PODIUMSim- Policy Dialogue Model: Version II

A Water and Food Security Planning Tool

User's Manual

April 2003

International Water Management Institute

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1. Background

The International Water Management Institute, as part of the World Water Vision 2025, has developed PODIUM - the policy dialogue model in 1999. The model, an interactive tool runs on a personal computer. The PODIUM enables the users to develop national level scenarios of water and food supply and demand on various policy options. Though PODIUM was recognized as a useful tool for generating scenarios, some limitations were also identified. The PODIUM beta version was a cereal based model. Expanding the analysis to cover other crop categories was thought to be useful. Inability to capture spatial variations, especially in large countries, was a major limitation. The revised version, named PODIUMSim addresses these limitations. The PODIUM was revised and improved under "Country Policy Support Studies" (CPSP) program of the International Commission for Irrigation and Drainage (www.icid.org). Under the CPSP program the revised model is being applied at the river-basin level for two of the largest countries India and China.

The PODIUMSim, with interface in Microsoft Excel, still runs on a personal computer in an interactive mode. It can generate future scenarios at sub-national level. For example, depending on the type of base line data, it can generate scenarios at river-basins or at administrative boundaries. The aggregated results show the national picture. This manual helps users to understand the basic features of different components of the revised version, the method of navigating from one component to other, developing and saving scenarios, and entering enter required data to the model.

2. Introduction

The PODIUMSim is intended for policy planners, researchers, students and those who are interested in developing water and food supply and demand scenarios under different options of policies or hypothesis. It can explore vital questions such as: Can river basins feed their population in 2025? What is the food surplus or deficit at sub-national level and then at national level? Do we have enough water to irrigate the crops needed to ensure future national food requirements?

The model maps the complex relationships between many factors (drivers in the model) that affect water and food demand and supply and displays output information in graphical and tabular formats. Projections for future years are determined with respect to base year data and the expected changes in the drivers from the base year to future year.

PODIUMSim enable for users to set goals, such as food production for an adequate per capita consumption, and explore ways of reaching that goal: through expanding irrigated area or rainfed area, increasing cropping intensity or importing more food. Likely scenarios can also be developed with respect to growth in population, changes in diets and developments in agriculture and water resources to ensure food security and sustainable water use.

PODIUMSim can also help explore critical planning questions such as:

- How much improvement in irrigation efficiency would be needed to cover additional water requirements?
- What is the required growth in rainfed yield, if additional food requirements were to be met by increases in rainfed productivity?
- How much food would a country have to import to feed its population in 2025, if there are no new investments in developing additional water resources?

PODIUMSim consists of three main components;

i. Annual consumption-demand scenario development at national level
ii. Seasonal production scenario development for irrigated and rainfed agriculture at sub-national level and,
iii. Annual water supply scenarios development at sub-national and seasonal water demand scenarios development for irrigated sector and annual water demand scenarios for domestic, industrial and environmental sectors at sub-national level.

Each of the components consists of several steps. These are embedded in one or several spreadsheets. This manual is intended to help user to understand what factors are used in different components for generating scenarios, how to generate scenarios, how to save scenarios and how to navigate between spreadsheets of different components.

In the next section we introduce some of the frequently appearing navigation tools in the model. Users are recommended to these navigation tools as much as possible. Second, we explain how to start the scenario building process for a target year. Third, generating scenario of national consumption is explained. Fourth, we explain how information of already formulated scenario at sub-national level are loaded to get an aggregate picture at the country level. Next creating a new scenario or editing an existing scenario of production, water supply and water demand for a unit level is explained. Finally we explain how to enter data for generating scenarios for a different spatial unit structure.

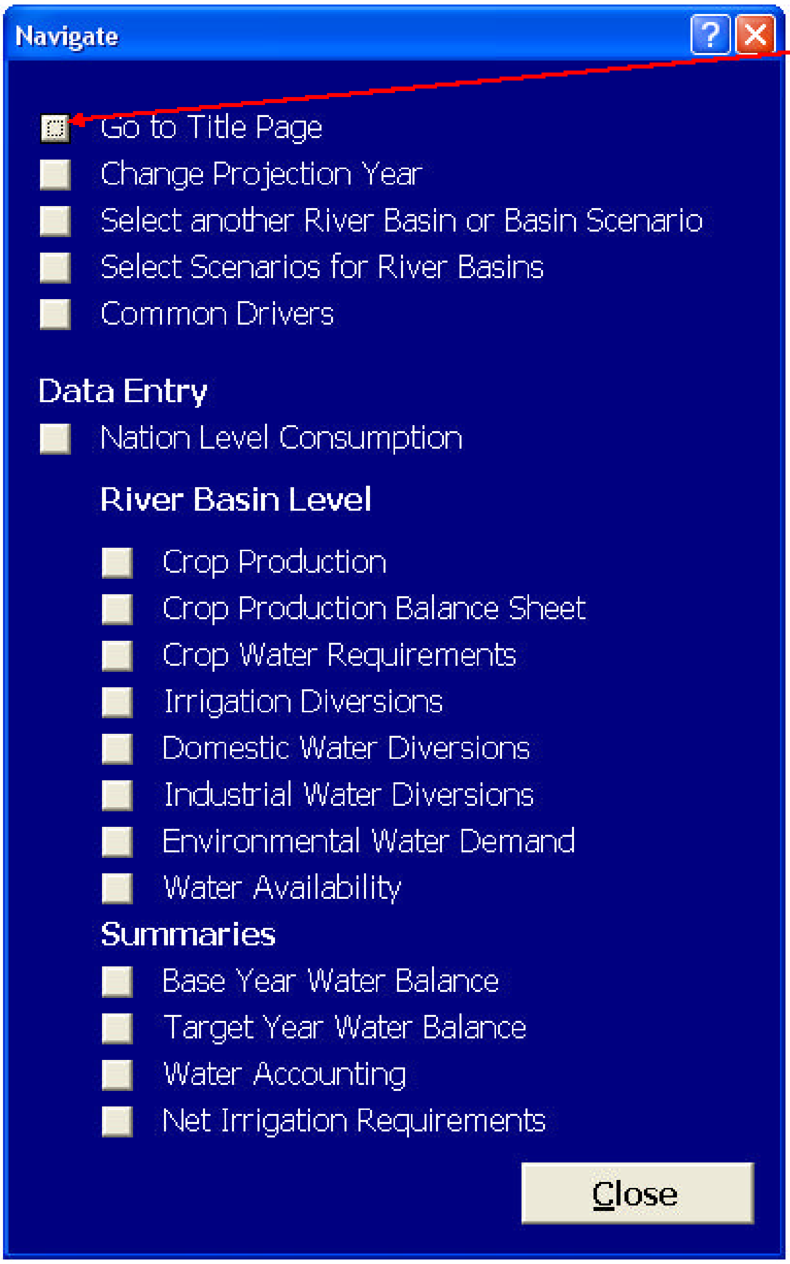
3. Navigation Tools

Following navigation tools will appear in most spreadsheets of the model.

Next	The "*Next*" button move to the next spreadsheet of action and is the preferred navigation method in the model.
Previous	The "*Previous*" button move to the previous spreadsheet in action and is the preferred navigation method in the model.
Restore Default	This option is provided in all the spreadsheets. "Restore Default" button restores the original values of the "Default" scenario that are provided in the model.
Save Scenario	Changes to the parameters in the model generate new scenarios. "Save Scenario" button will save these changes. This can be used to save a new scenario or replace a scenario. Detailed explanation will be given later.
Driver	Use this option to move to the *Driver* page. Driver sheet changes important variables and view changes graphically.
Options	Use this button to navigate around various spreadsheets/modules of the model. This button can be used to navigate between spreadsheets which are not close to each other.

"Next" and "Previous" buttons can move from one spreadsheet to next or previous spreadsheet of operation. The "Options" buttons allows user to move between any spreadsheet. These options are shown in the next figure.

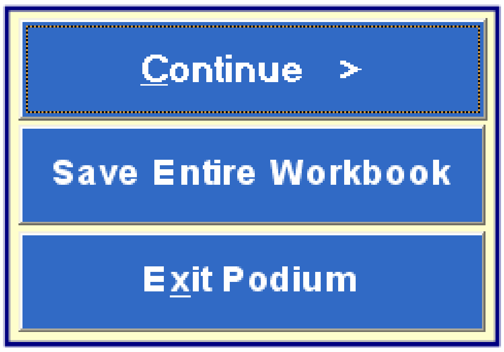
“Options” button window



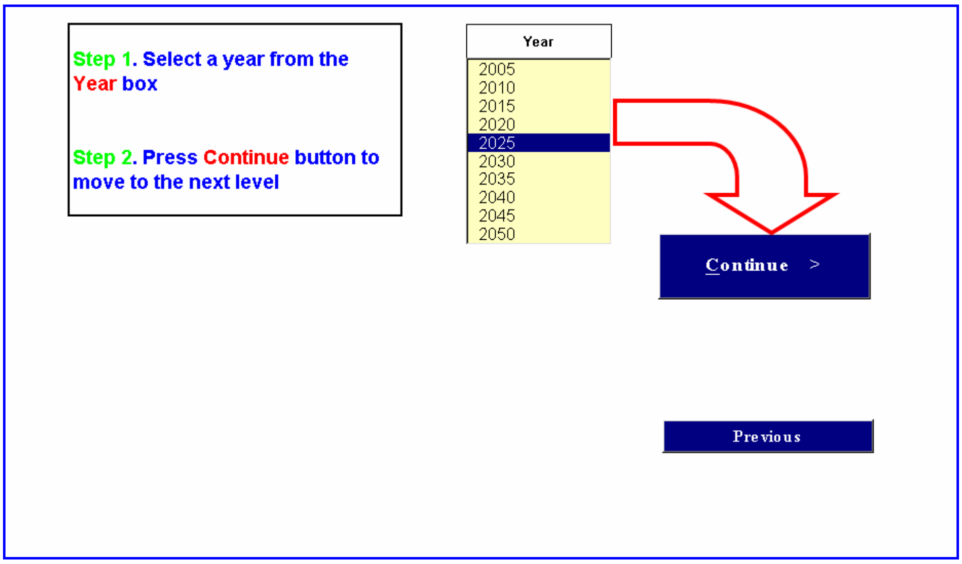
Clicking on a square would direct the user to the spreadsheet with the description in front. For example clicking on the square in front of “Crop production” would take the user to the crop production scenario generation module.

4. Starting PODIUMSim

First open the Microsoft Excel file "**PODIUMSIm-*countryname*"** and the title page appears in the screen. Pressing **"Continue"** button takes you to the next step shown in figure below. Pressing **"Exit PODIUM** " button will exit from the model



Pressing **"Continue"** button will take you to the **"Year"** box in the next page as shown below.



Select **a target year** for scenario development from the "**Year Box**". Every five-year periods from 2005 up to 2050 are available to choose. Clicking **"Continue"** button proceed to estimating national consumption component.

5. Estimating National Level Consumption

Consumption module in the spreadsheet, named "Con" estimates the annual demand for different crops at national level. Base year data, shown in blue and default growth rates, shown in red are provided in the model.

		Base Year 1995		Scenario Year 2025 Annual growth		Change 30 2025	
		Urban	Rural	Urban	Rural	Urban	Rural
Population	million	246	685	2.91%	0.29%	582	747
Daily Calorie Supply - Total	calories	2437	2437	0.70%	0.70%	3000	3000
- % from Grain products	%	67.4%	67.4%	-0.35%	-0.35%	60.8%	60.8%
- % from Animal products	%	7.3%	7.3%	1.61%	1.61%	11.9%	11.9%
- % from Oil Crops	%	9.4%	9.4%	0.00%	0.00%	9.4%	9.4%
- % from Fruits & Vegetables	%	3.3%	3.3%	0.00%	0.00%	3.3%	3.3%
- % from Other crop products	%	11.3%	11.3%			11.3%	11.3%
		Click to View Crop-wise Calorific Values ...					
Per Capita Food Consumption							
- Rice	Kg/day	0.212	0.212	0.21%	0.21%	0.226	0.226
- Wheat	"	0.166	0.166	0.54%	0.54%	0.195	0.195
- Maize	"	0.022	0.022	0.13%	0.13%	0.023	0.023
- Other Cereals	"	0.055	0.055	0.18%	0.18%	0.058	0.058
- Pulses	"	0.035	0.035	0.71%	0.71%	0.043	0.043
- Oil Crops (equivalent)	"	0.043	0.043	0.71%	0.71%	0.053	0.053
- Vegetables	"	0.152	0.152	0.71%	0.71%	0.188	0.188
- Roots & Tubers	"	0.057	0.057	0.71%	0.71%	0.070	0.070
- Sugar (raw equivalent)	"	0.096	0.096	0.71%	0.71%	0.119	0.119
- Fruits	"	0.094	0.094	0.71%	0.71%	0.116	0.116
Per capita cotton (lint) use	kg/year	2.356	2.356	0.00%	0.00%	2.356	2.356

The base year data and default growth rates of different drivers are available for urban and rural sectors.

These include

- *Population*
- *Daily calorie supply person*
- *Composition of calorie supply from different crop products* including grain products (cereals & pulses), oil crops, Fruits and vegetables and also from animal products (which includes meat, milk, butter, fish etc.) and
- *per capita daily consumption* of food crops and
- *annual cotton (lint equivalent) use per person* are

Two other drivers for major crop categories at national level are included as shown below.

Feed conversion ratios (=kg of feed used for supplying 1000 Calories of animal products)

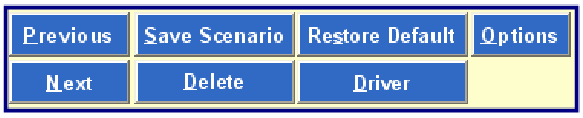
and

Percentages of seed, waste, other uses are provided at national level.

Crop ?	Feed Conversion Ratios (Kg per 1000 Calories)			Seeds/Waste&Other Uses - % of total consumption		
	1995	Growth	2025	1995	Growth	2025
Rice	0.006	0.24%	0.006	7.2%	0.00%	7.2%
Wheat	0.013	0.24%	0.014	11.8%	0.00%	11.8%
[redacted]	0.003	0.24%	0.003	19.6%	0.00%	19.6%
[redacted]	0.005	0.24%	0.005	9.5%	0.00%	9.5%
Pulses	0.021	0.24%	0.022	8.3%	0.00%	8.3%
Oil Crops (equivalent)	0.015	0.44%	0.017	14.6%	0.00%	14.6%
Vegetables	0.000	0.44%	0.000	6.2%	0.00%	6.2%
Roots & Tubers	0.000	0.44%	0.000	20.0%	0.00%	20.0%
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	0.00%	6.9%
Fruits	0.000	0.44%	0.000	13.4%	0.00%	13.4%

Pressing arrows (◂▸) buttons can generate different scenarios.

Use the buttons at the top of spreadsheet to navigate between spreadsheet, to save scenarios, to delete scenarios, to restore default growth rates as shown below.



"Save Scenario" button gives two options, to save the driver values of scenarios with a new name or to replace the scenarios with an existing name (**except the default scenario values**). The names of the scenarios are available in the pull down list in the right-hand side. Up to 15 national consumption scenarios can be saved in the model.

"**Delete Scenario**" button deletes an existing scenario (**"Default" scenario should not be deleted at any time**).

"Restore Default" button brings the default drivers values to the spreadsheet.

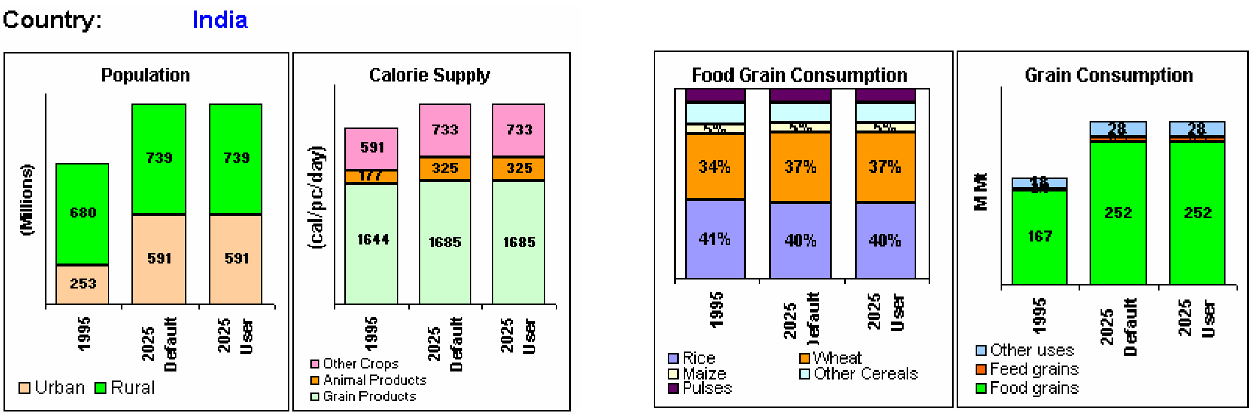
Two warning messages (one each for Urban and Rural sectors) appear in the left bottom corner (see below) show whether the specified calorie supply from different food crop products equal to the calorific value of food consumed from different crop products.

In both cases change, either the growth rates of "composition of calorie supply from different crop products" or change the per capita consumption until these messages disappear.

Urban population calorie supply from grain crops < calorific value of grains consumed !!! Adjust growth rates of per capita calorie supply or per capita consumption of grains

Rural population calorie supply from grain crops < calorific value of grains consumed !!! Adjust growth rates of per capita calorie supply or per capita consumption of grains

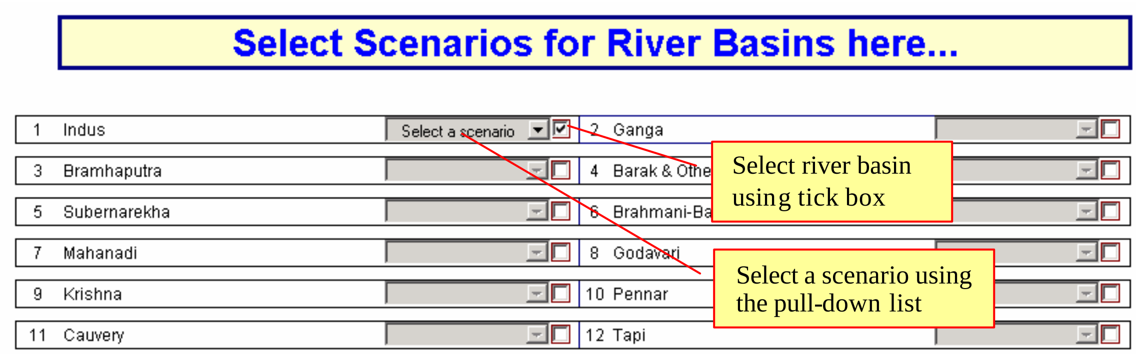
This spreadsheet offers few graphical outputs, including population, per capita calorie supply, composition of food grain consumption and total grain consumption.



"**Next**" button in the consumption sheet shift to the "**Scenario**" spreadsheet.

6. "Scenario": Loading Scenarios

"Scenario" This aggregates the results at sub-national level to get the national picture. Two options, selecting the default scenario or user formulated scenarios at sub-units are available here. To select a previously formulated scenario, select a sub-national name using the tick box and then select a scenario name from the pull-down list. If no previously formulated scenarios are selected, the sub-national scenarios on default growth rates are aggregated. For river basins this sheet looks like:



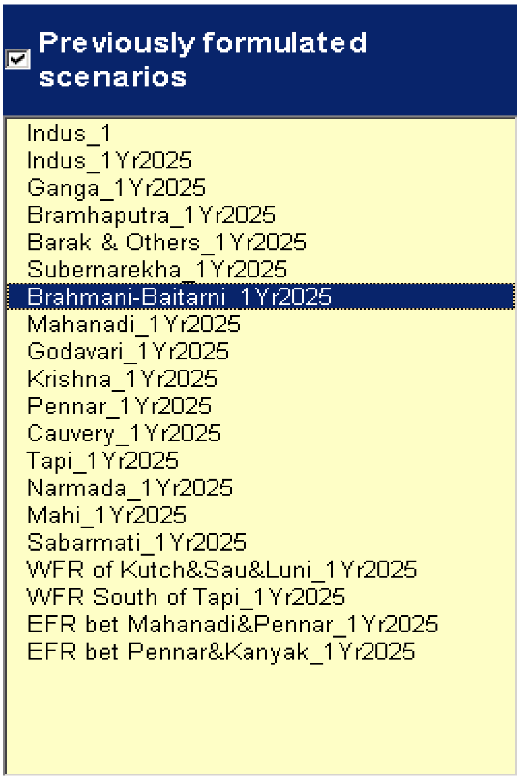
The **"Select all"** option automatically loads all scenarios of all sub-national units. This option loads different scenarios for aggregation. The scenarios can be selected from the pull-down list. If scenarios are unselected, only the scenarios on default growth rates are aggregated.

Pressing "**Next**" would take to the next spreadsheet of action, i.e., "**Basin Select**" .

7. "Basin Select": Loading Sub-National data

This sheet loads growth rates of the default scenarios or an already formulated scenario to the model.

The default scenario growth rates are loaded by first selecting the "***Basin level analysis***" button and then choosing a river basin name from the list.



An already formulated scenario can be selected by first pressing "***Previously Formulated Scenario***" button and then choosing a scenario from list. This loads base year data and the growth rates of the selected scenario.

A message "***Please Wait***" will appear while the data is being loaded. **Please wait until this message disappears.**

Press "***Next***" to go to next spread sheet of action named "*Driver*".

8. Driver

"Driver sheet helps the user to change important drivers of national and basins modules and view the changes simultaneously

This sheet is divided into three sections:

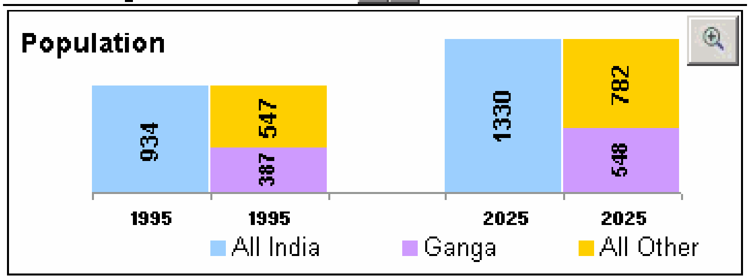
i. Demand drivers
ii. Cereal production drivers
iii. Water balance drivers

The demand driver section allows the user to change

i. national level urban and rural population
ii. basin level population
iii. daily per capita calorie supply of urban and rural populations
iv. percentages of calorie contribution from cereal and animal products
v. Per capita daily consumption of rice, wheat, maize, other cereals and pulses by urban and rural populations

Cereal Demand Drivers - 2025

		Total	Urban	Rural
Population				
All India	**(million)**	1330	591	739
Ganga		548	235	313



		Urban	Rural
Daily Calorie Intake	calories	2743	2743
% Cereal Products		61.5%	61.5%
% Animal Products		11.9%	11.9%
% Other crop products		26.7%	26.7%
Grain Consumption Pattern:			
Rice	Kg/day	0.218	0.218
Wheat	"	0.190	0.190
Maize	"	0.022	0.022
Other cereals	"	0.055	0.055
Pulses	"	0.033	0.033
Total Grains	Kg/day	0.519	0.519

Cereal Production Drivers - 2025

Grain area increase	Irrigated S1	Irrigated S2	Rainfed S1	Rainfed S2
Rice (MHa)	7.23	0.92	10.15	0.27
Wheat	0.00	18.07	0.00	0.72
Maize	0.86	0.00	2.29	0.00
Other Cereals	0.16	0.29	5.74	0.31
Pulses	0.15	1.90	2.78	4.58
Grain Yield Growth				
Rice (ton/ha)	1.95	4.16	1.48	2.83
Wheat	0.00	2.10	0.00	2.05
Maize	2.18	0.00	1.60	0.00
Other Cereals	1.31	2.59	0.74	1.33
Pulses	1.49	1.24	0.79	0.78

Cereal Production section in **"Driver"** spreadsheet allow changes in

i. irrigated and rain-fed areas of cereal crops

ii. Irrigated and rain-fed yield of cereal crops

Water Balance section in **"Driver"** allow changes in

i. surface irrigation efficiencies of paddy and other crops
ii. area irrigated with groundwater
iii. water transfers from and into a river basin and
iv. annual environmental water demands (Note that ,two options, estimating annual or monthly environmental water demands are available in the "EnvSup" spreadsheet.

Water Balance Drivers - 2025

Surface Irrigation Efficiency	
Paddy	
Season 1	50.2%
Season 2	47.5%
Other crops	
Season 1	36.3%
Season 2	42.2%
Area with GW Irrigation	
Season 1	63.3%
Season 2	70.5%
Water Transfers (km^3)	
into the System	0
out of the System	0
Annual Environmental Water Demand (km^3)	0.00

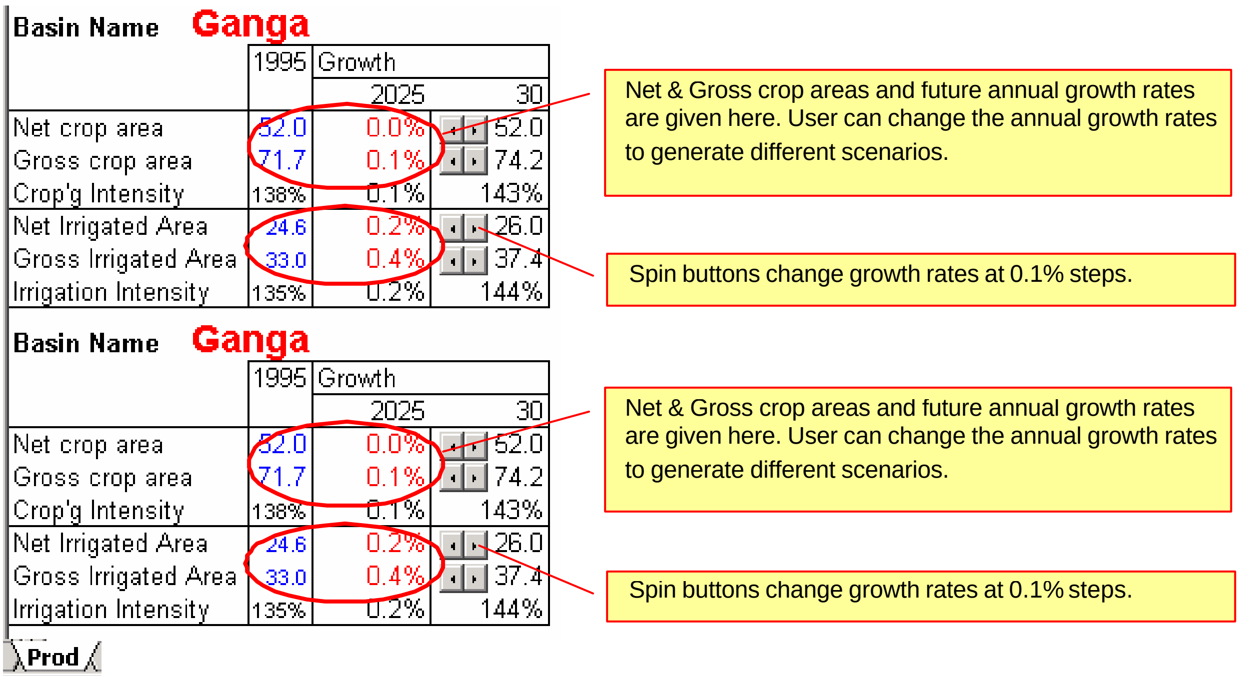
Note that the "Driver" sheet can only effect changes to limited number of drivers. Individual sheets have more drivers to develop different scenarios. These sheets are explained next.

9. "Prod": Estimating Crop Production

Pressing "Next" in "Basin Select" sheet leads to crop production component. This sheet develops a new scenario or alters an already formulated scenario for a sub-unit that is selected in the "BasinSelect".

Developing scenarios in this sheet involves several steps.

First, determine the future net and gross crop cultivated area and net and gross irrigated area as shown below. The annual growth rates can be



Next, estimate the agricultural production for individual crops for two seasons. The PODIUMSim covers 11 crop categories including cereals with rice, wheat and maize separately and other cereals in one category, pulses, oil crops, vegetables, roots and tubers, sugar, fruits and cotton. Change spin buttons to change the area and yield drivers of irrigated and rainfed crops.

Irrigated and rainfed crop areas and yield

The base year data, shown in blue, shows seasonal irrigated and rainfed crop area for 11 major crop categories in the basin. Model can handle three seasons of paddy crop. Growth of crop area can be changed using the spin buttons – in 0.1% intervals. The difference between the aggregate irrigated crop areas in season one and two and the Gross Irrigated Area is other irrigated crop area.

Irrigated Harvested Area

Crop	1995		2025			
	S1	S2	S1	S2	S1	S2
	M Ha	M Ha	%	%	M ha	M ha
Paddy	6.42	0.58	0.4%	0.4%	7.17	0.65
Wheat	0.00	13.41	0.0%	0.8%	0.00	16.94
Maize	0.70	0.00	0.7%	0.0%	0.85	0.00
Other Cereals	0.12	0.23	0.0%	0.0%	0.12	0.23
Pulses	0.11	1.35	0.8%	0.7%	0.14	1.69
Oil Crops	0.00	1.85	0.0%	0.8%	0.00	2.36
Vegetables	0.52	0.00	0.2%	0.0%	0.55	0.00
Roots & Tubers	0.00	0.00	0.0%	0.0%	0.00	0.00
Sugarcane	1.84		0.4%		2.07	0.00
Fruits	0.48		0.0%		0.48	0.00
Cotton	0.65	0.00	0.4%		0.74	0.00
Paddy - **S3**	0.00		0.0%		0.00	

Rainfed Harvested Area

Crop	1995		2025			
	S1	S2	S1	S2	S1	S2
	M ha	M ha	%	%	M ha	M ha
Paddy	10.49	0.27	-0.1%	-0.1%	10.18	0.27
Wheat	0.00	1.36	0.0%	-2.1%	0.00	0.73
Maize	1.90	0.00	0.0%	0.0%	1.90	0.00
Other Cereals	4.70	0.33	-0.5%	-0.5%	4.05	0.29
Pulses	2.07	4.13	0.0%	0.0%	2.07	4.13
Oil Crops	0.00	3.61	0.0%	0.4%	0.00	4.05
Vegetables	1.46	0.00	1.0%	0.0%	1.97	0.00
Roots & Tubers	0.00	1.05	0.0%	0.2%	0.00	1.13
Sugarcane	0.31		-0.4%		0.28	0.00
Fruits	0.26		1.3%		0.39	0.00
Cotton	0.27	0.00	0.3%	-3.1%	0.30	0.00
Paddy - **S3**	0.00		0.0%		0.00	

If the summation of projects irrigated crop areas (including season one & two) exceeds projected gross irrigated area, a warning message appears. If the summation of individual irrigated crop areas in either season exceeds the net irrigated area or because the area of one season overlapped with another, another warning message appear. To see the details press "Crop calendar"

WARNING: 2025 Total crop irrigated area is more than the projected GROSS irrigated area. Adjust growth rates

WARNING: 2025 Irrigated area is more than the projected NET irrigated area OR Due to overlapping seasons - view details in crop calendar.

The irrigated and rainfed yields of 11 crop categories appear as shown below. conditions are available in the model. Growth rates, shown in red, of irrigated yield can be changed by

Irrigated Yield (ton/ha)

	S1	S2	S1	S2
Paddy	1.40	2.99	1.1%	1.1%
Wheat	0.00	1.51	0.0%	1.1%
Maize	1.57	0.00	1.1%	1.1%
Other Cereals	0.94	1.87	1.1%	1.1%
Pulses	1.07	0.90	1.1%	1.1%
Oil Crops	0.00	1.47	1.1%	1.1%
Vegetables	14.56	0.00	1.1%	1.1%
Roots & Tubers	0.00	0.00	1.1%	1.1%
Sugarcane	6.28		1.1%	
Fruits	14.43		1.1%	
Cotton	0.40	0.00	1.1%	1.1%
Paddy - S3	0.00		0.1%	

Rainfed Yield (ton/ha)

	S1	S2	S1	S2
Paddy	1.34	2.55	0.3%	0.3%
Wheat	0.00	1.86	0.3%	0.3%
Maize	1.58	0.00	0.3%	0.3%
Other Cereals	0.75	1.22	0.3%	0.3%
Pulses	0.76	0.72	0.3%	0.3%
Oil Crops	0.00	0.88	0.3%	0.3%
Vegetables	9.99	0.00	0.3%	0.3%
Roots & Tubers	0.00	17.65	0.3%	0.3%
Sugarcane	5.61		0.3%	
Fruits	9.21		0.3%	
Cotton	0.15	0.00	0.3%	0.3%
Paddy - S3	0.00		0.0%	

0.1% intervals. Note that, spin buttons, where applicable, simultaneously change the growth rates of yields in season 1 and 2.

Press "**Save Scenario**" button to save production scenarios.

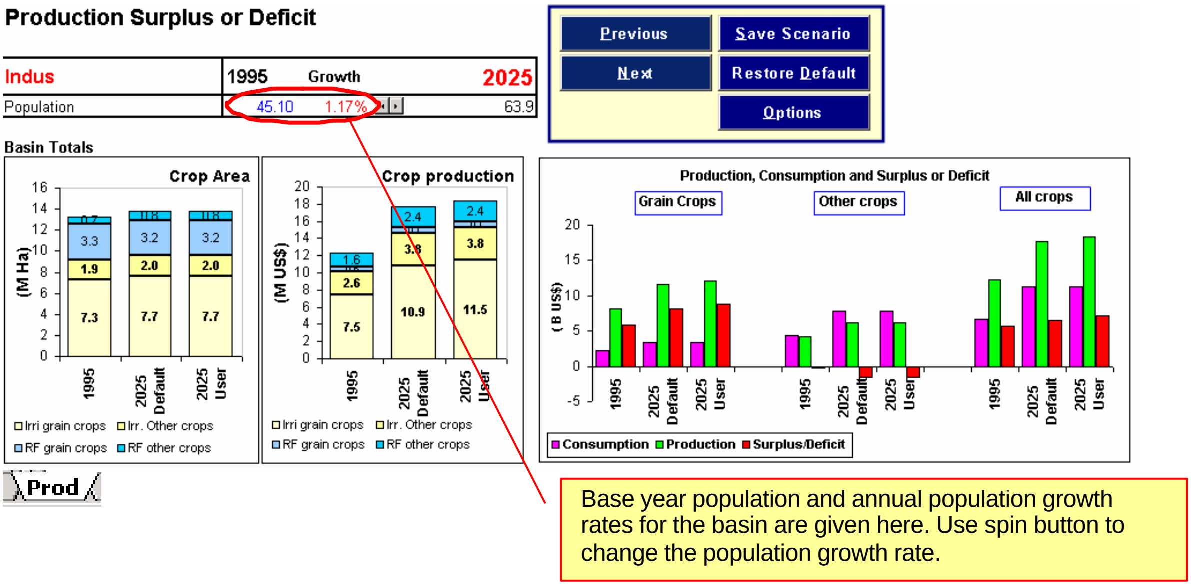
A "**Save Scenario**" box with different options will appear on the screen as shown above. First double click on the text box under the **"Enter Scenario Name"**. For a new scenario of a river basin *"river basin name*" will appear and for an existing scenario "river basin name"_scenario name" will appear. In both cases, follow the naming convention and press "**Save**" button to save the scenario. To replace a scenario, press the "**Replace**" button. "**Replace**" button will be active only when the growth rates loaded to model are from an already formulated scenario.

"Next" button directs to "**IxpEmp**" sheet.

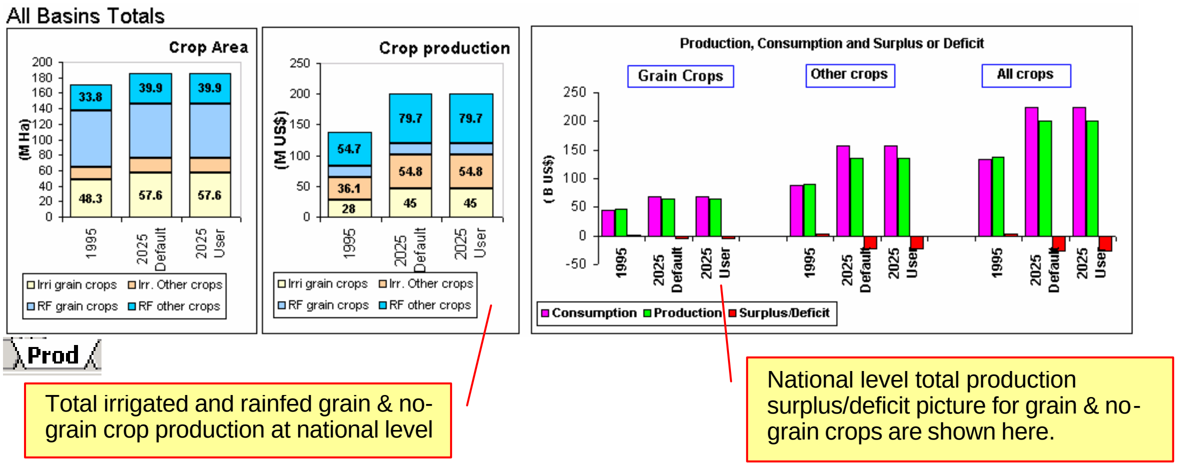
10. "ImpExp": Estimating Crop Production Surplus or Deficit

This sheet shows annual crop production surplus/deficit, the difference between the annual production and annual consumption, at river basin and at national level. The production surpluses or deficits are shown for the grain crops (cereals and pulses) and non-grain crops.

As the crop consumption was estimated at national level, the per capita crop consumption for a sub-unit is assumed to be same as the per capita consumption at national level. The differences of consumption of sub-units are only due to different growth rates of population. The summaries of grain and non-grain crop area, crop production and production surplus or deficit of the new scenario or the revised scenario are shown as below.



The production surplus or deficit of all basins is shown as in the figure below.



By pressing the *"Next"* button directs to the next spreadsheet of action: "NETmm". This sheet estimates crop water requirements.

11. “NETmm”: Estimating Crop Water Requirements

Water requirements of different crops are estimated in this sheet. Major drivers for estimating crop water requirements are,

i. Average daily potential evapotranspiration for different months - ET_p
ii. Monthly 75% exceedence probability rainfall - P_{75}
iii. Starting date of the seasons (Month and Day)
iv. Number of days in different growth periods of different crops in different seasons (Four different growth periods: Initial, development, middle and late are considered)
v. Crop coefficients (Kc_{ij}) of different crops (i) at different growth periods (j)

Seasonal evapotranspiration of a crop is the sum of evapotranspiration during the four growth stages. Crop evapotranspiration in a growth period (ET_{ij}) is obtained by multiplying the sums of ET_p's of the months (or part of the month) which fall in the growth period by associated crop coefficients. The seasonal evapotranspiration for i^{th} crop is given as

$$ET_i = \sum_{j=1}^{4} \sum_{month_p \in j} ET_p \times m_{pj} \times Kc_{ij}$$

where m_{pj} is the number of days of month p in the j^{th} growth period.

Seasonal effective precipitation is the sum of effective rainfall of the months (or parts of months) which falls in the particular season. This is given as

$$EP_{\cdot k} = \sum_{month_p \in season_k} \frac{m_{pk}}{n_{pk}} \times \left\{ \begin{array}{ll} P_{75_p}(125 - 0.2 \times P75_p)/125 & if \quad P_{75_p} < 250\ mm \\ 125 + 0.1 \times P_{75_p} & if \quad P_{75_p} > 250\ mm \end{array} \right\}$$

where m_{pk} is the number of days in p^{th} month which fall in the k^{th} season and n_{pk} is the number of days in the p^{th} month.

The net irrigation requirement for the i^{th} crop in k^{th} season given as

$$NET_{ik} = Max\{\ ET_i - EP_k,\ 0\ \}$$

The two drivers- the average daily potential evapotranspiration (ET_p) and 75 percent exceedance probability rainfall (P_{75_p}) appear in the model as shown below.

	Etp (mm/day)			P75 (mm/month)	
	1995	2025 Growth	30	1995	2025 Growth
Jan	1.6	0.0%		8.2	0.0%
Feb	2.4	0.0%		7	0.0%
Mar	3.6	0.0%		17	0.0%
Apr	5.2	0.0%		11	0.0%
May	6.1	0.0%		12	0.0%
Jun	5.9	0.0%		22	0.0%
Jul	4.5	0.0%		91	0.0%
Aug	4.1	0.0%		92	0.0%
Sep	4.0	0.0%		33	0.0%
Oct	3.1	0.0%		2	0.0%
Nov	2.1	0.0%		0	0.0%
Dec	1.5	0.0%		2	0.0%

The likely impact of climate change on crop evapotranspiration can be assessed through the changes in ET_p and rainfall.

The sowing dates and growth periods for the two seasons and the crop coefficients for different growth periods appear in the model as shown below.

1995	Start date - S1		Growth Period - S1				Crop Coefficients				Start date - S2		Growth Period - S2			
	Date	Month	Ini.	Dev.	Mid.	Late	Ini.	Dev.	Mid.	Late	Date	Month	Ini.	Dev.	Mid.	Late
Rice	15	Jun	30	30	60	30	1.20	1.15	1.10	0.80	15	Dec	30	30	60	30
Wheat	15	Jun	20	25	60	30	0.40	0.78	1.15	0.30	15	Nov	20	25	60	30
Maize	15	Jun	20	35	40	30	0.30	0.75	1.20	0.60	15	Nov	20	35	40	30
Other Cereals	15	Jun	15	30	50	30	0.30	0.73	1.15	0.25	15	Nov	15	30	50	30
Pulses	15	Jun	15	25	35	20	0.40	0.78	1.15	0.55	15	Nov	15	25	35	20
Oil Crops	15	Jun	35	45	35	25	0.35	0.75	1.15	0.35	15	Nov	35	45	35	25
Vegetables	15	Jun	15	25	70	40	0.60	0.85	1.10	0.90	15	Dec	15	25	70	40
Roots & Tube	15	Jun	25	30	45	30	0.50	0.83	1.15	0.75	15	Nov	25	30	45	30
Sugarcane	15	Jun	30	50	180	60	1.00	1.00	1.00	1.00	15	Nov	30	50	180	60
Fruits	15	Jun	30	60	40	80	0.75	0.75	0.75	0.75	15	Nov	30	60	40	80
Cotton	15	Jun	30	50	60	55	0.35	0.78	1.20	0.60	15	Nov	30	50	60	55
Other crops	15	Jun	30	30	30	30	1.00	1.00	1.00	1.00	15	Nov	30	30	30	30

2025	Start date - S1		Growth Period - S1				Crop Coefficients				Start date - S2		Growth Period - S2			
	Date	Month	Ini.	Dev.	Mid.	Late	Ini.	Dev.	Mid.	Late	Date	Month	Ini.	Dev.	Mid.	Late
Rice	15	Jun	30	30	60	30	1.20	1.15	1.10	0.80	15	Dec	30	30	60	30
Wheat	15	Jun	20	25	60	30	0.40	0.78	1.15	0.30	15	Nov	20	25	60	30
Maize	15	Jun	20	35	40	30	0.30	0.75	1.20	0.60	15	Nov	20	35	40	30
Other Cereals	15	Jun	15	30	50	30	0.30	0.73	1.15	0.25	15	Nov	15	30	50	30
Pulses	15	Jun	15	25	35	20	0.40	0.78	1.15	0.55	15	Nov	15	25	35	20
Oil Crops	15	Jun	35	45	35	25	0.35	0.75	1.15	0.35	15	Nov	35	45	35	25
Vegetables	15	Jun	15	25	70	40	0.60	0.85	1.10	0.90	15	Dec	15	25	70	40
Roots & Tube	15	Jun	25	30	45	30	0.50	0.83	1.15	0.75	15	Nov	25	30	45	30
Sugarcane	15	Jun	30	50	180	60	1.00	1.00	1.00	1.00	15	Nov	30	50	180	60
Fruits	15	Jun	30	60	40	80	0.75	0.75	0.75	0.75	15	Nov	30	60	40	80
Cotton	15	Jun	30	50	60	55	0.35	0.78	1.20	0.60	15	Nov	30	50	60	55
Other crops	15	Jun	30	30	30	30	1.00	1.00	1.00	1.00	15	Nov	30	30	30	30

NETmm

The future changes of these parameters are not effected through growth rates. To effect future changes the exact value of the parameter needs to be entered.

Whwn the required changes are incorporated the model estimates the net evapotranspiration of different crops for two seasons. These will be used to estimate the net irrigation requirement for different crops. The changes on the parameters can be saved as a new scenario name or replace under the existing scenario name by clicking the *"Save Scenario"* button and following the procedure explained in the previous section.

Details of net irrigation requirements for different crops can be seen by clicking on the *"Details"* button in the top right hand corner. This takes to the sheet named *"NETm3"*. This sheet is shown as below. If details of net irrigation requirements are not required at this stage press *"Next"* to go to irrigation withdrawal estimation sheet.

12. "NETm3": Net Irrigation Requirement

This sheet shows the net irrigation requirement as depth (mm) and also as a volume on the area irrigated for each crop in different seasons. The estimated volume of net irrigation requirement is used for estimating the irrigation withdrwals. While in "Netm3" sheet, press *"Next"* button to shift to the sheet estimating gross irrigation withdrawal.

Net Irrigation Requirement: Volum (km^3)

NET IRRIGATION REQUIREMENTS

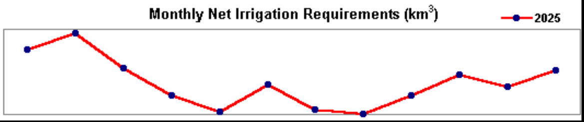
Ganga

Next Previous

Net Irrigation requirement (volume in km^3)

Crop	1995 S1 km^3	1995 S2 km^3	2025 S1 km^3	2025 S2 km^3
Basin Total	42.24	55.62	43.99	65.90
Crop total				
Paddy	18.07	3.85	20.18	4.30
Wheat		39.84		50.32
Maize	0.45		0.54	
Other Cereals	0.03	0.56	0.03	0.56
Pulses	0.01	2.52	0.02	3.14
Oil Crops		5.57		7.13
Vegetables	1.07		1.14	
Roots & Tubers				
Sugarcane	16.27		18.31	
Fruits	1.25		1.25	
Cotton	1.82		2.08	
Paddy - S3				
Other Crops	3.27	3.27	0.44	0.44

NET Evapotranspiration (mm/ha)



	2025: Monthly Net Irrigation Requirements (km3)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Paddy	0.55	0.69	1.10	1.20	0.48	6.62	1.25		3.50	7.06	1.75	0.29
Wheat	13.92	17.78	6.98								3.00	8.64
Maize						0.01			0.25	0.28		
Other Cereals	0.19	0.17	0.05			0.00			0.01	0.01	0.03	0.12
Pulses	1.32	0.52				0.02					0.32	0.99
Oil Crops	1.24	2.48	2.08	0.16							0.37	0.80
Vegetables						0.18			0.27	0.54	0.15	
Roots & Tubers												
Sugarcane	1.47	1.94	3.16	4.11		1.49			0.76	2.25	1.73	1.40
Fruits	0.08					0.22			0.03	0.38	0.30	0.24
Cotton						0.04			0.43	0.98	0.38	0.25
Paddy - S3												
Other Crops	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Total	**18.84**	**23.66**	**13.44**	**5.54**	**0.55**	**8.66**	**1.32**	**0.07**	**5.32**	**11.57**	**8.10**	**12.81**

Net Irrigation requirement: Depth (km^3)

NET Evapotranspiration (mm/ha)

Crop	1995 S1 mm	1995 S2 mm	2025 S1 mm	2025 S2 mm
Paddy	281	659	281	659
Wheat		297		297
Maize	64		64	
Other Cereals	22	244	22	244
Pulses	13	186	13	186
Oil Crops		302		302
Vegetables	207		207	
Roots & Tubers				
Sugarcane	883		883	
Fruits	262		262	
Cotton	281		281	
Paddy - S3				

13. “IrrDiv”: Estimating Total Irrigation demand

The total irrigated withdrawals include surface and groundwater irrigation withdrawals. Major drivers of total irrigation withdrawal estimate are

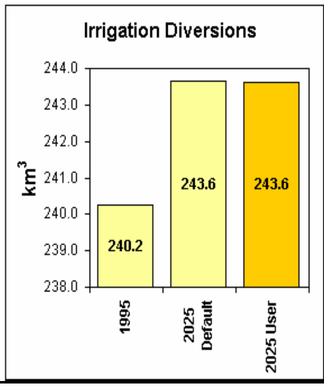
i. ground water irrigated area as percentage of total irrigated area
ii. project irrigation efficiency for areas with only surface irrigation (and/or conjunctive irrigation) for ponded crops (predominantly paddy)
iii. project irrigation efficiency for areas with only surface irrigation (and/or conjunctive irrigation) for non-ponded crops
iv. project efficiency for ground water irrigated areas
v. percolation requirement for paddy.

These information are given in the model as shown below.

Irrigation Diversions — Ganga

Previous | Next | Save Scenario | Restore Default | Options

Basin Name	Unit	1995 S1	1995 S2	Growth 2025 S1	Growth 2025 S2	2025 S1	2025 S2
Groundwater irrigated area - % of total	%	63%	63%	0.0%	0.0%	63%	63%
Irrigation Efficiency Surface - Paddy	%	31%	35%	0.3%	0.3%	34%	39%
Irrigation efficiency Surface - other crops	%	31%	34%	0.3%	0.3%	34%	38%
Irrigation Efficiency - Groundwater	%	60%	65%	0.3%	0.3%	66%	72%
Percolation requirement for paddy	mm	200	200	0.0%	0.0%	200	200
Utilizable BF							
Return flow to surface - % BF	%	7%	7%	0.0%	0.0%	7%	7%
Rechange to ground water - % BF	%	63%	63%	0.0%	0.0%	63%	63%
Un-utilizable BF							
Flows to sea - % of BF	%	5%	5%	0.0%	0.0%	5%	5%
Flows to Swamp - % of BF	%	25%	25%				



IrrDiv

The surface irrigation diversion is estimated as

$$Surf\ \ Irri.div = (1 - \%gw\, irri.area)\left(\frac{NET_{paddy} + Percolation_{paddy}}{Irri.\,effi.\,Surf_{paddy}} + \frac{\sum_{i\in other\,crops} NET_i}{Irri.Effi.Surf_{other}} \right)$$

and the groundwater irrigation diversion is estimated as

$$Groundwater\ \ Irri.\,div. = (\%gw\ irri.\,area) \times \frac{\sum_{i\in all crops} NET_i + Percolation_{paddy}}{Irri.Effi.GW}$$

The balance flow (or the return flow) of irrigation is defined as

$$BF = \text{Re}\,turn\ Flow\,of\ \ irrigation = Total\,irri.\,diversons - \sum_{i\in\, all\,crops} NET_i$$

The balance flow is divided into three parts: 1) the return flows to surface and groundwater 2) flows to swamps, and 3) flows to sink/sea. The latter two parts determine the amount of return flow that is available for recycling.

By changing the drivers, various scenarios of irrigation water demand and recycling of return flows in the irrigation sector are developed. As in the previous spreadsheets, the created scenarios can be saved as a new scenario or can be replaced as a scenario already formulated.

The *"Next"* button directs to the next spreadsheet of action: *"Dom"*.

14. "Dom Div": Estimating Domestic Water Demand

Domestic water demand consists of two parts: water demand for humans and "water demand for livestock.

The major drivers for determining the domestic demand are

i. Percent population in urban areas,
ii. Per capita domestic water use for humans in urban areas
iii. Per capita domestic water use for humans in rural areas
iv. Percent of the population with access to pipe water supply
v. % domestic & industrial diversions from groundwater
vi. Number of animals of different types (cattle, pigs, and other animals) and
vii. Per animal water demand from each category

The domestic water demand is estimated by

$$Dom\ water\ demand = \left\{ \begin{array}{l} totpop \times \%pop\ with\ pipe\ water\ supply \times \\ \quad (\%\ urbanpop \times per\ capita\ demand_{urban} + \%ruralpop \times per\ capita\ demand_{rural}) \end{array} \right\} \times 365 +$$

$$\left\{ \sum_{i \in (cattle,pigs,otheranimals)} number\ of\ animals_i \times per\ head\ demand_i \right\} \times 365$$

Basin Name		1995	Growth 2025	30	
Urban Population - % of total		29%	1.55%		0.4567
% urban population with Water supply	%	70%	0.00%		70%
% rural population with water supply	%	30%	0.00%		30%
Per capita water supply in Urban	l/pc/day	135	0.00%		135
Per capita water supply in Rural	l/pc/day	40	0.00%		40
Consumptive use factor	%	20%	0.00%		20%
Livestock water demand					
Number of cattles	1000's	10000	0.00%		10000
Number of pigs	1000's	10000	0.00%		10000
Number of goats	1000's	10000	0.00%		10000
Daily demand per head					
- Cattle	l/day	20	0.00%		20
- Pigs	l/day	20	0.00%		20
- Goats	l/day	20	0.00%		20
Utilizable Balance flow					
Return flow to surface- % of BF	%	60%	0.00%		60%
Recharge to Groundwater - % of BF	%	10%	0.00%		10%
Unutilizable balance flow - % of BF	%	30%			30%
% diversions from groundwater	%	50%	0.00%		50%

As in the irrigation module, this also estimates the consumptive use and the return flows from domestic withdrawals that can be recycled and the return flows that cannot be utilized for further use.

Click *"Save"* button and follow the procedure described earlier to save or replace the scenario. Pressing *"Next"* button directs you to the next spreadsheet of action: *"IndDiv"*.

15. "IndDiv": Estimating Industrial Water Demands

In the current version of the model, only growth in total industrial water demand is considered. The base year data of total industrial water withdrawals and the default growth rate for the total demand are available for future scenario generation. User is expected to make reasonable projections for growth rates for industrial demand.

			Growth		
Basin Name		1995		2025	30
Industrial water demand	km3	1.254	0.0%		1.254
Consumptive use factor	%	20%	0.0%		20%
Utilizable Balance flow					
Return flow to surface- % of BF	%	0%	0.0%		0%
Recharge to Groundwater - % o	%	70%	0.0%		70%
Unutilizable balance flow - % of E	%	30%			30%
% diversions from groundwater	%	50%	0.0%		50%

Click *"Save"* button to save a new scenario or replace an existing scenario. The *"Next"* button will direct to the next spreadsheet of action named *"Env"*.

16. "Env": Estimating Environmental Water Demand

The model estimates the portion of potentially utilized water resources that need to be reserved as environmental water demand. Two options are available for estimation. First option estimates annual demand directly. The second option estimates monthly demands and aggregate to get the annual values.

First select an option of annual or monthly assessment from the "Environmental flow Calculation" box.

Environmental flow calculations ....

- ○ Use Annual Values
- ◉ Use Monthly Values

	1995	2025
Environmental flow	0.0	0.00

If "Use Annual Values" is selected, specify the annual requirement in the target year in the left-hand side box.

If "Use Monthly Values" is selected then change appropriate drivers using arrow buttons to get the monthly requirements.

Data required for the base year when using monthly demand option are as follows;

i. Total environmental flow requirement of the month (EFR)
ii. Total renewable water resources of the month (MRWR)
iii. Potentially utilizable water resources of the month(PUMWR)
iv. % environmental flow met from the potential utilizable water resources

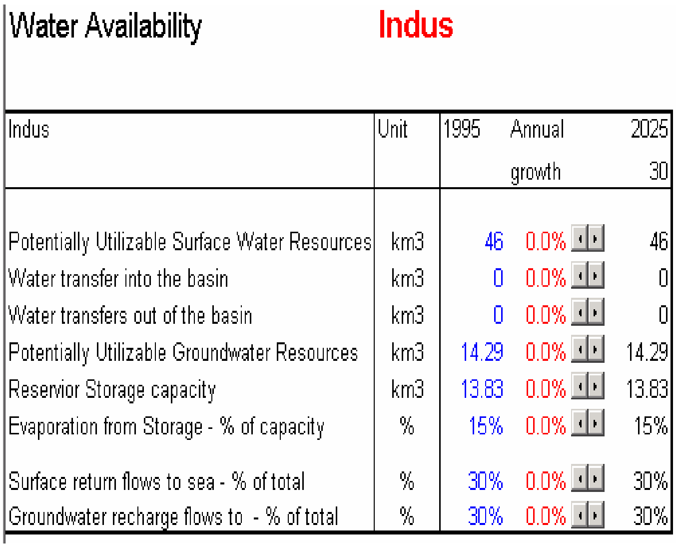
Month	Environmental Flow Requirements	1995 MMR	PUWMR	% EFR met from PUMWR	2025 MMR	PUWMR	% EFR met from PUMWR
Jan	0	0	0	0.00%	0.0%	0.0%	0.0%
Feb	0	0	0	0.00%	0.0%	0.0%	0.0%
Mar	0	0	0	0.00%	0.0%	0.0%	0.0%
Apr	0	0	0	0.00%	0.0%	0.0%	0.0%
May	0	0	0	0.00%	0.0%	0.0%	0.0%
Jun	0	0	0	0.00%	0.0%	0.0%	0.0%
Jul	0	0	0	0.00%	0.0%	0.0%	0.0%
Aug	0	0	0	0.00%	0.0%	0.0%	0.0%
Sep	0	0	0	0.00%	0.0%	0.0%	0.0%
Oct	0	0	0	0.00%	0.0%	0.0%	0.0%
Nov	0	0	0	0.00%	0.0%	0.0%	0.0%
Dec	0	0	0	0.00%	0.0%	0.0%	0.0%
Total	0	0	0				

The future monthly demand is based on the changes in MRWR, PUMWR and the % EFR met from the PUMWR. Monthly demands are aggregated to get annual environmental demand from the potentially utilizable surface water resources.

Press *"Save"* button and follow the procedure explained earlier to save a new scenario or replace an existing scenario. Press *"Next"* button to go the next spreadsheet of action: *"Water"*.

17. “Water”: Estimating Water Availability

This part of the model estimates available water resources (excluding return flows for reuse) in the sub-unit. Both surface and ground water resources that can be potentially utilizable form the total utilizable water resources generated in the basin. This module has the capacity to deal with water transfers in from other units and water transfers out to other basins. The total water available in the basin is the sum of total utilizable water resources and the net transfers into the basin.



Water Availability Indus

Indus	Unit	1995	Annual growth	2025 30
Potentially Utilizable Surface Water Resources	km3	46	0.0%	46
Water transfer into the basin	km3	0	0.0%	0
Water transfers out of the basin	km3	0	0.0%	0
Potentially Utilizable Groundwater Resources	km3	14.29	0.0%	14.29
Reservior Storage capacity	km3	13.83	0.0%	13.83
Evaporation from Storage - % of capacity	%	15%	0.0%	15%
Surface return flows to sea - % of total	%	30%	0.0%	30%
Groundwater recharge flows to - % of total	%	30%	0.0%	30%

Future scenarios of water availability can be developed by changing the drivers of potentially utilizable surface and groundwater resources and water transfers in and out of the basin. The changes in depletion through the evaporation from the surface of reservoir storages are captured by the two drivers: “Reservoir storage capacity” and “Evaporation from Storage”.

The utilizable outflows to sea from return flows (from both surface and groundwater) from all sectors are estimated through the remaining two drivers.

Changes to water supply can be saved as a new scenario or as an existing scenario by pressing the *“Save Scenario”* button. The *“Next”* button will direct to the next spreadsheet of action.

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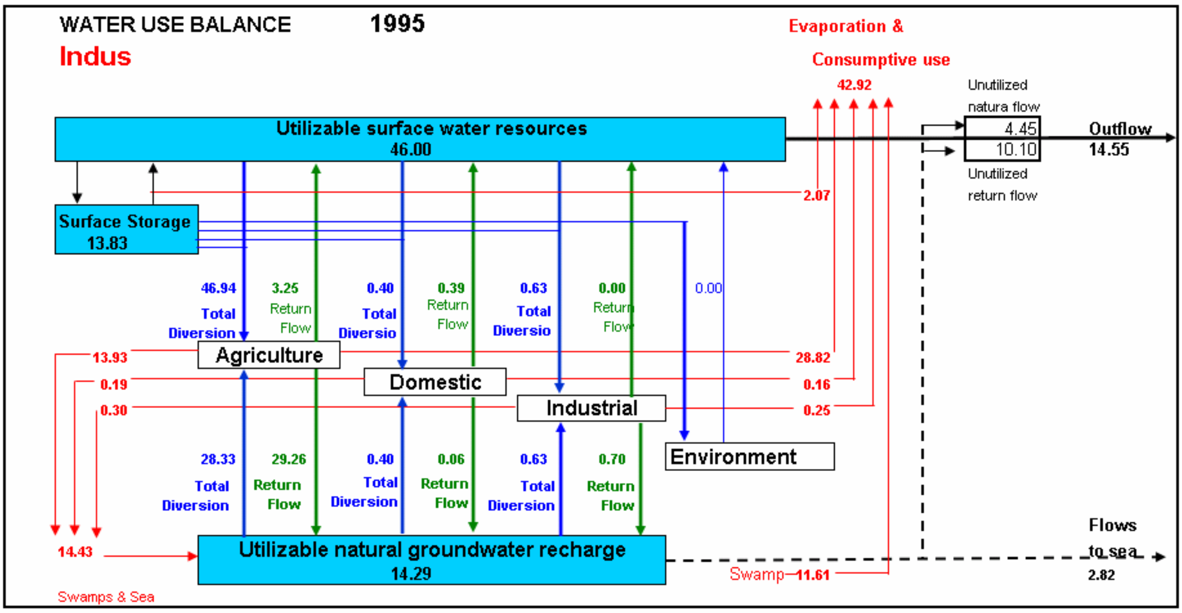
18. Water Balance at Sub-National Level

This section presents the sub-national level water balances. Water balance summaries are provided for the base year and also for the target year. Water balance figure shown below



Groundwater abstraction is 66% of total Groundwater Recharge

indicates all major sectors of water use.

19. Data Entry

The base year data and a default set of future growth rates needs to be entered in the model for scenario generation. This section describes where different pieces of data need to be entered.

19.1 Data entry for Crop Consumption Estimation module

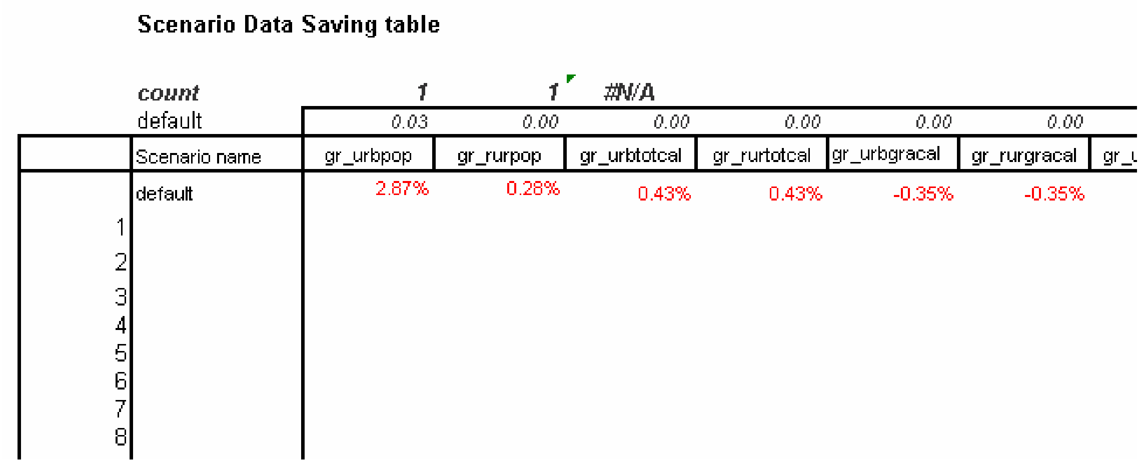
The information of this component is processed at national level and is shown in the spreadsheet named *"Con"*. The information here only consists of **annual data**. The data for this sheet is entered in the spreadsheet *"Con"* itself. These have to be entered manually. The information that has to be entered into the sheet is given in Table 1.

Table 1: Information of variables in the data entry sheet "Con"

Base year data Col. No.	Default growth rates Col No.	Variable description	Unit
L8-M8	N8-O8	Urban and Rural population	Millions
L9-M9	N9-O9	Total daily calorie supply per person	Calorie
L10-M10	N10-O10	% calorie supply from grain products	%
L11-M11	N11-O11	% calorie supply from animal products	%
L13-M13	N13-O13	Daily consumption per person in urban and rural area Rice	Kg/day
L14-M14	N14-O14	Daily consumption per person in urban and rural area Wheat	Kg/day
L15-M15	N15-O15	Daily consumption per person in urban and rural area Maize	Kg/day
L16-M16	N16-O16	Daily consumption per person in urban and rural area Other cereals	Kg/day
L17-M17	N17-O17	Daily consumption per person in urban and rural area Pulses	Kg/day
L18-M18	N18-O18	Daily consumption per person in urban and rural area Oil crops	Kg/day
L19-M19	N19-O19	Daily consumption per person in urban and rural area Vegetables	Kg/day
L19-M20	N20-O20	Daily consumption per person in urban and rural area Roots and tubers	Kg/day
L21-M21	N21-O21	Daily consumption per person in urban and rural area Sugar	Kg/Day
L22-M22	N23-O22	Annual cotton usage per person in urban and rural area	Kg/year
J28-J37	K28-K37	Feed conversion ratios of different crops	Kg/1000 Cal
N28-N37	O28-O37	(Seeds+Waste+Otheruses) - % of total consumption	%
Z28-Z37		Total domestic consumption of different commodity	M Mt
V42-V52		Average export prices (FOB) of different crops	US$/Ton

The base year data are entered in cells in blue color. The default growth rates are entered in cells in red color. When data entry is complete, use the *"Save"* button to save the information as **"Default"** scenario**.** After this save the PODIUM file itself.

Another method of entering default data is to enter them to the sheet directly as shown in the figure below. When data entry is complete then save the podium file.



Scenario Data Saving table

	count	1	1	#N/A				
	default	0.03	0.00	0.00	0.00	0.00	0.00	
	Scenario name	gr_urbpop	gr_rurpop	gr_urbtotcal	gr_rurtotcal	gr_urbgracal	gr_rurgracal	gr_u
	default	2.87%	0.28%	0.43%	0.43%	-0.35%	-0.35%	
1								
2								
3								
4								
5								
6								
7								
8								

19.2 Data entry for Other Modules

The information for all other modules is processed at sub-national level. Generating a new-scenario or editing an existing scenario is done only for one sub unit at a time. Therefore the information at sub-national level is stored in a separate location. The base year data and the default growth rates of sub units are stored in three different spreadsheets.

19.2.1 dataProd spreadsheet

The information entered in this spreadsheet is shown in table 2. Column 1 of the table indicates the column number of the spreadsheet of the base year data. Column 2 of the table indicates the column number of the default growth rates for the target year. Column 3 of the table indicates the variables descriptions. Column 5-7 indicates whether the data entered are annual, seasonal or monthly information.

Table 2: Information of variables in the data entry sheet *"dataProd"*

Base year data Col. No.	Default growth rates Col No.	Variable description	Unit	Annual	Seasonal	Daily
C	CK	Total population of the sub-unit	Millions	X		
D	CL	Urban population - % of total	M Ha	X		
E-F	CM-CN	Net and gross crop area	M Ha	X		
G-H	CO-CP	Net and gross irrigated area	M Ha			
I-AB	CQ-DJ	Irrigated area of different crops in two seasons	M ha		X	
AC-AV	DK-ED	Irrigated yield of different crops in two s easons	Ton/ha		X	
AW-BP	EE-EX	Rainfed area of different crops in two seasons	M Ha		X	
BQ-CJ	EY-FR	Rainfed yield of different crops in two seasons	Ton/ha		X	

19.2.2 "dataWat1" spreadsheet

The information entered in this spreadsheet are shown in table 3. Column 1 of the table indicates the column number of the spreadsheet of the base year data. Column 2 of the table indicates the column number of the default growth rates for the target year. Column 3 of the table indicates the variables descriptions. Column 5-7 indicates whether the data entered are annual, seasonal or monthly information.

Table 3: Information of variables in the data entry sheet *"dataWat1"*

Base year data Col. No.	*Default growth rates/values Col No.*	*Variable description*	*Unit*	*Annual*	*Seasonal*	*Daily*
C-N	DS-ED	*Average daily ETo of each month*	*mm/day*			*X*
O-Z	EE-EP	Average P75 of each month	*Mm/month*			*X*
AA-AL	EQ-FB[1]	Starting day of the first season of different crops	*Day*		*X*	
AM-AX	FB-FN[1]	Starting month of the season of different crops	*Month*		*X*	
AY-BJ	FO-FZ[1]	Length of the "initial" stage of growth in season 1 of different crops	Days		*X*	
BK-BV	GA-GL[1]	Length of the "development" stage of growth in season 1 of different crops	Days		*X*	
BW-CH	GM-GX[1]	Length of the "middle" stage of growth in season 1 of different crops	Days		*X*	
CI-CT	GY-HJ[1]	Length of the "late" stage of growth in season 1 of different crops	Days		*X*	
CU-DF	HK-HV[1]	Crop coefficients "initial" stage of growth in season 1 of different crops	Number		*X*	
DG-DR	HW-IJ[1]	Crop coefficients "development " stage of growth in season 1 of different crops	Number		*X*	

19.2.3 “dataWat2” spreadsheet

The information entered in this spreadsheet are shown in table 4. Column 1 of the table indicates the column number of the spreadsheet of the base year data. Column 2 of the table indicates the column number of the default growth rates for the target year. Column 3 of the table indicates the variables descriptions. Column 5-7 indicates whether the data entered are annual, seasonal or monthly information.

Table 4: Information of variables in the data entry sheet *“dataWat2”*

Base year data Col. No.	*Default growth rates/values Col No.*	*Variable description*	*Unit*	*Annual*	*Seasonal*	*Daily*
C-M	DI-DV[1]	Crop coefficients for mid stage of different crops	*number*	*X*		
O-Z	DW-EG[1]	Crop coefficients for late stage of different crops	*number*	X		
AA-AB	EH-EI	Percentage of ground water irrigated area	*%*		*X*	
AC-AD	EJ-EK	Project efficiency for surface irrigation for paddy	*%*		*X*	
AE-AF	EL-EM	Project efficiency for surface irrigation for other crops	%		*X*	
AG-AH	EN-EO	Project efficiency for groundwater irrigation	%		*X*	
AI-AJ	EP-EQ	Deep percolation of paddy	mm		*X*	
AK-AL	ER-ES	Irrigation return flows to surface water supply	%		*X*	
AM-AN	ET-EU	Irrigation return flows to ground water supply	%		*X*	
AO-AP	EV-EW	Irrigation return flows to sea/down stream countries	%		*X*	
AQ-AR	EX-EY	Percentages of population with pipe water supply in the urban and rural sector	%	X		
AS-AT	EZ-FA	Daily per capita water supply in urban and rural areas	Liters	X		
AU	FB	Consumptive use factor of domestic diversions	%	X		
AV-AX	FC-FE	Number of cattle, pigs and other animals	Number	X		
AY-BA	FF-FH	Daily water requirement per head of cattle, pigs, and other animals	Liters	X		
BB-BC	FI-FJ	Percent domestic return flows to surface and ground water	%	X		
BD	FK	Percent domestic withdrawals from groundwater	%	X		
BE	FL	Total Industrial water demand	Km^3	X		
BF	FM	Consumptive use factor of Industrial withdrawals	%	X		
BG-BH	FN-FO	Percent industrial return flows to surface and groundwater	%	X		
BI	FP	Percent industrial withdrawals from groundwater	%	X		
BJ-BU	FQ-GB	Environmental flow requirement in each month month (EFR)	Km^3			*X*
BV-CG	GC-GN	Average Water Resources in each month (MWR)	Km^3			*X*
CH-CS	GO-GZ	Potentially utilizable water resources in each month(MPUWR)	Km^3			*X*
CT-DE	HA-HL	Percentage of EFR to be met by MPUWR in each month	%			*X*
DF-DG	HM-HN	Potentially utilizable surface and groundwater resources	Km^3	X		
DH-DI	HO-HP	Water transfers in and out of the sub-unit	Km^3	X		
DJ	HQ	Reservoir capacity	Km^3	X		
DK	HR	Evaporation from reservoir storage - % of capacity	%	X		
HS-HT	HU-HV	Percent of utilizable return flows to surface and groundwater as outflows to sea	Number			
	HW-HX[1]	Target year crop coefficient of fruits in middle and late growing stages	number			

1 – Default values are same as the base year information.

19.2.4. "dataWat3"

The information entered in this spreadsheet is shown in table 5. Column 1 of the table indicates the column number of the spreadsheet of the base year data. Column 2 of the table indicates the column number of the default growth rates for the target year. Column 3 of the table indicates the variables descriptions. Column 5-7 indicates whether the data entered are annual, seasonal or monthly information.

Table 5: Information of variables in the data entry sheet *"dataWat3"*

Base year data Col. No.	*Variable description*	*Unit*	*Annual*	*Seasonal*	*Daily*	*Default growth rates/ values[1] Col No.*
C-N	Starting day of season 2 for different crops	*Number (1-30)*		*X*		BW-CH
O-Z	Starting month of season 2 for different crops	*Number (1-30)*		*X*		CI-CT
AA-AL	Length of "initial" growth period of different crops in season 2	*# days*		*X*		CU-DF
AM-AX	Length of "development" growth period of different crops in season 2	*# days*		*X*		DG-DR
AY-BJ	Length of "middle" growth period of different crops in season 2	# days		*X*		DS-ED
BK-BV	Length of "initial" growth period of different crops in season 2	# days		*X*		EE-EP

1 – Default values are same as the base year data.