# Consolidated Report on water productivity exercise being undertaken by SMIS Regional Project Management Unit (RPMU)

By: Aschalew Demie

Oct 2019

Addis Ababa, Ethiopia

Agriteam Canada Consulting Ltd.

In association with

# Contents

# 1 Descriptions

In physical terms, Water productivity is the amount of crop produced per unit volume of water utilized/ supplied (kg/m3). In economic/ financial terms, the water productivity can be expressed in terms of income/revenue generated per unit volume of water (Birr/m3). The water productivity presented here is limited to direct output of irrigated crops versus water supplied (irrigation & rainfall).

On SMIS practical demonstration, the measurement was conducted for vegetables crops deploying surface irrigation. Parshall flume was used for flow measurement and weighing balance to know the weight of the crops immediately after production. Based on the finding, water productivity output is calculated and presented in physical terms.

Common vegetables like cabbage, onion, potato and tomato were considered in water productivity measurement. The measurements were conducted at four regions (Amhara, Oromia, SNNP and Tigray) on SMIS pilot sites.

*Table 1- Activities accomplished by each regional SMIS*

| **S.N.** | **Activities** | **RPMU ( mark (x) under each for conducted activity or fill as requested** | | | |
|---|---|---|---|---|---|
| | | Amhara | Oromia | SNNP | TIGRAY |
| 1 | Water productivity measurement (Kg/m3) | x | x | x | x |
| 2 | Water productivity measurement (Birr/m3) | - | - | x | - |
| 3 | Consideration of rain in WP measurements | - | X | - | X |
| 4 | Canal efficiency measurements | x | - | - | x |
| 5 | Crops in type/variety, number | 1/NA | 5/5 | 3/3 | 4/7 |
| 6 | Consideration of post-harvest loss | - | x | - | - |
| 7 | Number of trial site | 1 | 1 | 1 | 2 |
| 8 | Number of trial plots | 1 | 12 | 5 | 24 |
| 9 | Soil laboratory analysis | - | - | x | - |

# 2 Rationale

Though the importance of water is known in crop production, the productivity of crops was expressed in terms of the land coverage (production/ ha) due to absence of water measurement for each crops. Water was not quantified and its real value was not known. Considering the situation in crop

production, water can be regarded as a scarce and highly valuable resources, hence need to measure and know how sensitive the water amount in irrigation. As a country, there is also a need to set a base line in this regard by measuring the water utilized for different irrigation crops.

This measurement along with its procedure gives standard working method in this regard and also provide productivity output as a baseline for next measurement. This can be scaled up by irrigators and help them know the water volume required for each crops at different crop development stage and as a total, the total amount of water required for certain amount of production. Hence, it is possible to know the productivity of flow in the river, springs & wells discharges, and storage structures. It gives also good information for irrigation water management for different crops. In economic terms, the income generated per m3 of water for each crops will be known and give clue for investment decision.

# 3 Implementation and output

The water productivity measurement was implemented by technical and material support of SMIS on the existing irrigation projects with full participation of beneficiaries, DA and concerned woreda experts. There was also zonal and regional involvement to execute the task.

## 3.1 Implementation procedure

Steps of the water productivity measurements are as follow:

1. Training on implementation planning and conducting JES for each activity listed below
2. Agricultural development Plan
3. Selecting irrigation site
4. Taking soil sample and conducting laboratory analysis
5. Crop selection
6. Selecting Climate station for crop wat calculation
7. Crop water requirement calculation at different stages
8. Land preparation, levelling and furrow layout
9. Seedling development and management
10. Transplanting the seedling and crop management
11. Irrigation scheduling
12. Schedule for fertilizer application, weed control and IPM
13. Installing par shall flume near to the field canal
14. Recording flow depth and irrigation time during each irrigation
15. Calculating the flow volume for each stage
16. Sum-up the total volume of water for one cropping season.
17. Weighing the harvesting crops (sample)
18. Divide the crops weight by water volume, it will give water productivity (kg/m3).
19. If the sales value of the produced crop is known, water productivity (Birr/m3)

## 3.2 Personnel requirements

To conduct the water productivity well trained personnel is required, to plan as per the list under 3.1 , for crop management, for input management, for IPM, for taking flow and harvested crop

measurements. Hence Labour for routine farm activities, skilled labour with crop, input, IPM and flow measurements knowledge and practice.

## 3.3 Data, Material and Equipment

When irrigable land and water is available, for successful implementation: Data, material and equipment like, climate data, soil physical and chemical properties, cropwat software, PC, direct soil moisture measuring equipment, inputs (seed, fertilizer, pest and weed chemicals), gauged parshall flume with known throat width and formula, mm gauged ruler, watch and weighing balance are required.

## 3.4 Water productivity out put

Water productivity measurements were exercised for last three years by Oromia SMIS, while it is conducted only this year (2018/19) in the rest of SMIS regional offices. The demonstration work will give practical way to execute similar task for the irrigation sector and the output can also be used as a baseline for the next study. Table 1: below show detail of water conductivity measurement taken for year 2018/19 by SMIS regional offices.

*Table 2-Water productivity output with site information for year 2018/19*

| Regions | Woreda | Crop | Crop variety | Site Name | Soil type | Altitude (m) | Avg. Temperature ($^{o}$c) | Average Yearly rainfall (mm) | Avg. Water productivity, irr +rain (kg/m3) | Avg. Water productivity, irr only (kg/m3) |
|---|---|---|---|---|---|---|---|---|---|---|
| Amhara | | onion | | Leza | | | | | | 4.39 |
| Oromia | Gechi | Head cabbage | Copenhagen | Doma | | 2011 | 19 | 2000 | 11 | 14.6 |
| | | Tomato | Roma PF | | | | | | 9 | 13 |
| | | Beet Root | Detroit dark red | | | | | | 9.5 | 13.5 |
| | | Onion | Red crown | | | | | | 6 | 8 |
| | | Pepper | Local | | | | | | 1.2 | 2.8 |
| SNNP | Shebedeno | potato | Durame | wamole | Sandy-loam | 1822 | 28 | 1277 | | 2.2 |
| | | cabbage | Euro | | Clay loam | 1822-30 | 22 | 1277 | | 10.5 |
| | | tomato | Gelila | | Clay loam | 1836 | 26 | 1277 | | 4.6 |
| Tigray | Enda mekoni | Onion | Russet | Gebrhigaza | | 2500 | | | 17.3 | 26.07 |
| | | onion | R/king | | | | | | 13.02 | 30 |
| | | onion | R/creole | | | | | | 10.8 | 12.5 |
| | | Maize | Melkasa2 | | | | | | 2.28 | 3.6 |
| | Ofla | wheat | wane | Adi asela | | 2450 | | | 3.02 | 6.9 |
| | | wheat | kingbird | | | | | | 1.68 | 3.8 |
| | | Head cabbage | Copenhagen | | | | | | 16.12 | 26 |

Analysis

**AMHARA REGION**

Full irrigation

- Water productivity= $\frac{Production}{irrigation\ water}$ = kg/m3
    - This is irrigation water productivity

**OROMIA**

Full irrigation

- Water productivity= $\frac{Production}{irrigation\ water}$ = kg/m3 and
    - This is irrigation water productivity
    - Water productivity= $\frac{Production}{irrigation\ water+rain}$ = kg/m3
    - This is water productivity for total water applied.

**SNNP**

Full irrigation

Water productivity= $\frac{Production}{irrigation\ water}$ = kg/m3 and

This is irrigation water productivity

Water productivity= $\frac{Production\ sale\ value}{irrigation\ water}$ = Birr/m3 (gives monetary value of water)

**Tigray**

Supplementary irrigation

- Water productivity= $\frac{Production}{irrigation\ water}$ = kg/m3
    - This is irrigation water productivity
- Water productivity= $\frac{Production}{Actual\ evaporation}$ = kg/m3
    - Highest yield, since it doesn't account loss and rain
- Water productivity= $\frac{Production}{Actual\ evaporation+rain}$ = kg/m3
    - Comparatively Low yield, because it includes rain

- The output of each crop indicates different values. It is not possible to compare one result with other due to different varieties in some crops and different environmental conditions in similar varieties. But it might help to choose the productive variety, provided that the nutritional and market value is the same.

# 4 Challenges

During this practical exercise, the encountered challenges are: Some farmers are using local variety while some are using improved varieties and this leads to productivity differences for the same crop. Lack of skilled and committed experts; and lack of standard water productivity references to compare and contrast the result. Lack of precaution in furrow flow release and cut which leads to over /under irrigation. And for actual irrigation water application there is no device to measure soil moisture stress directly, so the scheduling is theoretical which is based on the crop wat calculation by using climatic variables, this affect productivity of crops.

# 5 Sustainability and Institutionalization

## 5.1 Human resource

Since this water productivity measurement is new practices, it requires trained multi dispensary and committed professionals for data collection, measurement and interpretation. So, Commitment of officials are also required to assign reliable experts and logistics and keep eye on watching the result.

## 5.2 Logistics

To conduct the productivity measurements, the logistic has to be in place in required quantity, quality and timely. So, it is necessary to plan logistic procurement/ maintenance ahead of time. The require basic logistics are flow measuring Parshal-flume, meters, balance, quadrats, computer are important for the measurement of discharge and crop yield. Vehicles and motor bike are also important for close supervision and data recording of the activities. In addition to this soil laboratory, Cropwat software and meteorological data are also required.

## 5.3 Planning, Monitoring and Evaluation

Irrigation water productivity measurement should be planned ahead. The planning should include Human resource allocation, Logistic arrangement, site selection, input provision, training, and implementation schedule. Monitoring of irrigation scheduling, rainfall, maturity and other activities need closely. Finally, evaluation of the result with others standard reference results are important.

## 5.4 Gender

On this water productivity measurement, it is important to considered gender issues starting from site selection. The site has to be as much as possible near to the farmer's residence and crop selected has to be useable by family consumption and/or sold to nearby market. The flow measuring time has to consider favorable time in terms of weather and other household and farm activities. The measuring site has to be easily accessible having the required social infrastructure. Finally, women should involve in result interpretation and benefit sharing.

## 6 Risk

Farmers' resistance not to exercise water productivity on his filed, lack of official commitment on supporting this activity, lack of experts' commitment on continuous measurement and recording. Trained expert turnover.

## 7 Recommendations

Need to develop standard WP implementation manual, hence common working modality for conducting water productivity exercise will be set for conducting water productivity assessment for SSI scheme.

As a new intervention area, there is a need for provision of further on - job training for responsible PI experts who would be conducting water productivity data measurement and analysis to improve knowledge and the skills on water productivity assessment.