From Africa to Asia and Back Again: Testing Adaptation in Flood-based Farming Systems

On farm water management in GAS

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Research Team

- **Researchers**

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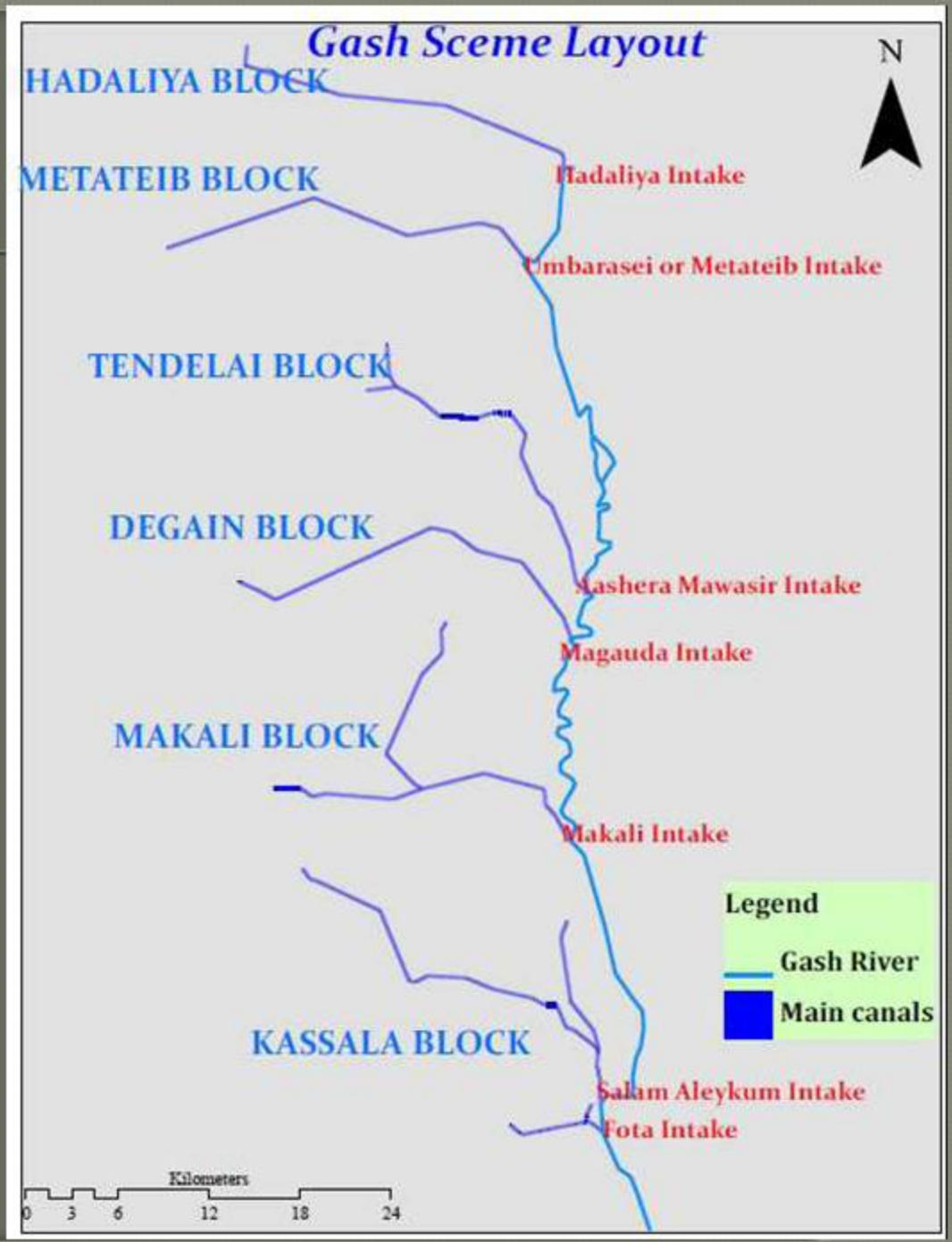
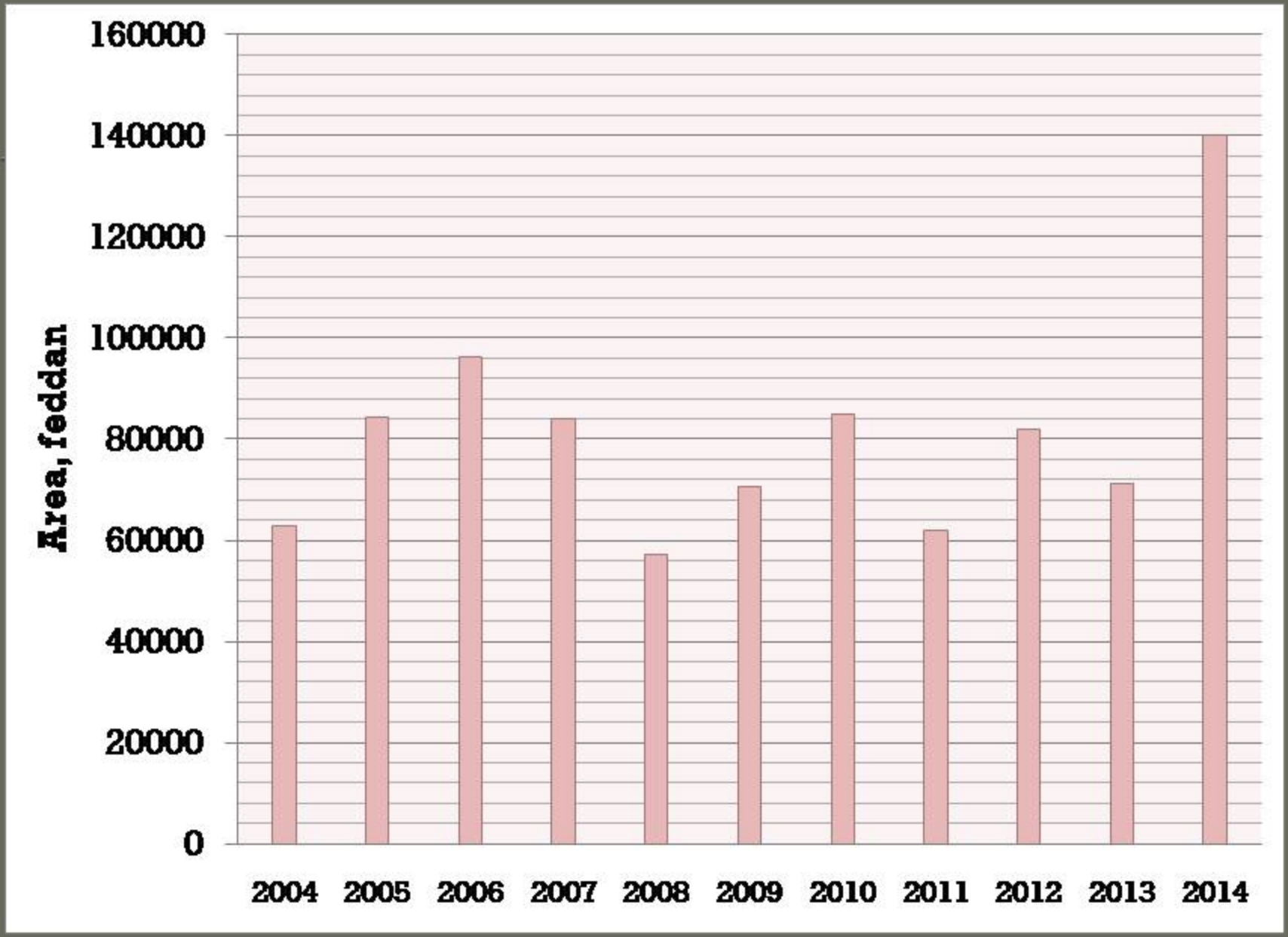
- **Assisting staff**

  Ms. Tamani A. Rahman
  Soil mechanics lab. staff (field & official work)

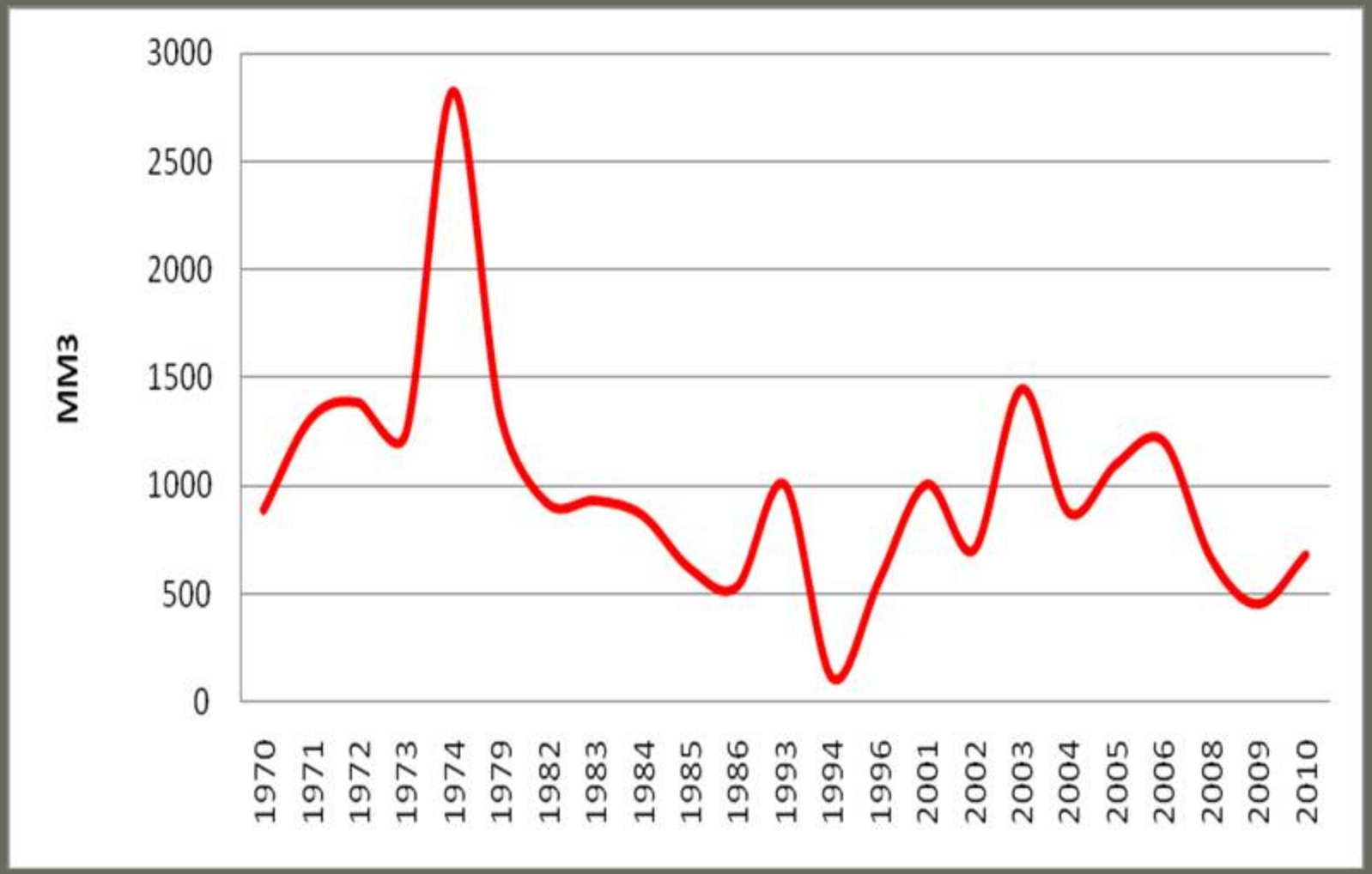
About GAS

- The arable land is 120,000 feddans (50% is cropped area).




160000
140000
120000
100000
80000
60000
40000
20000
0
Area, feddan
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

About Gash River



Objective

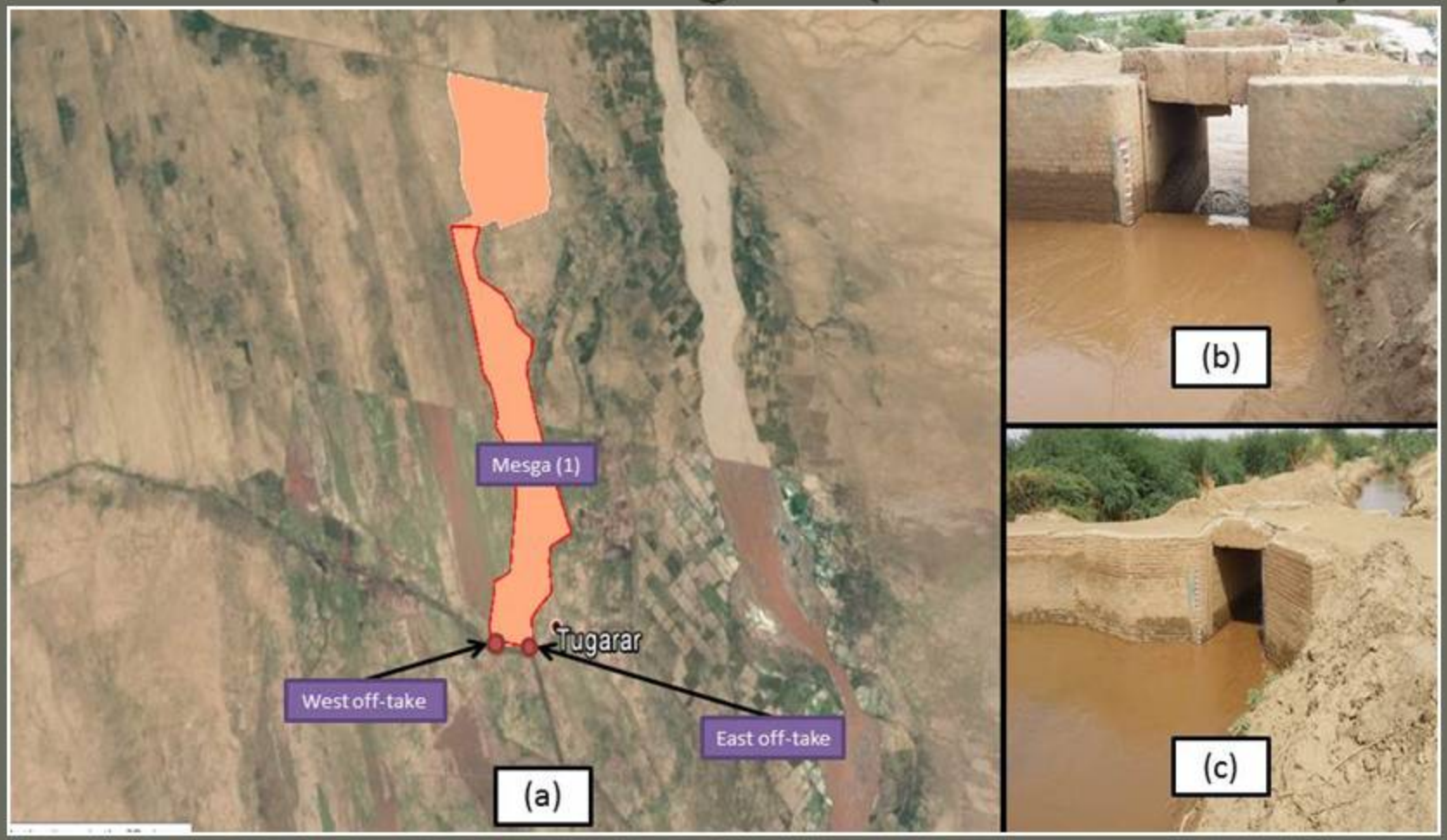
- To investigate the appropriate irrigation schedule on Mesga level in GAS by recommending on optimal:
  - **Applied amount of water (number of days 25 -30); and**
  - **Mesga Size.**

Methodology

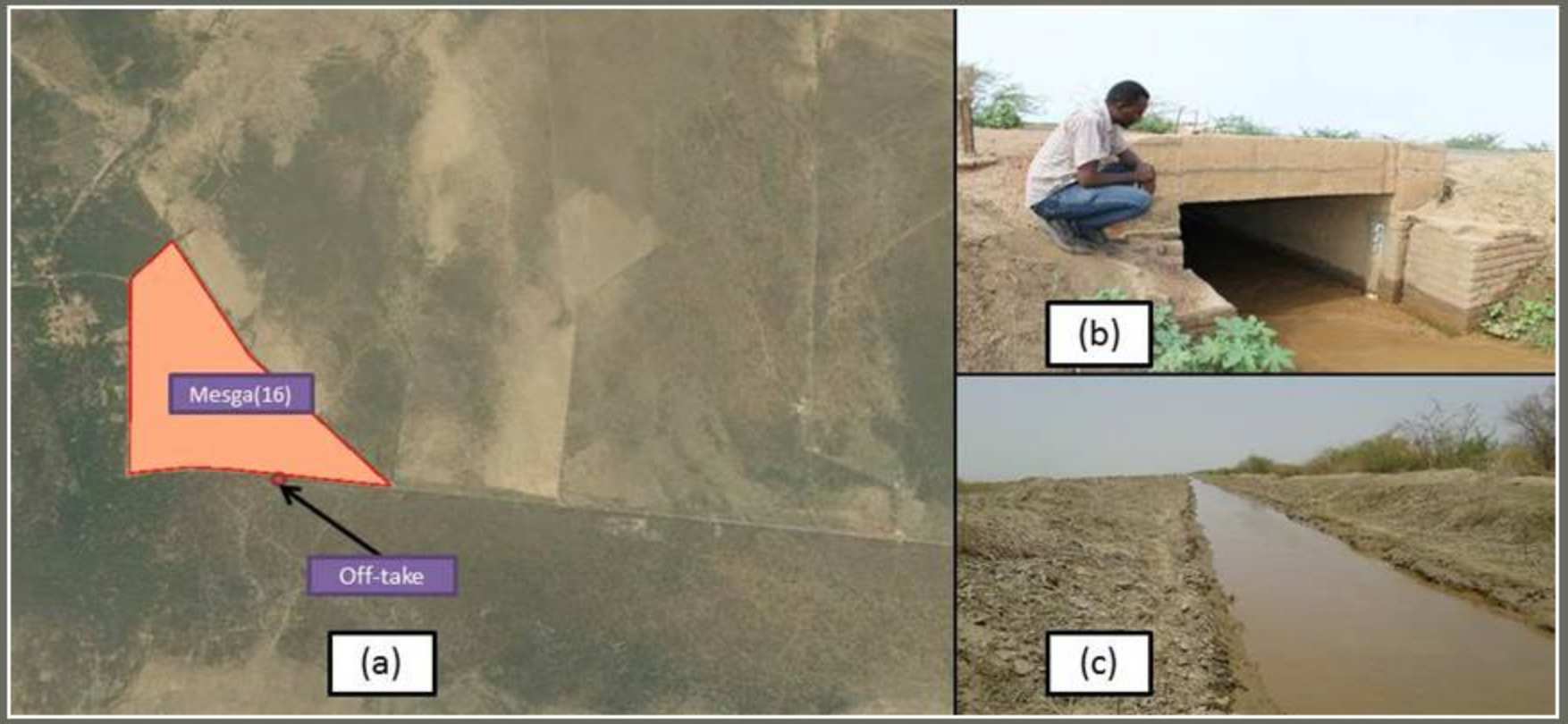
- (2) Mesga selection
- Pre-season investigation
- Field survey
- Flow measurements (Jul.-Aug.)
- SMC sampling (by **2** methods)
- Reporting (Phase I)

1. Pilot farms selection

Kassala Block – Mesga 1 (2000 feddans)

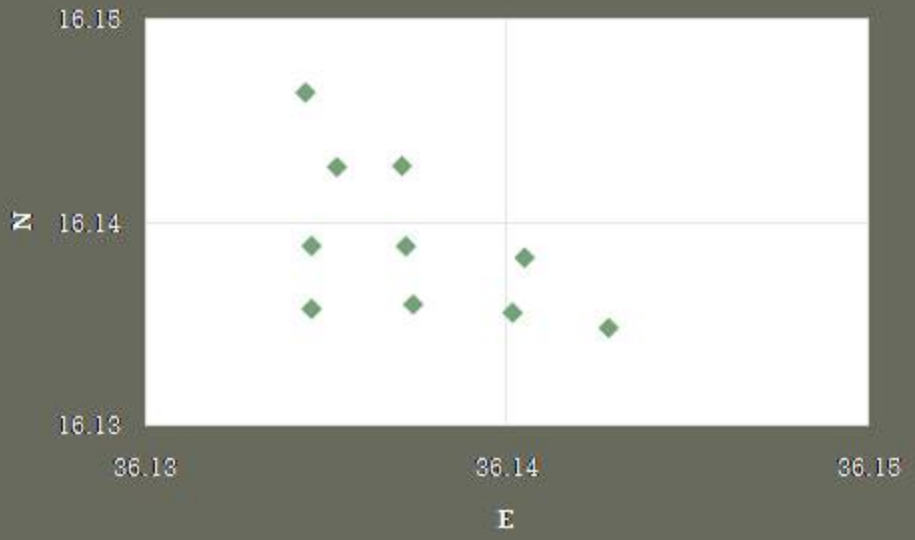


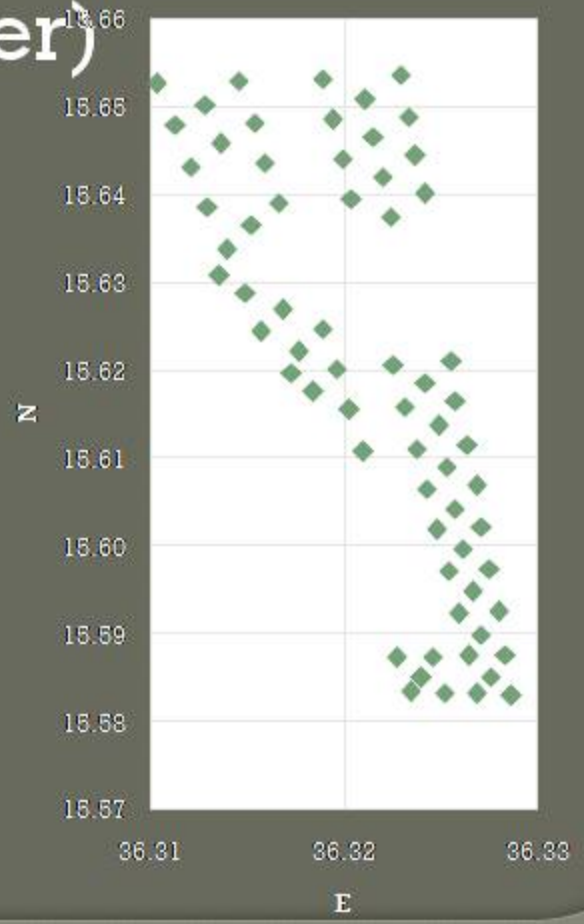
Hadalya Block – Mesga 16 (300 feddans)



2. Pre-season measurements:

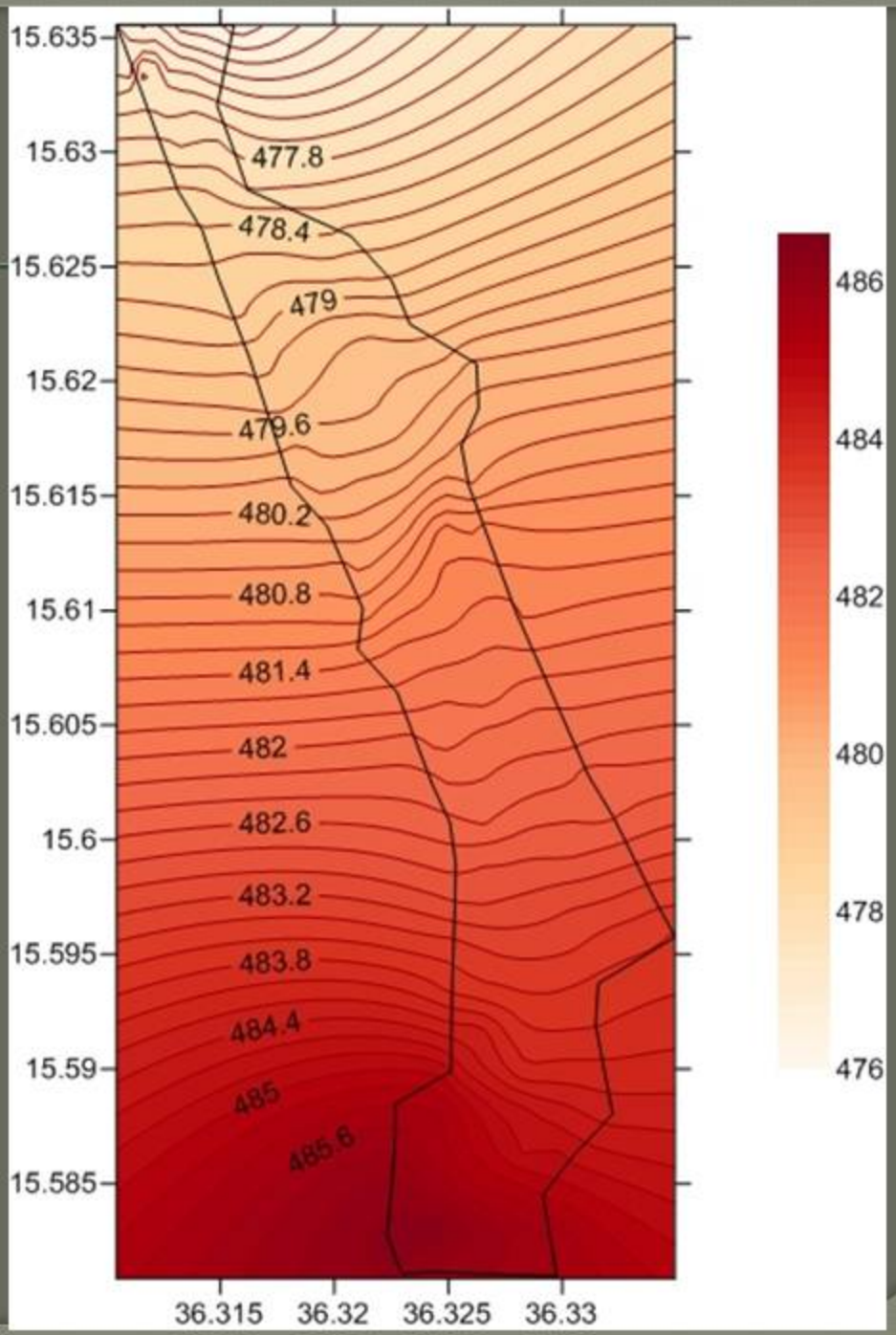
- Chemical/Physical characteristics
- Sampling of soil MC (Auger)





3. Survey work

- To accurately define the Mesga topography and to generate the corresponding contour map.



4. Flow measurements

- WL measurements

	Interval	Duration	No. of days
Mesga 1	2-hour	26/7-10/8 25/7-15/8	16 22
Mesga 16	2-hour	30/7-5/9	37

Cont.

- Discharge measurements

Cont. associated activities

(a)

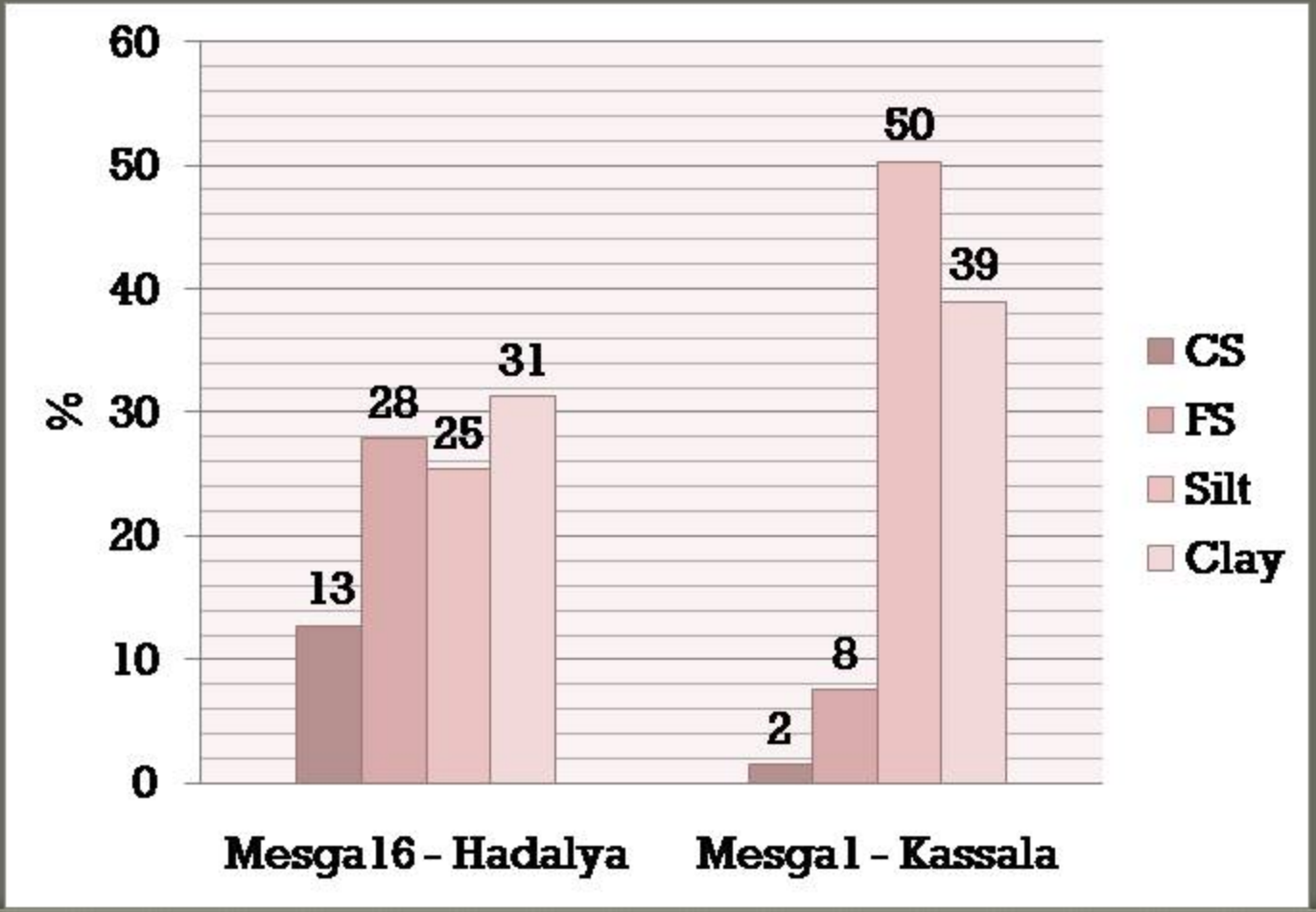
(b)

5. SMC sampling

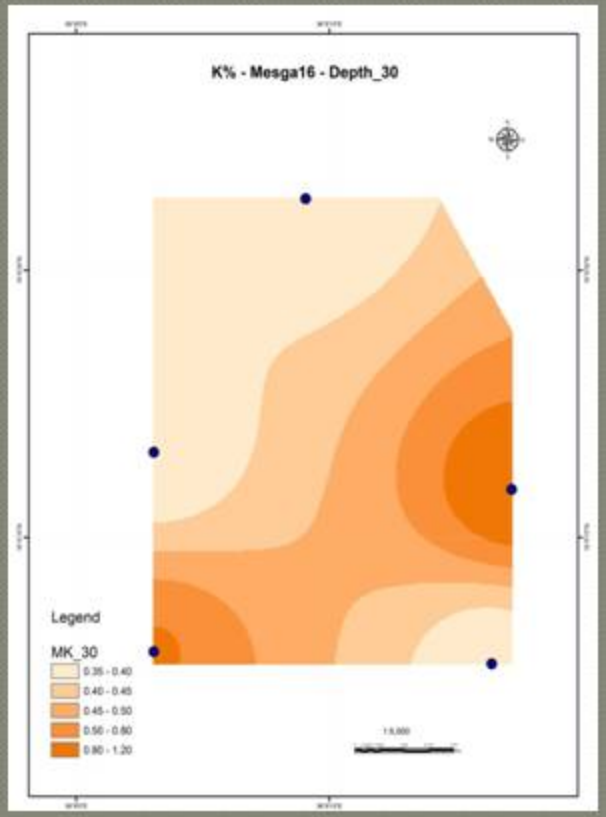
Sampling / Mesga	Pre-season	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5	Batch 6
Mesga 1	31/5-6/6	29/8-2/9	9/9-12/9	30/9-4/10	23-25/10	26-28/11	-
Mesga 16	6/6	-	10/9	3/10	26/10	26/11	2/1

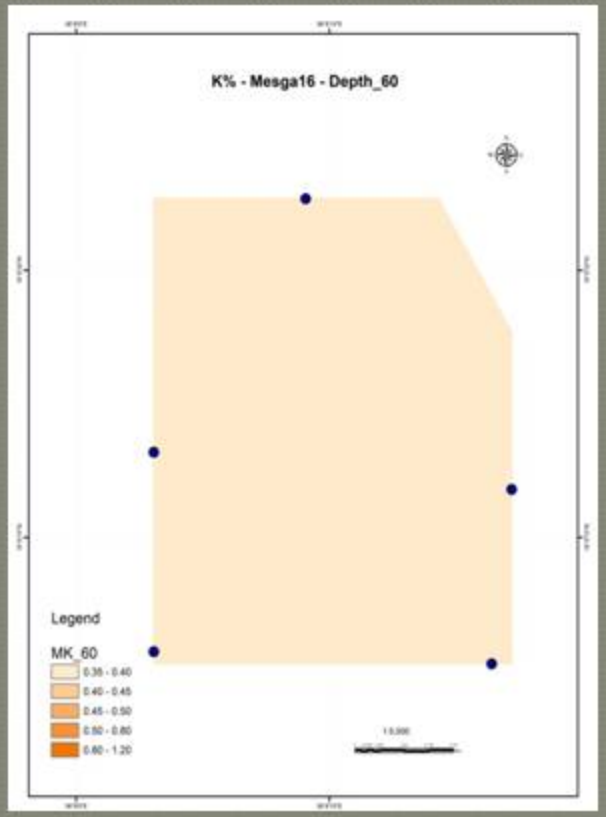
Analysis & Results

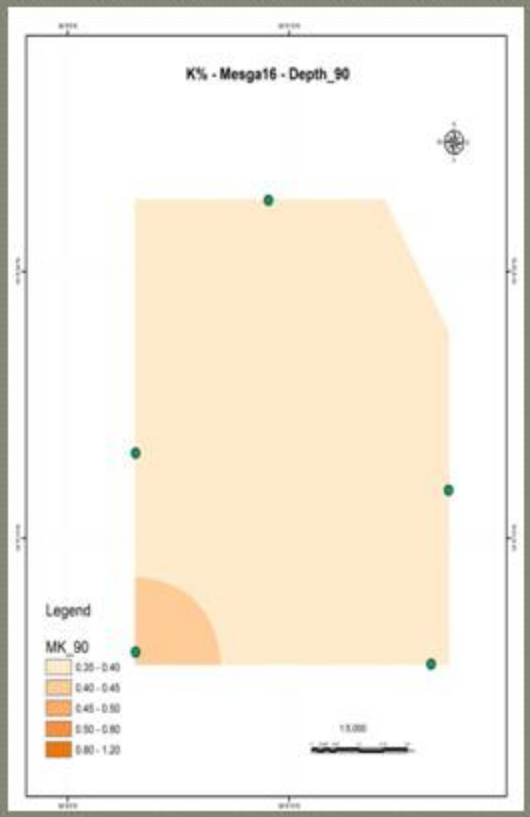
I. Soil characteristics



Soil property	*Kassala*	*Hadalya*	*Classification*
Physical characteristics:			
SMC, %	0.80 -18.50	2.80 -11.60	
k (cm/hr)	1.60 - 4.42	2.00 - 4.41	Slow to moderate class
Chemical characteristics:			
CEC (cmol+/kg)	21.0 - 40.0	27.0 - 41.0	Fertile
EC (ds/m)	0.10 - 0.75	0.08 - 0.60	Salt free class
pH	6.60 - 7.70	6.90 - 7.70	Neutral
N (%)	0.03 - 0.81	0.04 - 1.09	Very low-very high
K (cmol+/kg)	0.28 -1.11	0.39 - 1.11	Medium-high
P (mg/kg)	1.00 - 6.00	1.29 - 4.00	Low
$CaCO_2$	0.12 - 0.78	0.03 - 0.37	Very low
$CaCO_3$	1.20 - 5.60	3.00 - 5.10	-

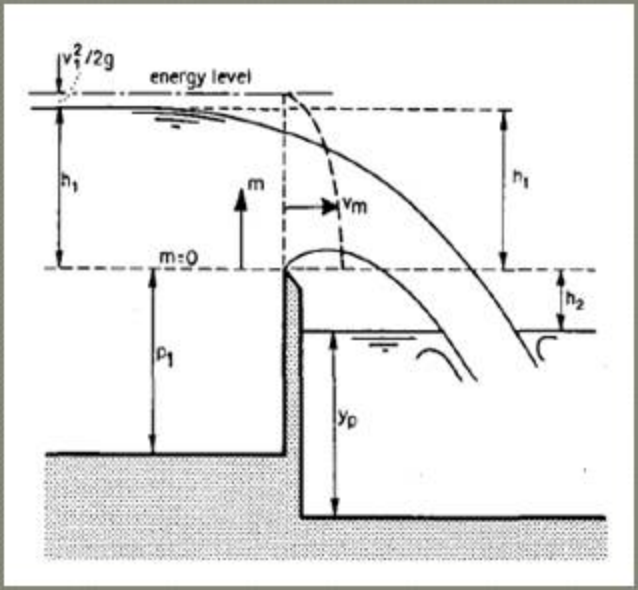

K% - Mesga16 - Depth_30
Legend
MK_30
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.60
0.60 - 1.20


K% - Mesga16 - Depth_60
Legend
MK_60
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.60
0.60 - 1.20

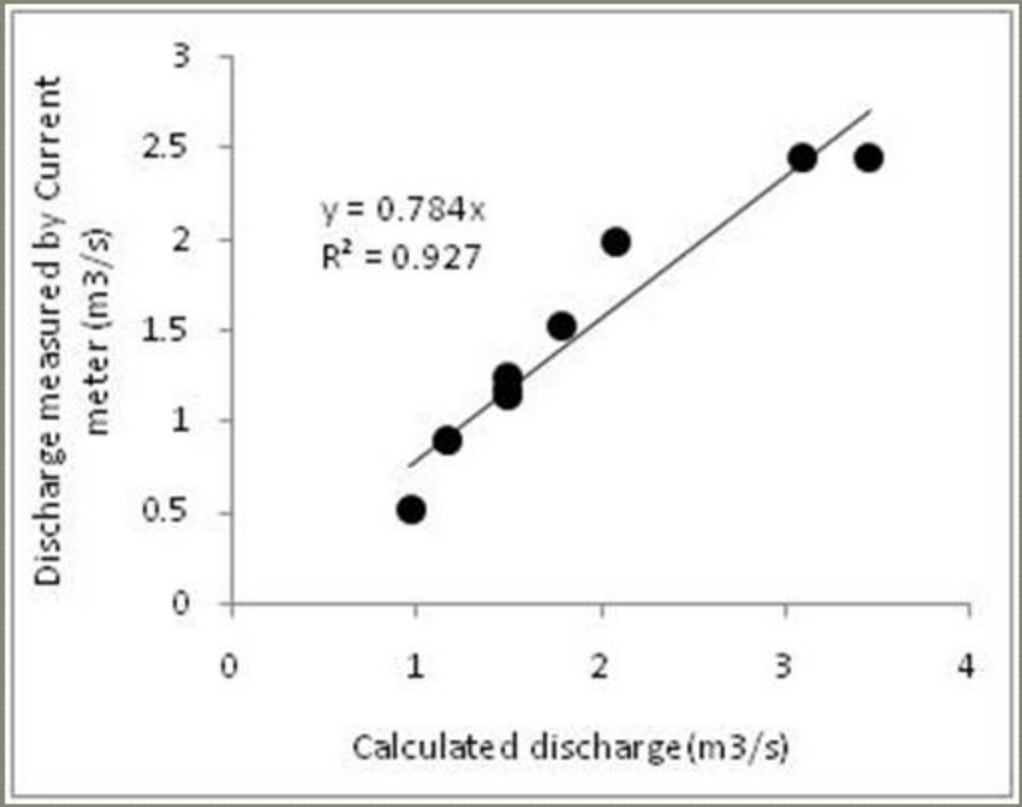

K% - Mesga16 - Depth_90
Legend
MK_90
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.60
0.60 - 1.20

II. Quantification of flows

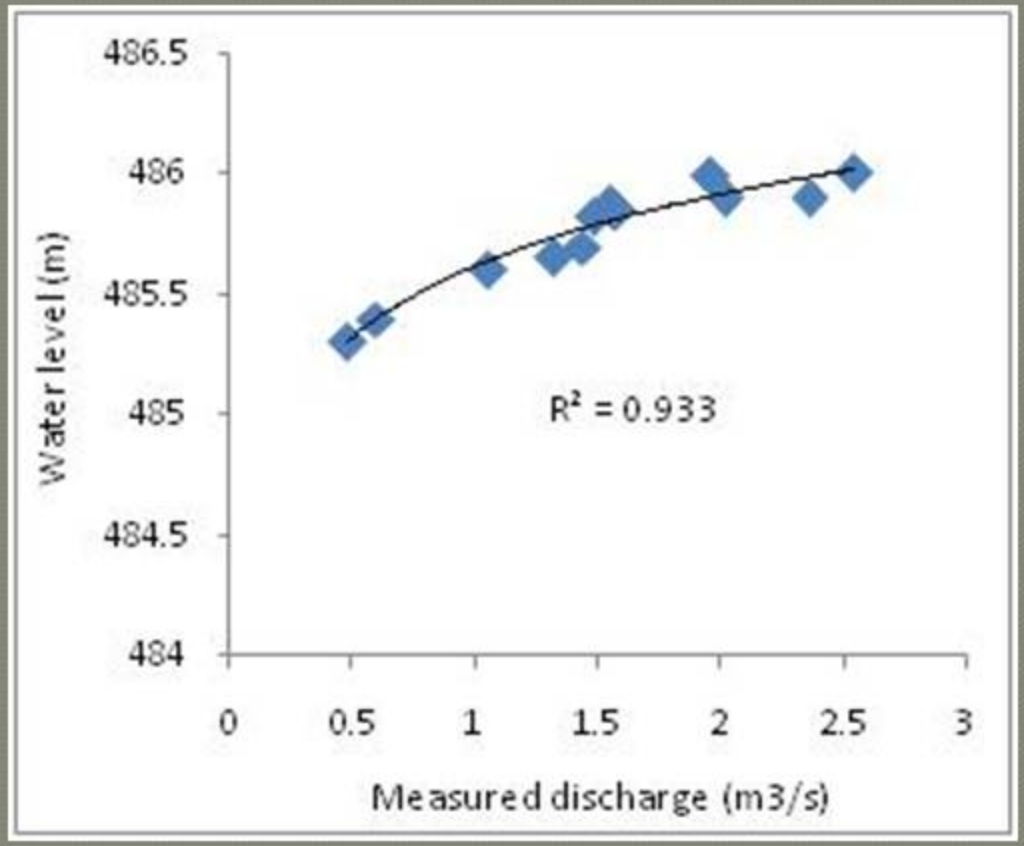
Mesga 1 – Kassala Block

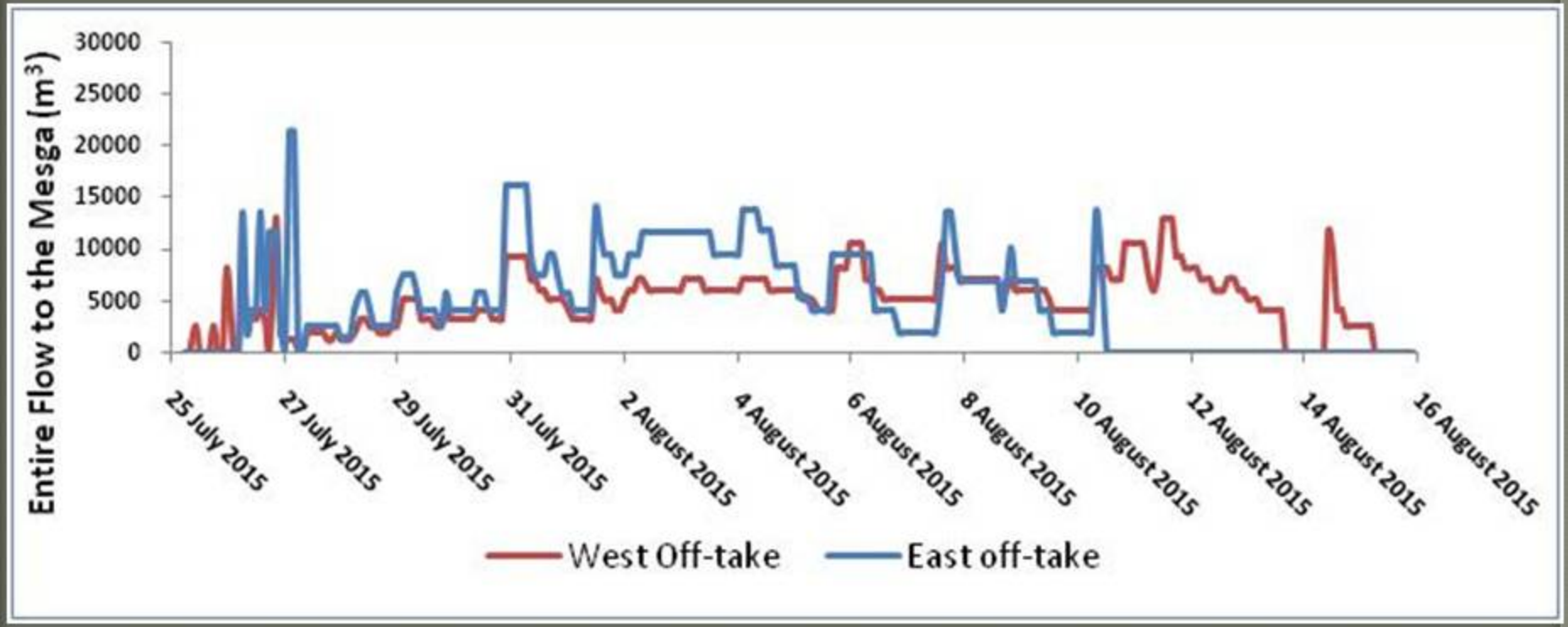


$$Q = C_e \frac{2}{3} (2g)^{0.50} b_c h_1^{1.50}$$



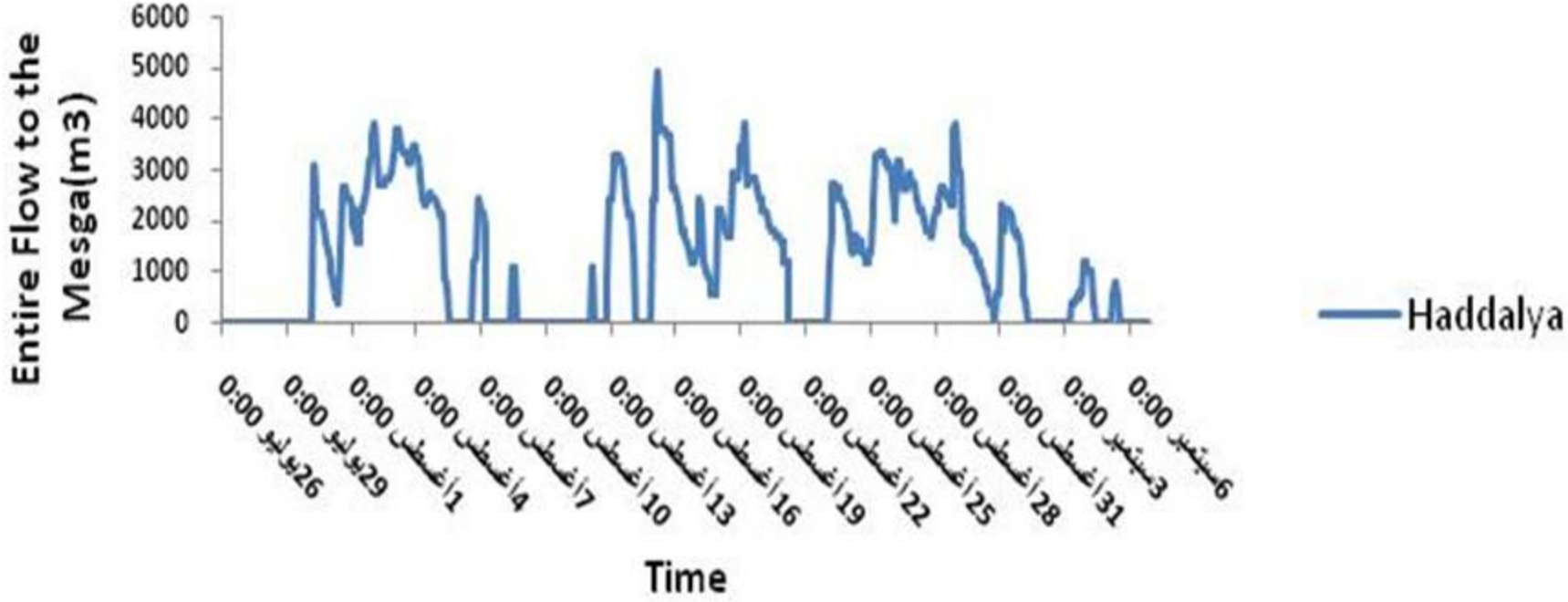
$$Q = a\,(H - H_0)^b$$


486.5
486
485.5
485
484.5
484
Water level (m)
R² = 0.933
0
0.5
1
1.5
2
2.5
3
Measured discharge (m3/s)



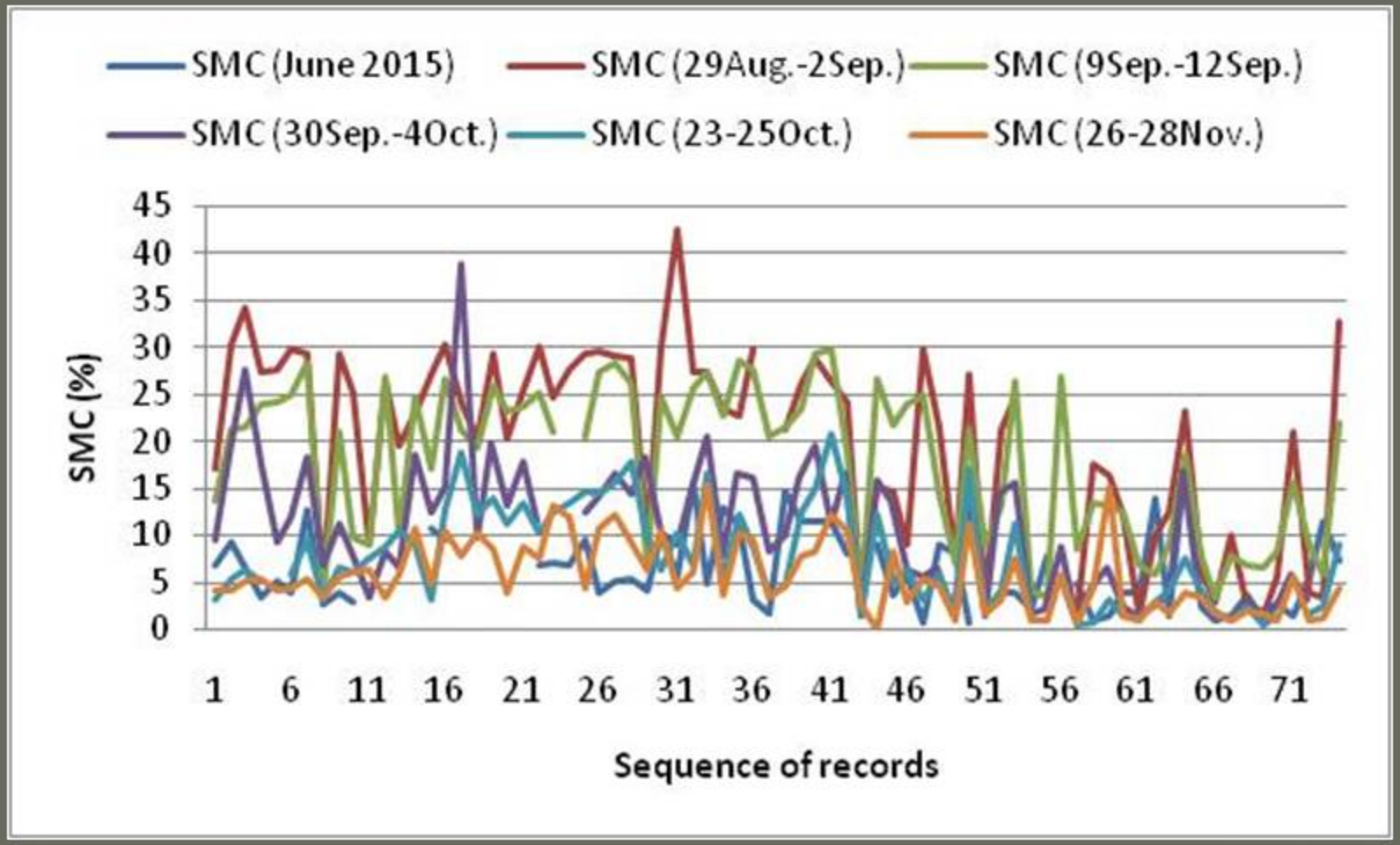
Total flow ~ 4.70 Mm^3

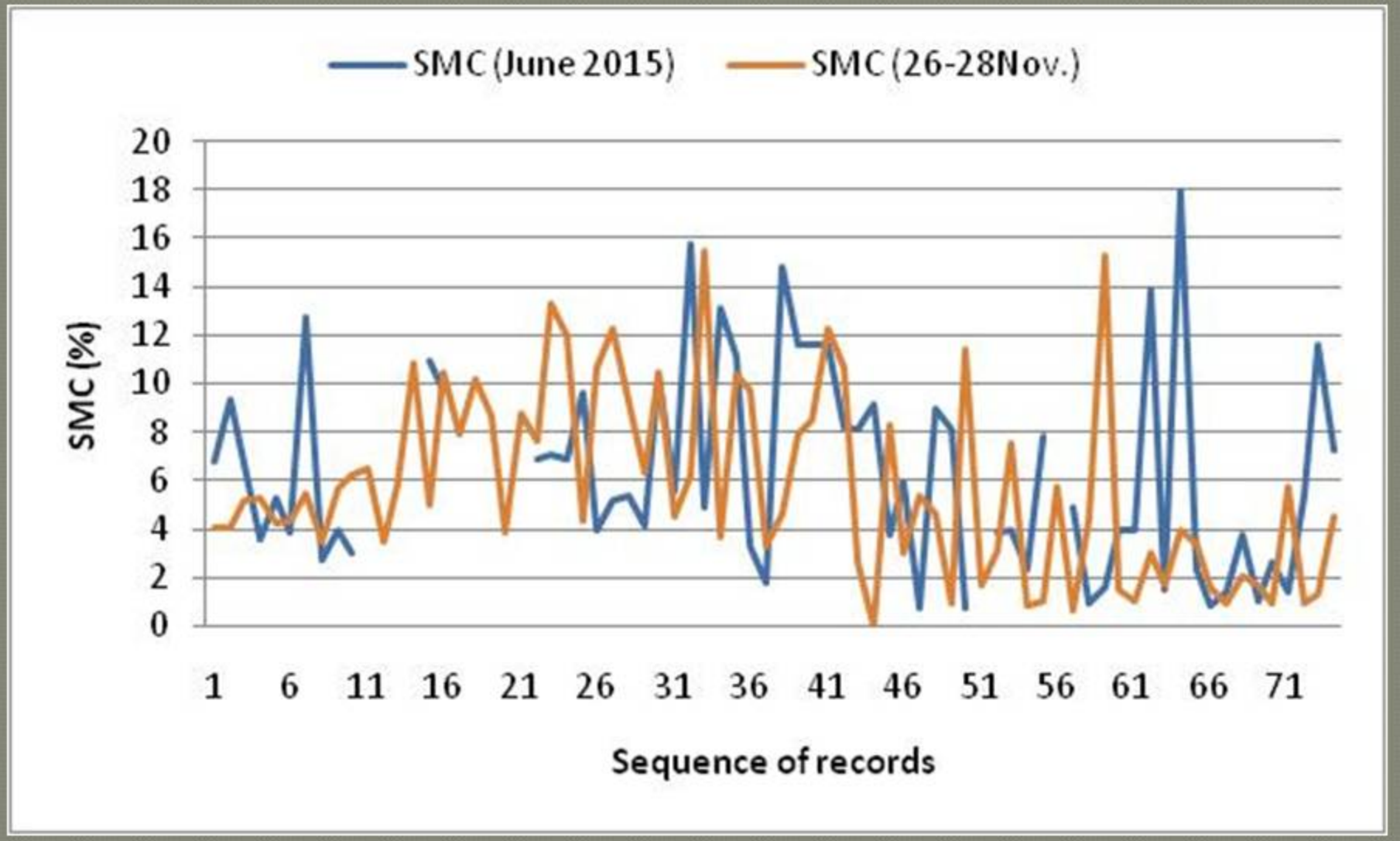
Mesga 16 – Hadalya Block

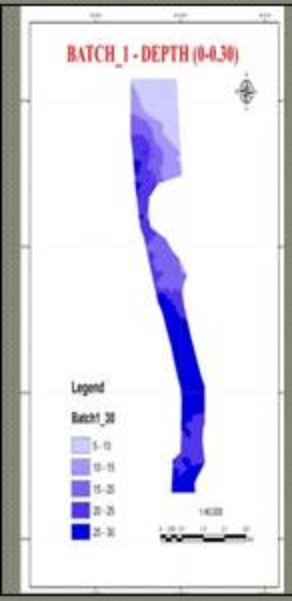


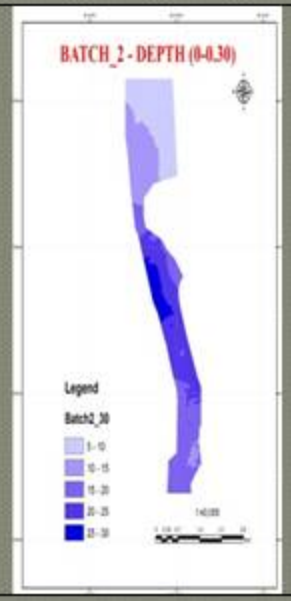
Total flow ~ 1.29 Mm^3

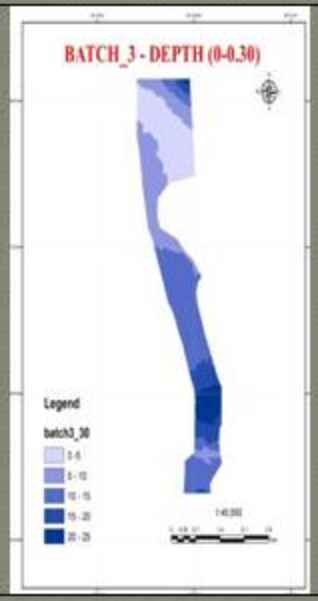
III. Determination of SMC

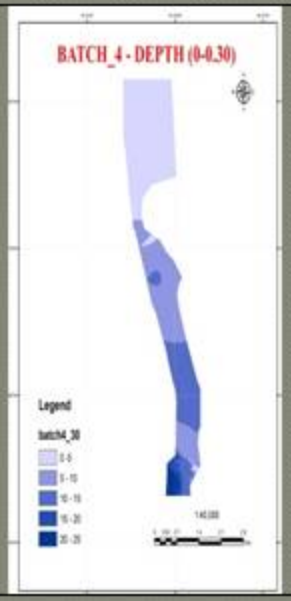


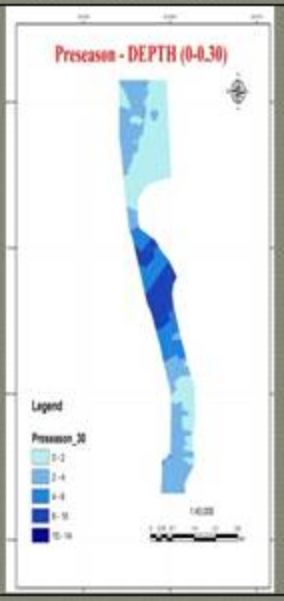

SMC (June 2015)
SMC (26-28Nov.)
SMC (%)
20
18
16
14
12
10
8
6
4
2
0
1
6
11
16
21
26
31
36
41
46
51
56
61
66
71
Sequence of records

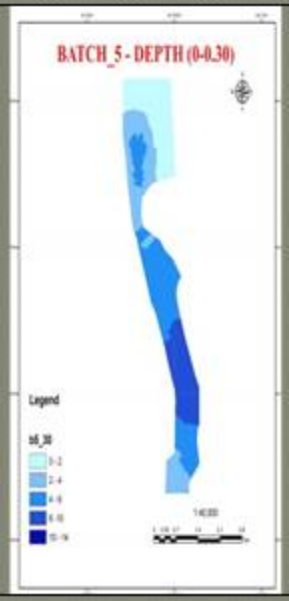

BATCH_1 - DEPTH (0-0.30)
Legend
Batch1_30
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30

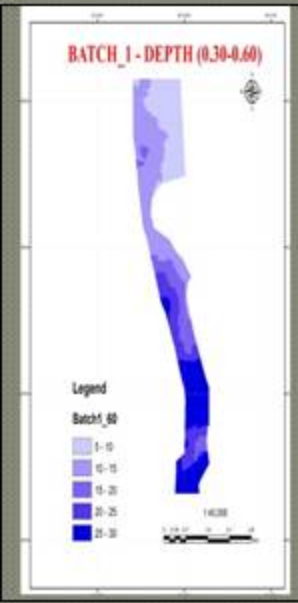

BATCH_2 - DEPTH (0-0.30)
Legend
Batch2_30
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30

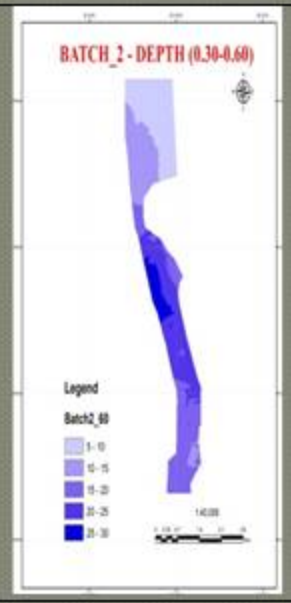

BATCH_3 - DEPTH (0-0.30)
Legend
batch3_30
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25

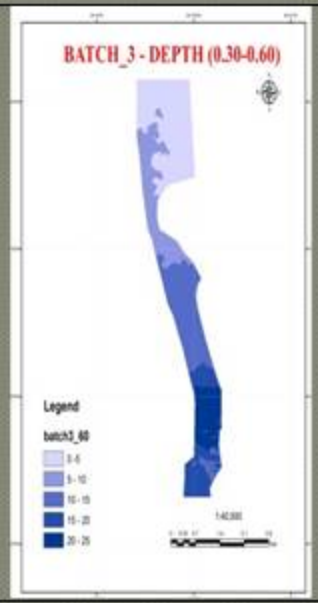

BATCH_4 - DEPTH (0-0.30)
Legend
batch4_30
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25

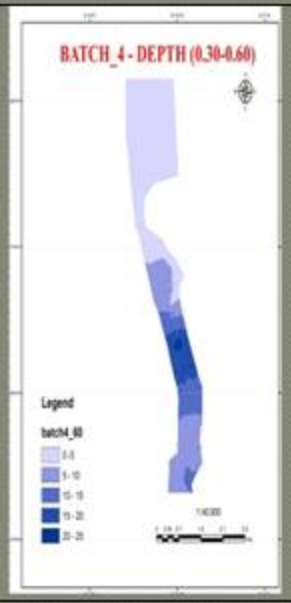

Preseason - DEPTH (0-0.30)
Legend
Preseason_30
0 - 2
2 - 4
4 - 6
6 - 10
10 - 14

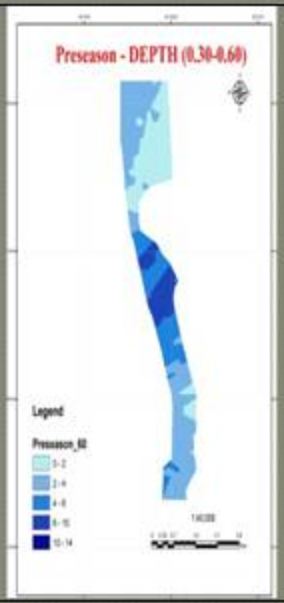

BATCH_5 - DEPTH (0-0.30)
Legend
b5_30
0 - 2
2 - 4
4 - 6
6 - 10
10 - 14

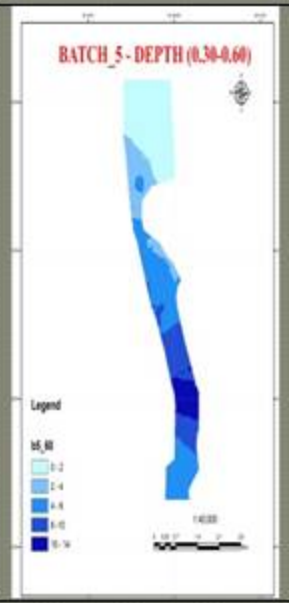

BATCH_1 - DEPTH (0.30-0.60)
Legend
Batch1_60
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30

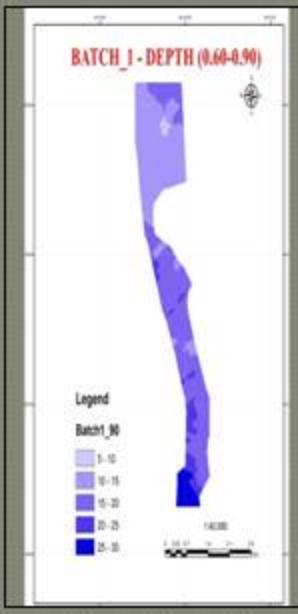

BATCH_2 - DEPTH (0.30-0.60)
Legend
Batch2_60
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30

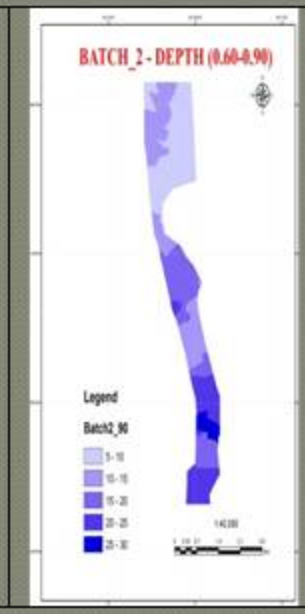

BATCH_3 - DEPTH (0.30-0.60)
Legend
batch3_60
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25

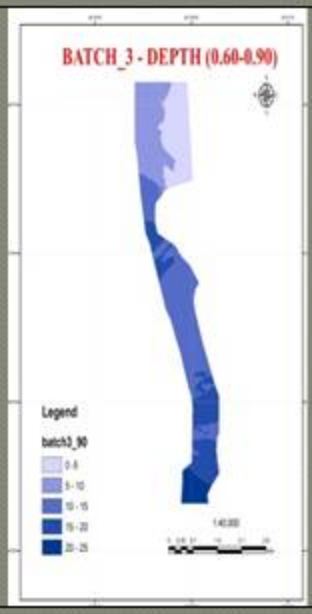

BATCH_4 - DEPTH (0.30-0.60)
Legend
batch4_60
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25

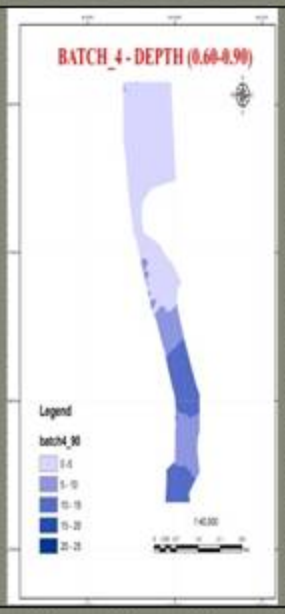

Preseason - DEPTH (0.30-0.60)
Legend
Preseason_60
0 - 2
2 - 4
4 - 6
6 - 10
10 - 14

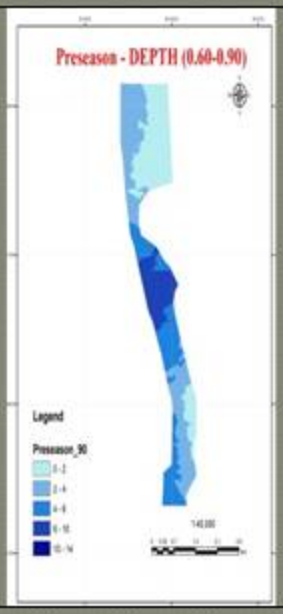

BATCH_5 - DEPTH (0.30-0.60)
Legend
b5_60
0 - 2
2 - 4
4 - 6
6 - 10
10 - 14

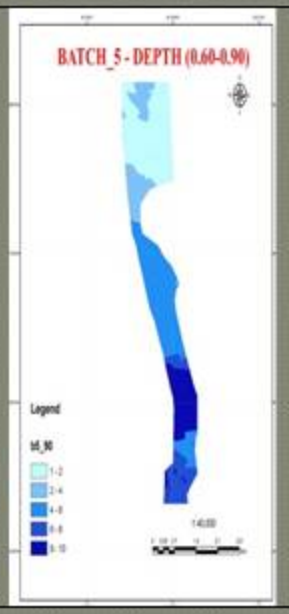

BATCH_1 - DEPTH (0.60-0.90)
Legend
Batch1_90
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30

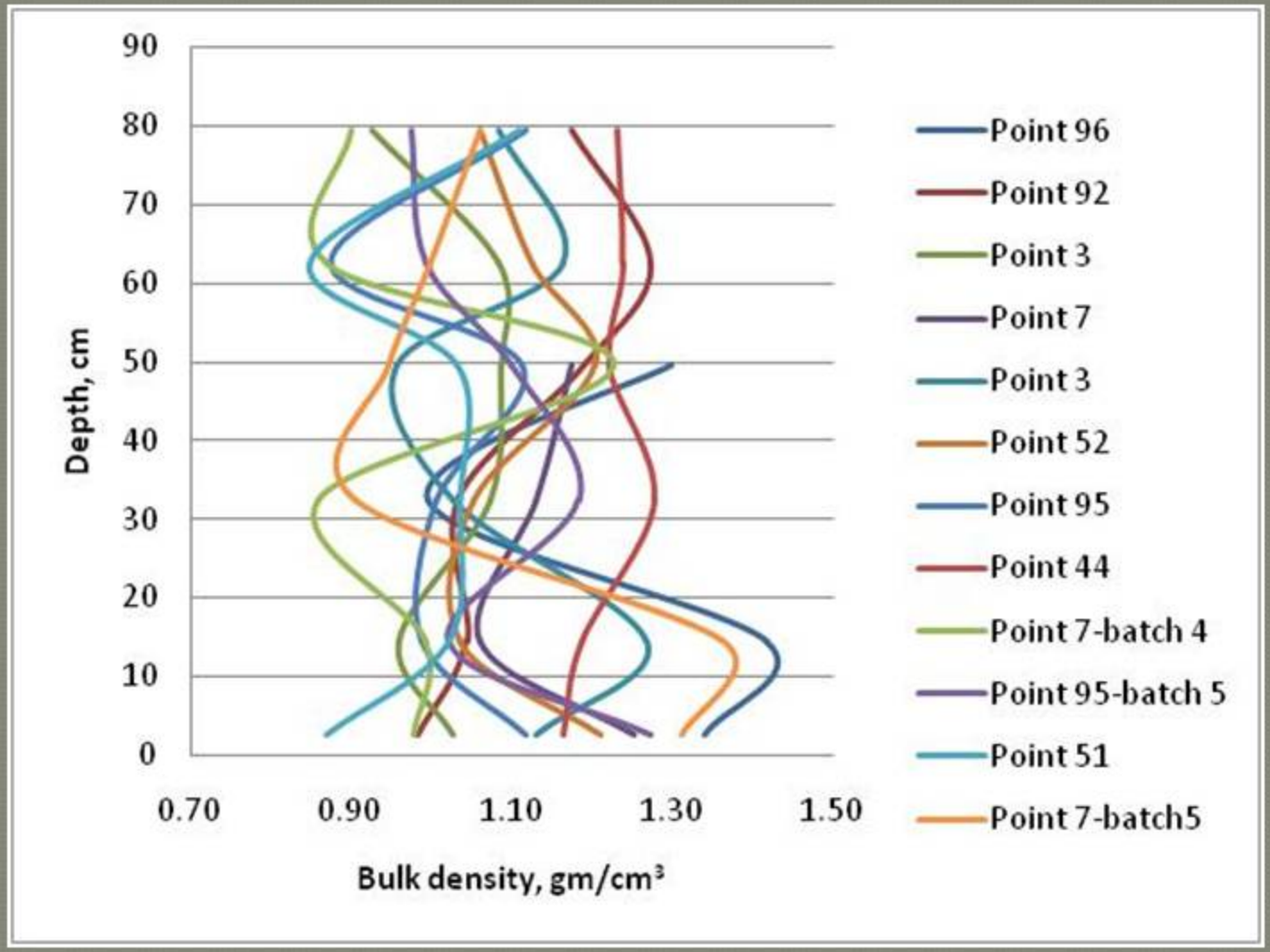

BATCH_2 - DEPTH (0.60-0.90)
Legend
Batch2_90
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30


BATCH_3 - DEPTH (0.60-0.90)
Legend
batch3_90
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25

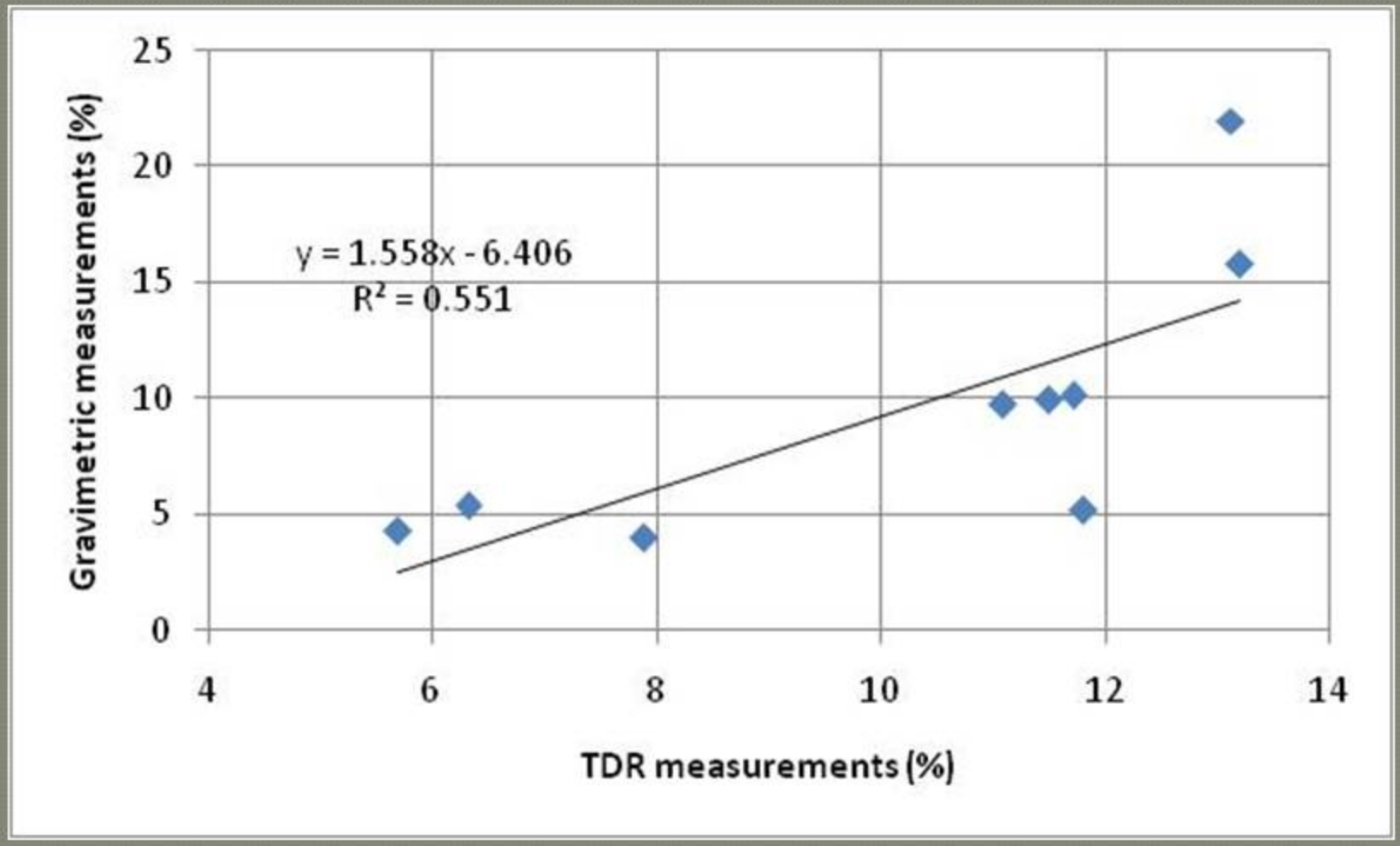

BATCH_4 - DEPTH (0.60-0.90)
Legend
batch4_90
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25


Preseason - DEPTH (0.60-0.90)
Legend
Preseason_90
0 - 2
2 - 4
4 - 6
6 - 10
10 - 14


BATCH_5 - DEPTH (0.60-0.90)
Legend
b5_90
1 - 2
2 - 4
4 - 6
6 - 8
8 - 10



$\rho \sim 1.1\ g/cm^3$


Gravimetric measurements (%)
25
20
15
10
5
0
y = 1.558x - 6.406
R² = 0.551
4
6
8
10
12
14
TDR measurements (%)

Constraints/obstacles

Con.

The Way Forward

Using WinSRFR:

- Event Analyses
  - Evaluation of previous irrigation performance
  - Calculation of field/crop parameters
- Physical design
  - Optimization of field length and/or width
- Operations analyses
  - Optimization of inflow
- Simulation
  - What if? Different Scenarios (computer)


THANK YOU