First repayment expected end of 2015		• 2 new Msc. Students • Melaku (bio) and Teshager (socio) research coordinator

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Ethiopia

Dangistha	Nat. Partners	Sites	Interventions:			Farmers	Students
			Technical interventions	Crops	Finance		
Year 2- Plan	BDU, WOA	1	• Pulley + Tank • Rope and washer • WFD	• Onion	• Credit/ Revolving fund • Credit and savings training	• 22	• 3 Msc. students
Year 2- Good	BDU and WOA are very involved		• Rope and washer and WFD well received	• Overall better • crop management	• Multi-purpose coop involved from the start		• MSc. student Miheret submitted
Year 2 -Moderate			• Pulley + tank not very well received	• Late start of the season • Water shortage for some households			• Need for irrigation research capacity building
Year 2-Challenges			• 1 farmer returned their pulley	• Some wells too shallow/water shortage • Local and low yielding onion variety			• 2 MSc. Thesis irrigation delayed
Year 3 -Plan	Monthly payment of DA and woreda officials		• 1 pulley has been transferred to Robit • 8 R&W have been installed from Robit	• Extension of wells • Better yielding variety planted	• First Repayment expected end of 2015		• 2 new Msc. students • Melaku (bio) and Teshager (socio) research coordinator

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Ethiopia

Bochesa	Nat. Partners	Sites	Interventions:			Farmers	Students
			Technical interventions	Crops	Finance		
Year 2- Plan	AMU, SECA, WOA	1	• Rope and washer • Motorized pump	• Tomato	• Credit/ Revolving fund	• 26	• 2 PhD students • 1 MSc. student
Year 2- Good	Kebele DA and WOA are very involved		• Access to technology resulted in Improved inputs • Success of female hhs demonstrated	• Improved production	• Improved income		• MSc. Minyahel defended his thesis
Year 2 -Moderate			• Time and labor requirement to operate R&W pumps	• Poor management of research plots by target farmers			
Year 2-Challenges	AMU & SECA/SEDA not very involved in the project activities		• Safety problems related to watershed monitoring equipment • Regular follow-up of field implementation was poor • Poor data collection	• Soil quality and irrigation water quality issues • Pests and diseases / high pesticide cost	• Gender analysis and financial training not done yet		• PhD students' proposals are slowly progressing
Year 3 -Plan	SECA/SEDA's and AMU's contract not renewed		• Security guards posted at the monitoring points	• Farmers to buy their own seeds (difference in planting dates)	• Consultant to undertake C&S training • Irrigation coop to handle credit repayment/ the revolving fund		• Improved involvement & Direct scholarship to PhD students

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Ethiopia

Upper Gana/Angacha	Nat. Partners	Sites	Interventions:			Farmers	Students
			Technical interventions	Crops	Finance		
Year 2- Plan	AMU, SARI/Areka, WOA, OMFI	2	• Rope and washer • Solar pump • WFD	• Avocado • Napier grass • Desho grass • Oats-Vetch	• Credit/ Revolving fund • Credit and savings training	• 38 (Upper Gana) • 35 (Angacha)	• 1 MSc. student • 2 PhD students
Year 2- Good	Good collaboration of SARI in Angacha		• WFD well received • R&W trainings given to DAs and target farmers	• Higher production of Desho and oats/vetch with WFD	• Farmers to "try" R&W for 6 months • Credit and savings training well received		• Irrigation • Research capacity at AMU • MSc. Deslegn thesis defended
Year 2 -Moderate	AMU not very involved aside from the Msc. student		• Late commencement of interventions • Reluctance of some farmers to adopt R&W (technical issues)	• Economic benefit for fodder? Influencing adoption of technology			
Year 2-Challenges	Communication between SARI and students need to be improved		• Follow up on R&W issues not fast enough • Delay in training • Solar pump installation delayed	• Shortage of water in the dry season	• Delay in OMFI contract signing		
Year 3 -Plan	AMU's contract not renewed ILRI & SARI continue in Angacha		• 4 Solar pumps installed • R&W reinstalled and farmer willingness to credit improved	• Carrot and Cabbage added • Replanting of elephant grass	• Farmers to sign credit contract with OMFI		• Improved involvement & Direct scholarship to PhD students

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PRELIMINARY RESULTS: IRRIGATION TECHNOLOGY

Photo curtesy: Desalegne Tadesse, IWMI

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DATA COLLECTED

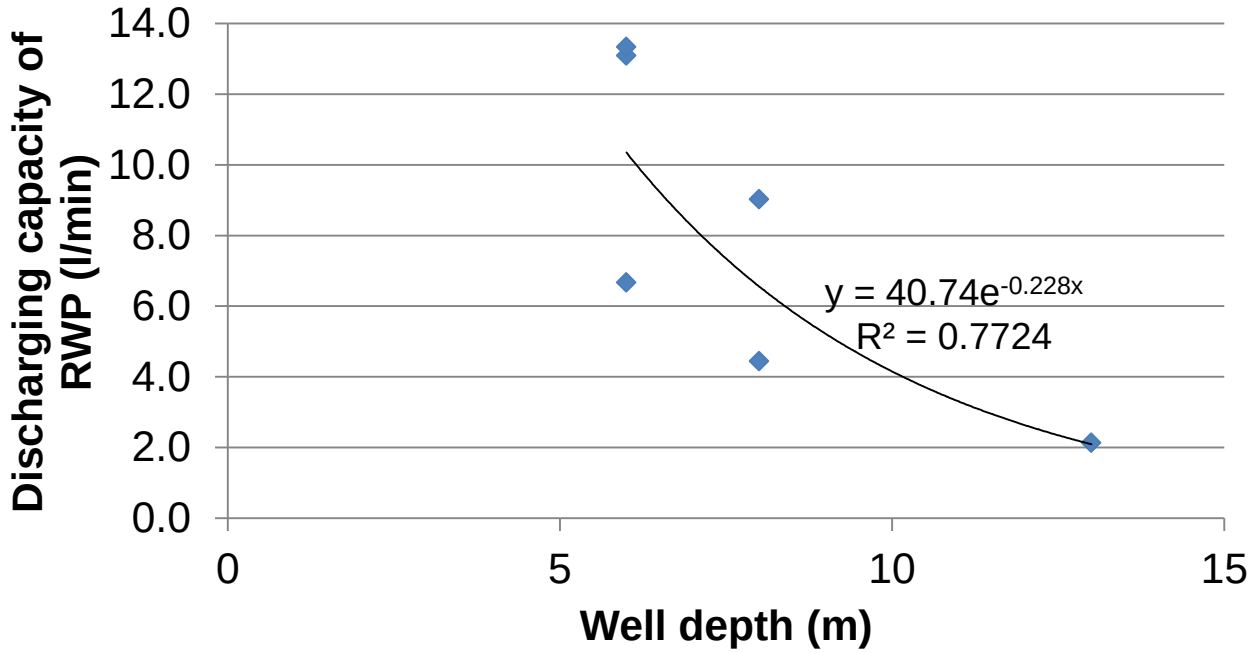
- Crop specific management data
- Agronomic performance of irrigated fodder and horticultural crop
- Detailed irrigation data f(technology) (quantity, discharge, time, event, method)
- Soil moisture and soil physico-chemical properties
- Yield (marketable and non marketable characteristics and N,P status)
- Famers perception and technology issues

AVERAGE TECHNOLOGY DISCHARGE*

Lifting technology	Site	Discharge rate (l/min)
Pulley/tank/hose (n=28)	Danghista and Robit	15
Rope and washer (n=27)	Danghista, Robit and Bochesa	14
Motor pump (n=20)	Bochesa	170
Solar pump (n=4)	Upper Gana	16

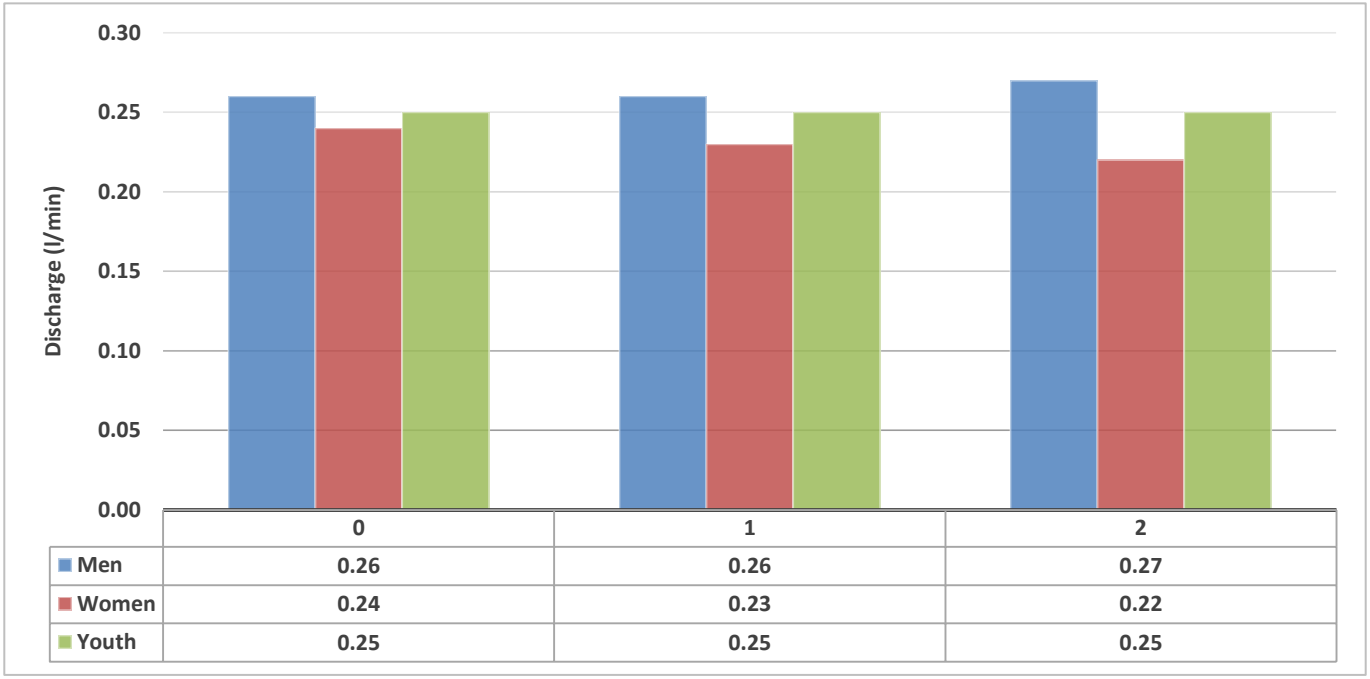
* Data are preliminary and need a full assessment accross sites as function of manpower and well depth

EFFECT OF WELL DEPTH ON R&W DISCHARGE IN ROBIT BATA



Pulley discharge did not vary signficantly with depth

EFFECT OF HUMAN POWER ON R&W DISCHARGE AS FUNCTION OF SLOPE (0-2%)*



	0	1	2
Men	0.26	0.26	0.27
Women	0.24	0.23	0.22
Youth	0.25	0.25	0.25

* Data was collected by filling 5 buckets within one irrigation event and not for the entire irrigation event – duration of irrigation is most likely to effect the discharge

TECHNOLOGY PERFORMANCE: FARMER'S FEEDBACK

RWP	1. Wheel hard to rotate; maintained by applying oil to the joints
	2. Rope breaking thus needing replacement
	3. Poor installation; delivery pvc pipe not erected perpendicular
Pulley	No issues reported

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FIRST SEASON VEGETABLE AND FODDER PRODUCTION

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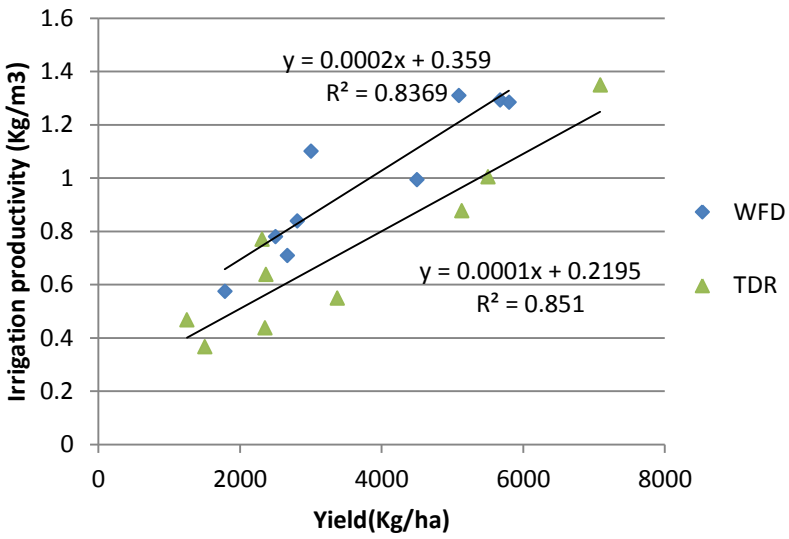
IRRIGATION OF TOMATO IN ROBIT*

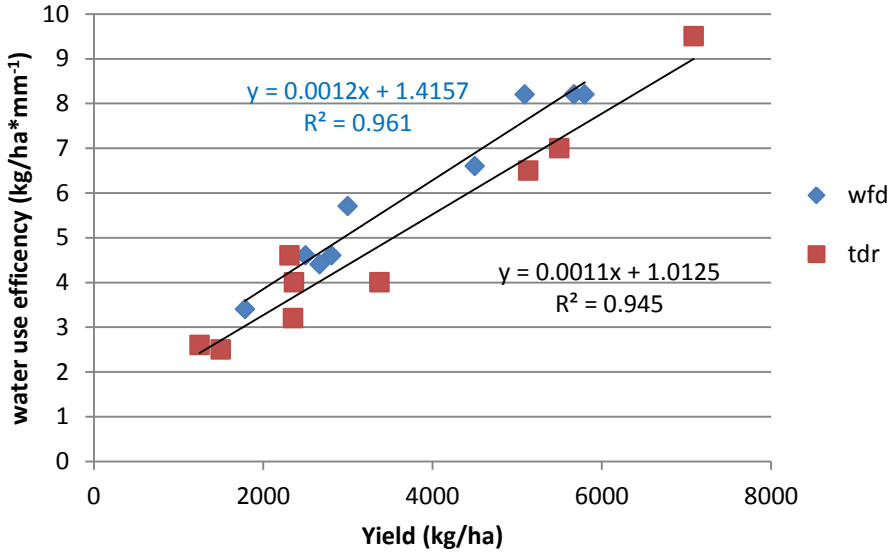
	Irrigation applied (mm)	ET_c (mm)	Yield (kg/ha)	WUE (kg/m^3)	IP (kg/m^3)
Lifting technology					
RWP	609 a	858a	24778 a	2.80 a	3.94 a
Pulley	927 b	1176 b	61263 b	5.43 b	6.89 b
Irrigation scheduling					
TDR	897 a	1144 a	45020 a	4.17 a	5.48 a
Control	791 a	1041 a	55202 a	5.06 a	6.70 a

Means that share a letter down the column are not significantly different at a significance level of 5%.

* Study was constrained by attacks from pests and diseases, and livestock grazing some plots during the study period.

EFFECT OF IRRIGATON SCHEDULING ON ONION YIELD – DANGHISTA*





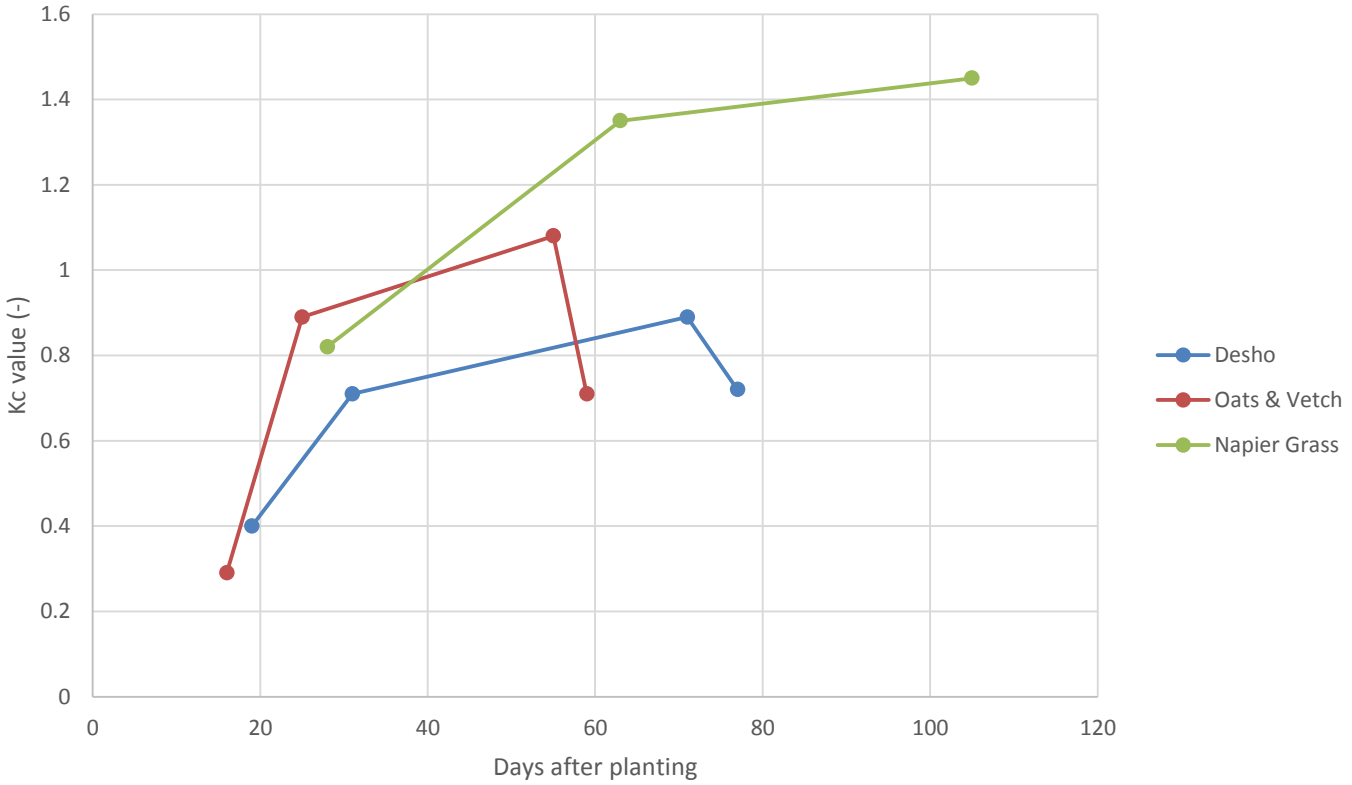
* No significant yield difference was observed between both irrigation scheduling treatments, the TDR group is rather theoretical as applied irrigation discharges were not collected continuously

PRODUCTIVITY OF IRRIGATED FODDER

Lifting technology	Fodder	Scheduling method	Irrigation (mm)	ET_c (mm)	DM Yield (t/ha)	WUE (kg/m^3)	IP (kg/m^3)
R&W	Napier grass*	TDR	453 a	662 a	1.1a	0.2 a	0.2 a
Pulley		TDR	333 a	496 b	1.6a	0.4 a	0.5 b
R&W	Oats & vetch	WFD	590 a	-	23.9a	1.1a	4.1a
		FP	603 a	-	19.8b	0.9b	3.3b
R&W	Desho	WFD	729 a	-	23.9a	1.0a	3.3a
		FP	698 a	-	20.0b	0.9b	2.9b

* The Napier results were affected by livestock grazing the grass during the period of the study due to poor fencing and water shortages

ESTIMATED K_C VALUES FOR THE 3 FODDER SPECIES*



* The Napier grass results were affected by livestock grazing

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SOCIO-ECONOMIC IMPACT OF INTERVENTIONS

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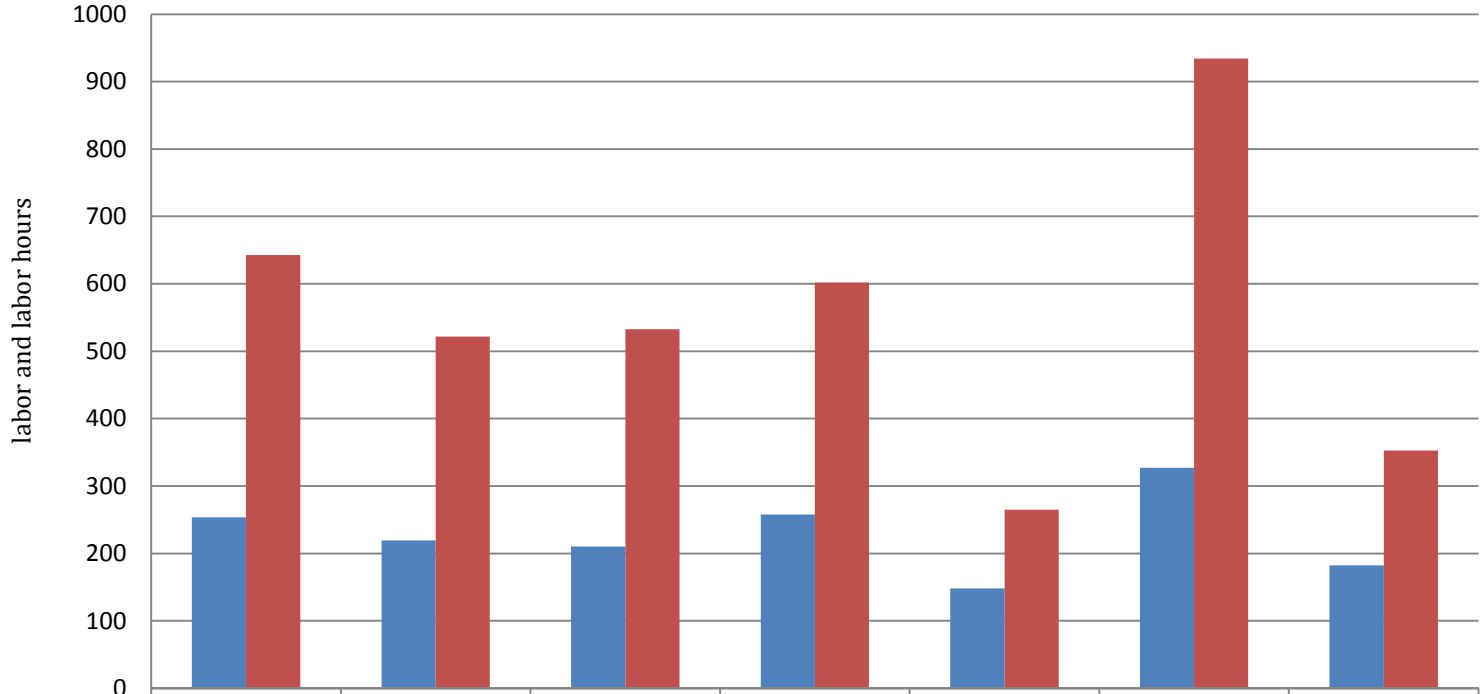
DATA COLLECTED

- Gender disaggregated labor input during irrigation
- Gender disaggregated labor for agronomic practices
- Operation and maintenance cost of the technology
- Irrigation agricultural inputs (fertilizer, seeds, etc.)
- Bi-weekly market price for specific vegetables and fodder at the various sites

LABOR RELATED TO IRRIGATED AGRICULTURE



	Female	Male	Pulley	R&W	tomato	onion	fodder
	Gender		Technology		Crop Type		
total amount of labour	253	219	210	258	148	327	182
total labor hours borhrs	643	522	533	602	265	934	353

TECHNICAL EFFICIENCIES OF SMALL SCALE IRRIGATION TECHNOLOGIES: ROBIT AND DANGESHTA

Variables	Coefficients	Odds Ratio	p-value
Size of family	0.00864	1.009	0.0019
Highest education of the head of the household	0.0546	1.056	0.031
Age of the head of the household	0.005	1.004	0.049
Type of crop cultivated	0.17	1.18	0.042
Type of irrigation technology installed	0.18	1.2	0.005
Size of plot allotted for the experiment	0.005	1	0.002
Sex of the head of the household	0.128	1.14	0.002
Distance to the market	0.0318	1.03	0.044
Marital status o fthe household head	0.169	1.18	0.12
Income obtained from non-farm activities in 2014	0.00000526	1	0.049
cut1	-0.887		
cut2	1.281		

FARMERS' WILLINGNESS TO PAY (WTP) FOR IRRIGATION TECHNOLOGIES

Sex	WTP (%)	Study area	Technologies		
			Motor pump	RWP	Pulley
Male headed	79.0	Adami-Tulu	73.3	23.3	3.4
		Lemo	20.0	34.3	45.7
		Dangila	9.1	60.6	30.3
		Bahir Dar Zuria	59.5	2.7	37.8
		Average	**40.5**	**30.2**	**29.3**
Female headed	64.9	Adami-Tulu	25.0	75.0	0.0
		Lemo	0.0	50.0	50.0
		Dangila	0.0	85.7	14.3
		Bahir Dar Zuria	14.3	0.0	85.7
		Average	**9.8**	**52.7**	**37.5**

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HARD PAN STUDY: ONGOING

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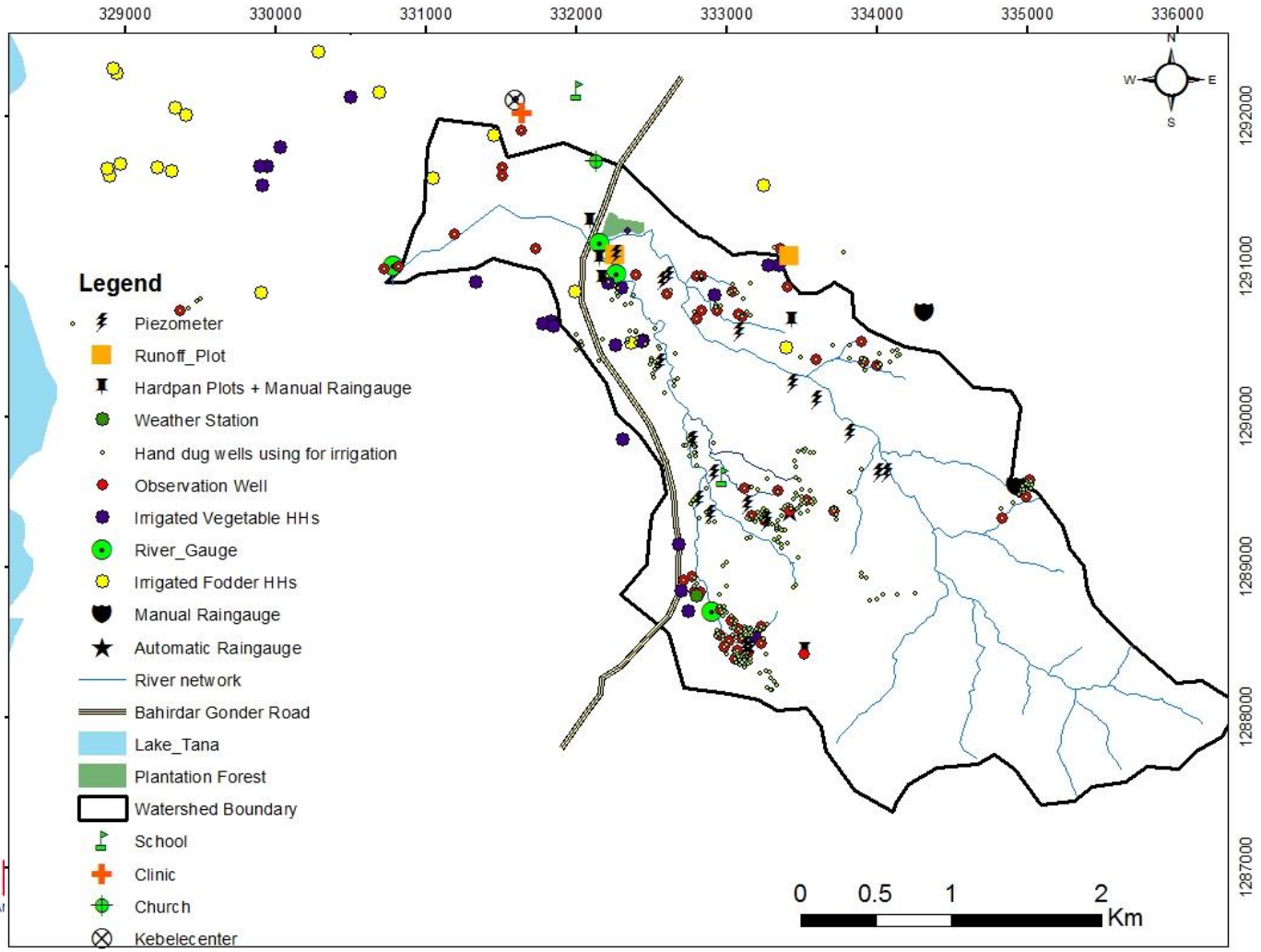
DATA COLLECTED

- Runoff and sediment quantity (event based)
- Agronomic practices during the rainfed season
- Rainfall (daily based)
- Agronomic data for the various crop stages
- Yield
- Soil physico-chemical characteristics

WATERSHED MONITORING

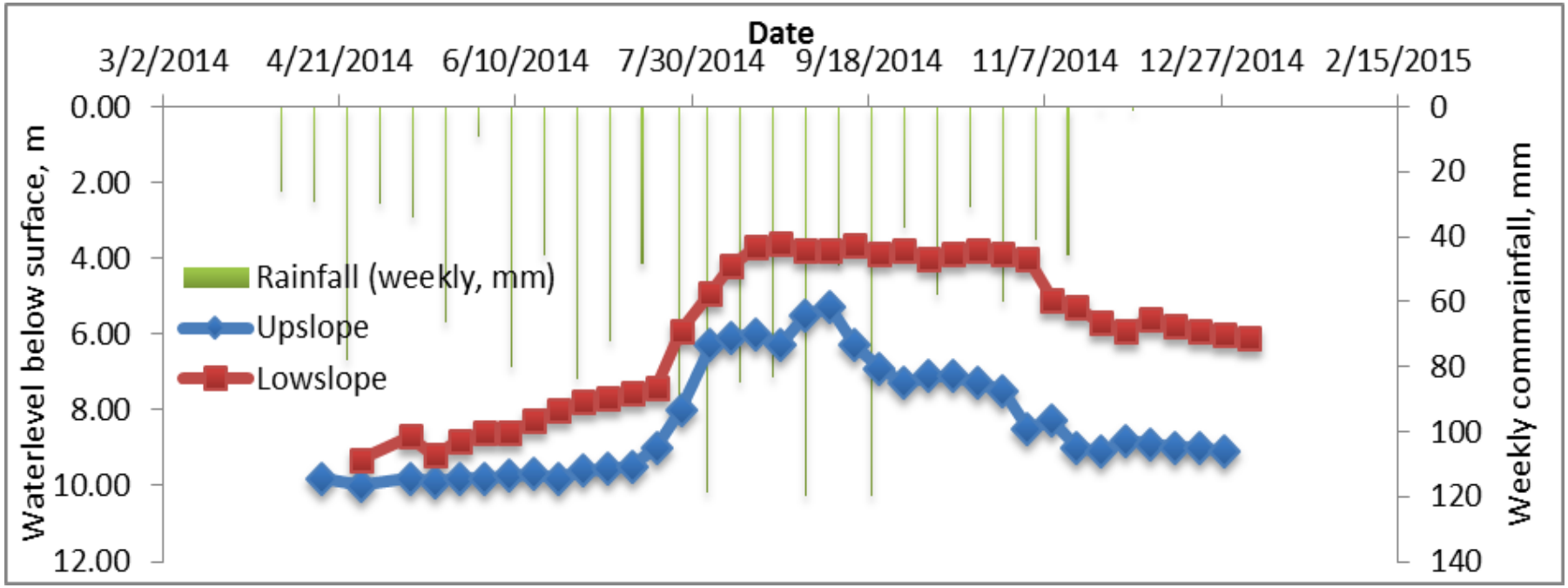


DATA COLLECTED

- Groundwater levels for 30 wells/ watershed
- Rainfall and other climatic data
- Land use
- Water level in rivers/streams (daily, or 10 min depending on station) at watershed scale
- Groundwater recharge tests (specific yield, manual vs. motorized pumping)
- Istopic monitoring to determine dominant hydrological processes, sw/gw interaction, etc.

WATERSHED SCALE

Groundwater level response to rainfall in Robit watershed



Monthly average groundwater recharge response to monthly average rainfall for Robit kebele