ONLINE IRRIGATION BENCHMARKING SERVICES (OIBS)

User guide (Draft)

IWMI
International Water Management Institute

CGIAR
RESEARCH PROGRAM ON Water, Land and Ecosystems

Online Irrigation Benchmarking Services Version 3

User Guide

Contents

1 Introduction

Irrigation benchmarking is a process of comparative analysis of the performance that allows scheme managers to understand the service delivery, agricultural, financial, and environmental and gender aspects of their system's performance over time and in relation to other similar irrigation systems. Online Irrigation Benchmarking Services (OIBS) is a publically accessible online tool (http://oibsv3.iwmi.org/) that facilitates data storage and performance comparisons within and across irrigation systems.

OIBS is a useful tool for system managers to enter data and compare performance of their systems over time and those with other similar systems. The irrigation agency officials or policy makers can monitor performance of a group of systems under their managerial purview and compare performance with other similar systems. The OIBS reduces the considerable time and effort required to compile information from data available in hardcopies to assess performance of irrigation systems of previous years. It also facilitates communication with irrigation management of systems high performance to assess their best practices.

2 OIBS components

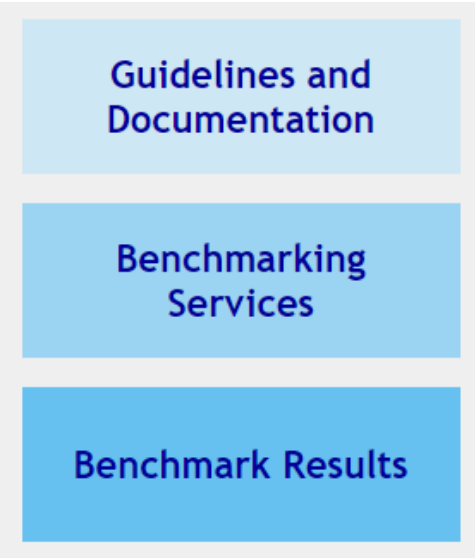
This section provides a brief introduction to the services that OIBS version 3 (http://oibsv3.iwmi.org/) provides to the user.

The OIBS has three main services:

- *Benchmarking guidelines and documentation*
- *Benchmarking services, and*
- *Benchmark results*

Users can start with any of the services available with OIBS.

Figure 1. Description of OIBS services



Guidelines and Documentations of benchmarking provides information of BM guidelines for irrigation systems prepared by the World Bank, IFTRID, IWMI, ICID and the FAO (Malano and Burton 2001). These guidelines were the basis for OIBS development. It also has BM related research and other published documents.

Benchmarking services is mainly useful for irrigation mangers/users to enter data and conduct BM analysis -- comparison of system performance over time or with across systems. The access to this component requires to register first, and use a login name or password.

Benchmark Results is useful for any user to have quick comparison of indicators over years or across systems with similar characteristics. It does not require registration.

Figure 2. Services of OIBS

OIBSv3 has imposed restrictions on confidentiality and integrity of names and primary data entered for irrigation systems. Only the registered users, who entered data using "Benchmarking Services" know the names and have access to data of the system they entered data. However, any user can compare BM indicators over time and across systems. The entered data are stored in Central Data Processing Unit (CPDU) in International Water Management Headquarters (CDPU@cgiar.org). IWMI maintains the integrity of data and information of irrigation systems within and outside its boundaries. The CDPU facilitate to establish a link with the irrigation managers of a particular system for which any user wants further information. Thereafter, users can communicate with managers of a particular irrigation system where they need more information about the BM indicators, or data or interventions.

2.1 Benchmarking Services

This section provides information for accessing OIBS components in **"Benchmarking services"**

Users first require to register to use **"Benchmarking services"**. Click on "Benchmark Services" in Figure 2 to go to login page. New users click to "**Click here to Sign Up"** in the bottom right-hand corner (Figure 3) and fill the details required in the form (Figure 4) that appear next with a username (maximum of 20 characters) and a password (maximum of 15 characters).

Figure 3. Login page for BM services

The information entered in the form in Figure 4 are stored in the OIBS central database. The Central Data Processing Unit (CPDU) will use the email/telephone/fax to communicate when required with the users. CPDU will maintain the confidentiality of users' information, and will not disclose without their consent. Therefore, please make sure to include an email address and telephone number that CPDU can easily access for any request from other users. Figure 4. OIBS Registration form for users

The registered users can compare the BM results systems over time and with other systems for which the users or partner organizations have entered data for irrigation systems in different regions, countries, agro regions or water sources. It shows a summary of registered systems with data available online for comparisons. Click on "**Login verified-Proceed"** at the bottom of the page (Figure 5) to compare performance across irrigation systems. Unregistered users click "**Benchmark Results"** on the Figure 2 to carry out performance comparisons as explained in the next section.

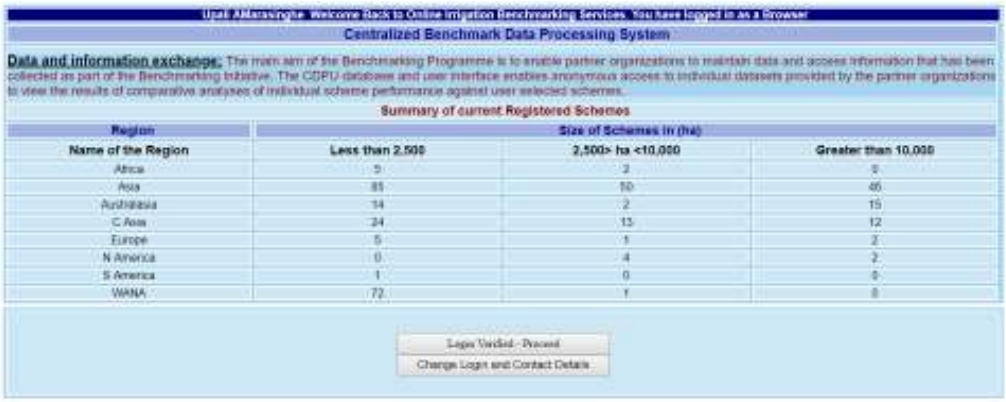


Figure 5. Summary information of irrigation systems available in OIBS.

2.2 Benchmarking Results

Any user can access ***"Benchmarking Results"*** and requires no registration. ***"Benchmarking Results"*** in Figure 2 provides information for selecting comparators for benchmarking (Figure 6).

Users can select all systems or those by region or country, and further by agro-ecological region or water source to start comparison of BM indicators. Click **"Submit"** (Figure 6) after selecting the desired level of comparison.

Figure 6. Selection of systems for BM comparisons

It will then display a page with all BM indicators available in the OIBS. The indicators are available in five groups:

- Service Delivery (Figure 7A, Table 1A)
- Agricultural performance (Figure 7B)
- Financial performance (Figure 7C)
- Environmental performance (Figure 7D)
- Gender Performance (Figure 7E).

Users can select a single, or multiple indicators for performance comparison. For detailed information on the definition for each indicator please click the question mark.

Figure 7A. Performance indicators in OIBS

Table 1A. The definitions of service delivery indicators

Indicators	Description
Total Annual Water Delivery (MCM)	Total volume of surface diversions[1] into the scheme and net groundwater abstraction[1] for irrigation, plus total rainfall, excluding any recirculating internal drainage within the scheme.
Main system water delivery efficiency	$\frac{\text{Total annual volume of irrigation water delivery}^{2}}{\text{Total annual volume of irrigation water supply}^{3}}$
Relative water supply	$\frac{\text{Total annual volume of water supply}^{3}}{\text{Total annual volume of crop water demand}^{4}}$
Relative irrigation supply	$\frac{\text{Total annual volume of irrigation water delivery}^{2}}{\text{Total annual volume of crop irrigation demand}^{5}}$
Water Delivery capacity	$\frac{\text{Canal caapcity to deliver water at system head}^{6}}{\text{Peak irrigation water demand}^{7}}$
System water rights (MCM)	The bulk volume or bulk discharge of water to which the scheme is entitled per annum
Security of water supply (%)	Probability of meeting water entitlement[8]

Notes:

1- Surface diversions are measured at the diversion point and groundwater abstractions are measured at the point of delivery of groundwater or river pumps

2- Total volume of irrigation water delivery is the total volume of water delivered to *water users* over the *irrigation/agriculture year*. Agriculture year is the 12-month period that begins at the start of a cropping season. If there is more than one cropping season per year in the system, the beginning of year should closely align as possible with the beginning of the financial year. Water users in this context describe the recipients of irrigation services. They may include single irrigators or groups of irrigators organized into water user groups

3- Total annual volume of irrigation supply is the total annual volume of water diverted or pumped for irrigation (not including diversion of internal drainage)

4- Total annual volume of water used by the crop to meet evapotranspiration demand. For rice, percolation losses must be included.

5- The annual volume of irrigation water required by the crop less effective rainfall. For paddy rice percolation losses must be included

6- Actual discharge capacity of main canal at diversion point.

7- The peak crop irrigation water requirement for a monthly period expressed as a flow rate at the head of the system

8- Frequency at which irrigation agency can meet system water rights

Figure 7B. Agricultural performance indicators in OIBS

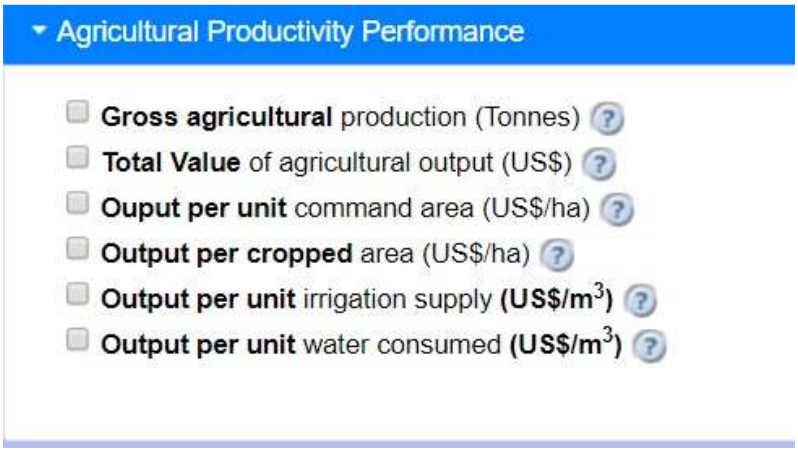


Table 7B. Agricultural performance indicators

Indicators	Description
Total value of agricultural output (USD)	Total annual value of agricultural production received by producers.
Output per unit command area (USD/ha)	$\frac{Total\ Annual\ value\ of\ agricultural\ production}{Total\ command\ area\ of\ the\ system}$
Output per unit cropped area (USD/ha)	$\frac{Total\ Annual\ value\ of\ agricultural\ production}{Total\ cropped\ area\ of\ the\ system}$
Output per unit irrigation supply (USD/m3)	$\frac{Total\ Annual\ value\ of\ agricultural\ production}{Total\ cirrigation\ supply}$
Output per unit water consumed (USD/m3)	$\frac{Total\ Annual\ value\ of\ agricultural\ production}{Total\ volume\ of\ water\ consumed^{1}}$

Notes:

1- Total volume of water consumed by the crop to meet evapotranspiration demand. For rice crops, this includes deep percolation losses. The total volume of water consumed is the total evapotranspiration from the crop area. For rice crop, deep percolation demand should be included

Figure 7C. Financial performance indicators in OIBS

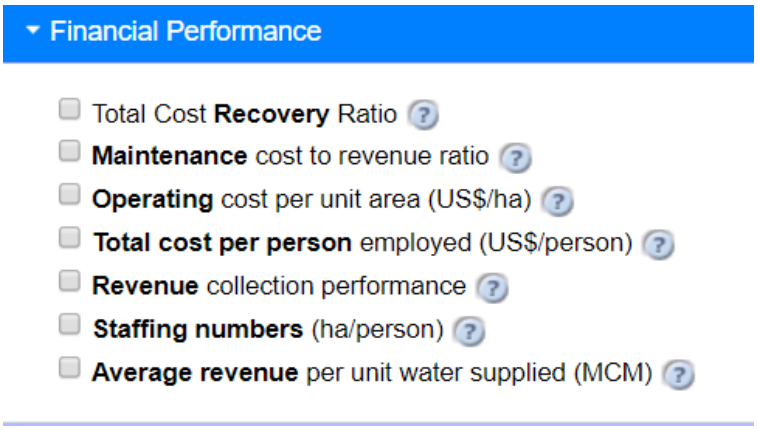


Table 1C. Financial performance indicators

Indicators	Description
Cost recovery ratio	$\frac{Gross\ revenue\ collected^{1}}{Total\ MOM\ cost^{2}}$
Maintenance cost to revenue ratio	$\frac{Total\ cost\ maintenence\ of\ the\ system}{Gross\ revenue\ collected}$
Operating cost per unit area (USD/ha)	$\frac{TCost\ of\ operation\ of\ the\ system}{Total\ command\ area}$
Total cost per person employed (USD/person)	$\frac{Total\ Annual\ value\ of\ agricultural\ production}{Total\ cirrigation\ supply}$

Revenue collection performance	$\frac{Gross\ revenue\ collected}{Gross\ revenue\ assessed^{3}}$
Staffing numbers (ha/person)	$\frac{Total\ number\ of\ personnel\ engaged\ in\ I\&D\ service}{Total\ annual\ irrigated\ area\ service\ by\ the\ system}$
Average revenue per unit water supplied (USD/mcm)	$\frac{Gross\ revenue\ collected}{Total\ annual\ volume\ of\ irrigation\ supply}$

Notes:

1- Total revenues collected from payment of services by water users.
2- Total MOM (management, operation and maintenance) cost of providing the irrigation and drainage service excluding capital expenditure and depreciation/renewals
3- Gross revenue assessed is the total revenue due for collection from water users for provision of irrigation and drainage services.

Figure 7D. Environmental performance indicators

Table 1D. Environmental performance indicators

Indicators	Description
Irrigation & drainage salinity (EC)	Salinity (electrical conductivity) of the irrigation supply and drainage water
I & D BOD (mg/litre)	Biological load of the irrigation supply and drainage water expressed as Biochemical Oxygen Demand (BOD)
Depth to water table	Average annual depth of water table calculated from water table observations over the irrigation area
Water table depth change over time	Change in water table depth over the last five years.
Salt balance	Differences in the volume of incoming salt and outgoing salt

Figure 7E. Gender performance indicators

Table 1E: Gender performance indicators

Indicators	Description
% of women farmers in the system	$\frac{Total\ numbe\ of\ women\ farmers}{Total\ number\ of\ farmers}$
% of women farmers involved in O & M activities	$\frac{Total\ number\ of\ women\ farmers\ involved\ in\ O\ \&\ M}{Total\ number\ of\ women\ farmers}$
% of women farmers attended seasonal planning meeting	$\frac{Total\ number\ of\ women\ farmers\ attened\ seasonal\ planning\ r}{Total\ number\ of\ women\ farmers}$
% of women managing WUAs	$\frac{Total\ number\ of\ women\ manging\ WUAs}{Total\ number\ WUAs}$
% of women farmers in system management	$\frac{Total\ number\ of\ women\ manging\ theirrigation\ system}{Total\ number\ in\ the\ management}$

2.3. Comparison of indicators

After the selection of indicators, values of BM indicators across systems can be obtained in graphical or tabular form, or uploaded into Excel by selecting appropriate buttons in the performance indicators page. Figure 8A show the comparison of time of relative water supply (RWS) in an irrigation scheme; Figure 8B shows comparison across systems

Figure 8A. Relative water supply of an irrigation system over time

Figure 8A shows the comparison of RWS of the selected year (red) with other years (blue) in decreasing order. Value "0" shows that water supply was not available (or the crop water demand was not available for the particular year.

Table 2A. Relative water supply of an irrigation system over time

Scheme Number	Country	Scheme Name	Year	Relative Water supply
531	India	Sina	2016	0
531	India	Sina	2011	5.75
531	India	Sina	2012	4.2013
531	India	Sina	2013	0
531	India	Sina	2014	2.4118
531	India	Sina	2015	5.6824
531	India	Sina	2010	6.1827
531	India	Sina	2017	2.4547
531	India	Sina	2019	0

Users can create maps with different ordering of years by downloading the data into excel (Table 2)

Irrigation system name will only appear if comparing his/her own system, or is registered and have access permission to information of the particular system.

Figure 8B, Total cost recovery across systems.

Figure 8B shows comparison across systems. It compares the indicator "total cost recovery ratio" of the selected system (red) with the same system in other years (blue) and other systems in different years (green).

Click on any bar to show the value. OBIS will then ask the user whether it requires to contact the system/manager with its number. If yes, the Central data Processing unit (CPDU) will facilitate the communication after receiving the consent of a particular system manager The indicator values can be uploaded into excel for further analysis.

Table 2B. Total cost recovery across systems in tabular form

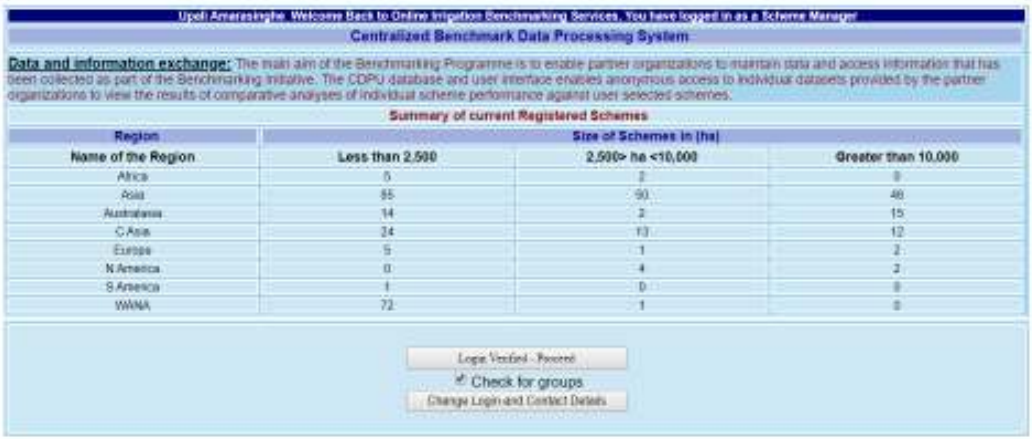
Scheme Number	Country	Year	Total Cost Recovery Ratio
543	**India**	2005	0.0154
543	India	2006	0.0227
543	India	2007	0.0206
543	India	2008	0
543	India	2009	0.2182
543	India	2010	0.0326
543	India	2011	0.161
545	**India**	2005	0.0696
545	India	2006	0.0466
545	India	2007	0.1197
545	India	2008	0.1189

The system identifier is shown in the first columns. System names will not appear unless the user has permission to access information.

If requires, users can communicate CPDU to facilitate communication with other systems/mangers.

3 Data entry

Only registered users can enter data into the OIBS though "**Benchmarking Services".** An irrigation manger after registering with OIBS can request permission from the CPDU for entering data for an individual system. An administrator, such as a senior irrigation engineer, irrigation agency official or policy maker, in charge of several systems, can request system managers to enter data for their systems. Next, the senior management/policy makers, after registering with the OIBS, can request the CPDU the access permission to the view performance of the systems in the group under their managerial purview. When senior managers click on "**Benchmark Services"** will provide the information sheet of systems in OIBS (Figure 9) In this sheet, they can have access to detail information of the systems in the group by clicking **"Check for groups"**, and "**login verified-proceed"** at the bottom of Figure 9. Simultaneously, the senior management can provide the same login information to their system managers to access information of systems within the selected groups. This could be useful for system managers to compare performance across similar systems in the same locality.



An individual manager/user can only view the indicators, but can access information for another system/group of systems only if they have access to enter or edit data and BM analysis. The CPDU can facilitate communication to access details of indicators and their data with any other systems for which OIBS has information. By clicking "Login verified- Proceed" will take the user to Irrigation System Benchmarking sheet (Figure 10)

Figure 10. Data entry/edit/analysis sheet for a new system/old system or group of systems

3.1 Adding/editing system description

The data entry/edit/analysis sheet (Figure10) can initiate multiple tasks:

- Add a new system description, or edit an existing description
- Add or edit the data of irrigation systems, or
- Run the "Benchmark Analysis"

Users have the discretion to start with any tasks they prefer. The manual has already described the scope of actions in the "Benchmark Analysis". We describe here two other tasks.

1. Entering system description
2. Entering time series data for estimating indicators

The system description are static information. Several data entry sheets will capture the system description (Figure 10- Figure 19). Some data entry boxes have built-in dropdowns. Users choose the most appropriate/predominant option that describes their systems.

Figure 11. Location details Figure 13. Institutional details Figure 15. Water resources and availability Figure 17. Size Figure 19. Infrastructure for drainage	Figure 12. Climate and soil Figure 14. Socio-economic details Figure 16. Allocation and distribution methods Figure 18. Infrastructure for irrigation Figure 20. Cropping pattern (designed)
Figure 11. Location details 	Country can be selected from the dropdown box. Geographical data of each scheme needs to be submitted in degree format. Clicking the submit button at the bottom save data in the CDPU. Users can revisit the saved information later to make any changes.
Figure 12. Climate and Soils 	Rainfall and ET data are average annual values. Select the appropriate category closest to your system from dropdown menus. **Soil type:** Choose the predominant soil type for the system (clay, loam, sand, clay-loam, and silty-clay-loam). **Climate**: Humid, Monsoon, Arid, Semi-arid, dry, wet-dry, dry-dry, wet-wet
Figure 13. Institutional details 	**Agency function**: water resources management, reservoir management, flood control, domestic water supply, fisheries or unknown); **Revenue collection:** Charge per crop type/area, charge per irrigation, tax on irrigated area, charge per volume; **Land ownership:** Private, leased, government, unknown; **Type of management:** Government agency; private; government/local; WUAs

Figure 14. Socio-economic details

Pricing source: Government controlled, local market or international markets.
Farming system: subsistence, cash crops, mixed cropping; unknown
Marketing: Local markets; private traders; national/regional markets; Government marketing boards; unknown.

Figure 15. Water source and availability

Specify the seasons for your system, which can be different between and within countries. For example, In India Khraif (mainly from June to September) and Rabi (November to March) are the main seasons. Hot weather or summer season is from March to June.
Water availability: Abundant, sufficient, water scarce; unknown.
Water source: Storage, run of river diversion, groundwater, surface and groundwater etc.

Figure 16. Water allocation and distribution

Type of water distribution: Supply oriented, On demand, Arranged demand
Frequency of irrigation..: On demand; daily; weekly, bi-weekly; monthly; seasonally
Predominant on farm irrigation practice: Flood, sub-surface, furrow, surface-furrow, drip/trickle; basins, furrow in basin, centre-pivot sprinkler**.**

Figure 17. Size

In this section, enter the average annual data for farm size, irrigated area; and cropping intensity. Differences of duration in different seasons cannot be entered here.

Difference in performance for seasons wit with different duration will be captured in annual performance assessment

Figure 18. Infrastructure irrigation

Method of water diversion: Gravity diversion; groundwater; pump diversion;
Water delivery infrastructure: enter the % of distance under lined canal, unlined canal and pipe distribution.

<table>
<tr>
<td> 
</td>
<td>Type of water control: Gated-manual, gated-automatic-local, gated-automatic-central, fixed proportional, unknown.
Location of water control: main canal, primary and secondary, primary to tertiary
Type of discharge measurements: Calibrated sections; calibrated gates; flow meter, fixed weir or flume,</td>
</tr>
<tr>
<td>Figure 19. Infrastructure drainage
 
</td>
<td>Nature of surface drain: Natural, constructed, none</td>
</tr>
<tr>
<td>Figure 20. Cropping
  </td>
<td>Enter the design/recommended cropping patterns for different seasons. Select crops from the dropdown menu.</td>
</tr>
</table>

3.2 Data entry for BM Indicators

OIBS has separate data entry sheets for estimating the indicators for irrigation Service delivery (Figure 21), financial (Figure 22) and environmental performance (Figure 23), gender performance (Figure 24) and agricultural performance (Figure 25). All except agricultural performance module has annual data entry. The agricultural performance indicators module captures the seasonal cropping patterns and production. However, the indicators of production and productivity will be available only at annual basis.

Figure 21. Irrigation service delivery data 	Click question mark **(?)** in the last column to find information of data in data entry sheets. All data entered in this table are annual values. Estimates of the volume of total annual crop water demand, total annual rainfall, total annual effective rainfall on the cropped area in million cubic meters (MCM) are required before the entry of data into this sheet (see details of crop water demand and effective rainfall estimation at the end of manual).

Figure 22. Financial Performance data entry 	Financial information are annual data for the agricultural/irrigation year defined for the system.

Figure 23. Environmental performance data entry

These are the mean annual data estimated for the agricultural/ irrigation year defined for the system.

Figure 24. Gender performance data entry

These are the annual data estimated for the agricultural/ irrigation year defined for the system.

Agricultural performance indicators are estimated using seasonal crop production data. OIBS allows the user to enter agricultural production data for three seasons. Water use for the cultivated area is the consumptive water used by all crops in the irrigated and is not the water delivered to the irrigated area. The consumptive water use is to be estimated outside the OIBS system. Figure 24. Shows the data entry sheet for season one. Similar sheets are available for seasons two and three.

Figure 25. Crop production data entry for season 1.

The water use for each crop in the final column is the irrigation consumptive water use (crop evapotranspiration) minus effective rainfall on the crop area for the particular year/season to be estimated using equation 1.

$$CWU_{crop\ i} = A_i \times (k_i\ ET - EFFrf) \dots\dots\dots\dots\dots\dots\dots (eq\ 1)$$

Where A_i is the area of the crop and d k_i is the crop coefficient. The details of estimation of crop ET using CROPWAT are available in Smith (1992). The $EffRf_j$ is effective rainfall for season. The OIBS recommends using USDA-Soil Conservation Service model in equation 2. The other methods are available in Smith (1992).

$$EFFRf_i = \begin{cases} RF\left(125 - 0.2 \times RF_j\right)/125 & if\ RF \leq 250\,mm \\ 125 + 0.1 \times RF & if\ RF_j > 250\,mm \end{cases} \dots\dots\dots (eq\ 2)$$

The following example show how to quickly estimate the total CWU (crop ET) and irrigation CWU for a particular crop. This assumes 140 rice crop with four growth periods: initial, development, mid- season, and late-season with 32, 32, 44, and 32 days respectively, and 1.15, 1.10, 1.05 and 0.92 crop coefficients respectively. The columns 2-4 show the monthly ETp, rainfall and effective rainfall in mm/day); columns 5-7 shows the growth periods and respective crop coefficients and number of days in each month; columns 8-10 shows the estimates of monthly Eta (CWU), and effective rainfall and irrigation CWU of different growth periods.

Month	ETp	Rainfall	Effective rainfall	Growth period	Crop coefficient	Number of days	ETa (total CWU)	EFF Rf	Irri CWU
	mm/day	mm/day	mm/day			days	mm	mm	mm
Jun	4.58	3.64	3.00	Initial	1.15	8	42	24	18
July	3.53	3.40	2.83	Initial	1.15	24	97	68	29
July	3.53	3.40	2.83	Development	1.10	7	27	20	7
August	3.41	3.86	3.12	Development	1.10	25	94	78	16
August	3.41	3.86	3.12	Mid season	1.05	6	22	19	3
September	3.46	6.39	4.43	Mid season	1.05	30	109	133	-24
October	3.71	2.36	2.09	Mid season	0.92	8	27	17	11
October	3.71	2.36	2.09	Late season	0.92	23	79	48	31
November	3.54	0.45	0.44	Late season	0.92	9	29	4	25
Total						140	526	410	116

In OBS, the crop water demand assume further requirement of deep percolation requirement (about 2 mm/day).

Reference:

Malano, H. and Burton, M. 2001. Guidelines for Benchmarking performance in the irrigation and drainage sector. Rome, Italy: IPTRID Secretariat Food and Agriculture Organization of the United Nations

Smith, M. 1992. CROPWAT A computer program for irrigation planning and management. Rome: Food and Agriculture Organization of the United Nations.