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MOROCCO ECONOMIC COMPETITIVENESS

FARM SIMULATOR USER GUIDE

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MOROCCO ECONOMIC COMPETITIVENESS

FARM SIMULATOR USER GUIDE

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Moroccan Economic Competitiveness Program

8, rue du Rif

Souissi

10 000 Rabat

Morocco

Tel: (212) 05 37 63 05 59

Fax: (212) 05 37 63 05 61

andrew_watson@dai.com

Http://www.mecprogram.ma

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WHAT IS THE FARM SIMULATOR?

The Farm Simulator is an interactive application that uses planting month, location, weather patterns, and price seasonality to accurately predict profits for a farmer.

The user inputs the desired plant month and location, as well as land and water resource limitations, and the Farm Simulator uses the expected rain water requirements, price at harvest time, and production costs to calculate the profit.

Factors used in calculating the profit are:

- Water Available
- Irrigation Type
- Costs of production (work, energy, equipment, inputs, etc.)
- Share of land used for different crops
- Planting month
- Evapotranspiration expectations (rain water absorbed, based on temperature and rainfall)
- Yields
- Expected market prices

As the user makes minor changes to the planting scenario, the profit is adjusted to reflect the change, so they may see how each change impacts the bottom line of the farmer.

This program can be used in multiple capacities:

- Government policymakers can use the simulator to measure the impact of public policy on small-scale farmers (for example, changes in the price of subsidized water, or seed).

- Individual farmers could use the simulator to determine the optimal crop mix based on the time of year and input limitations

- Agricultural organizations can identify which changes would have the biggest impact on farmers (for example, by changing to drip irrigation from gravity), and decide what methods of aid would be most effective.

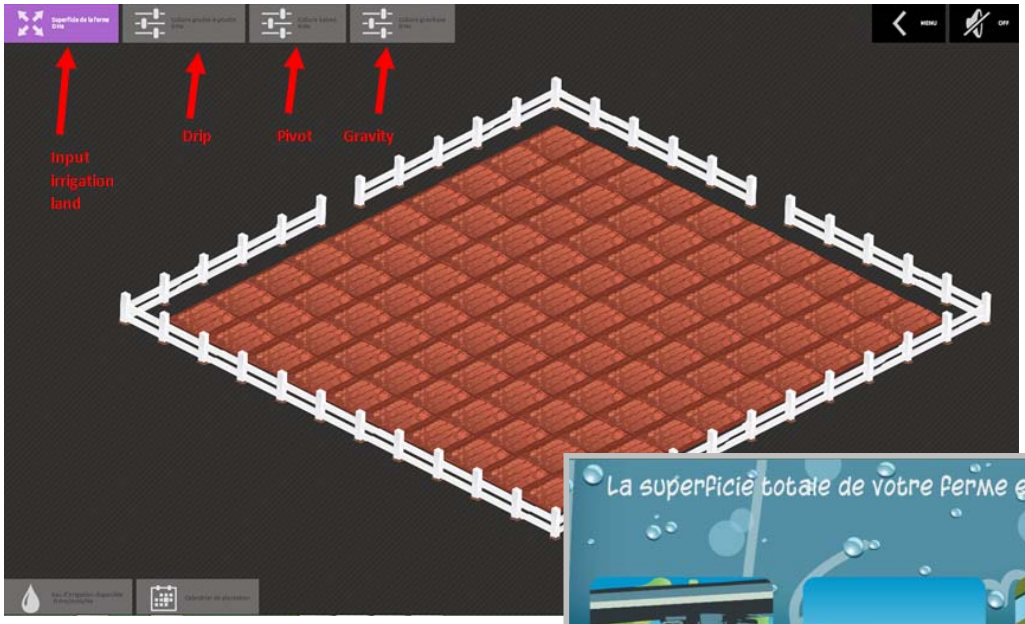
NAVIGATING THE USER INTERFACE

When the application is launched, the home screen presents the user with two options: “Demarrer,” (start), and “Parametres,” (parameters).

The simulation section will be described in detail first, and the parameters section, which allows the user to change any of the underlying assumptions of the simulator, will be described in more detail later.

THE SIMULATION

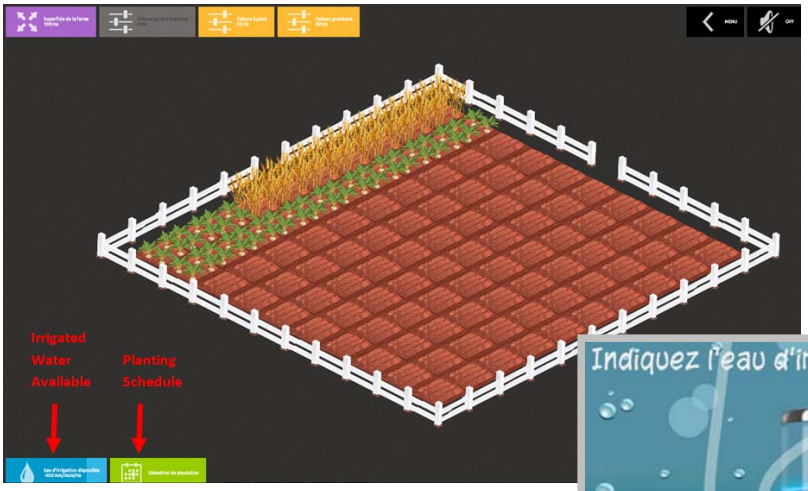
Once the user has clicked the “Demarrer” button to start the simulation, they will be presented with an empty plot of farmland to work with. The top left button allows the user to appropriate land to the different types of irrigation being used on the farm (drip, pivot, or gravity). The buttons to the right are enabled if any land is designated to that irrigation type.



Clicking on the Drip, Pivot, or Gravity irrigation buttons, allows the user to select the crops planted in that irrigated area.

The user can click the crop they wish to plant and use the slide bar to adjust the amount of land dedicated to that crop and irrigation type.

As crops are added, the farm plot is populated.



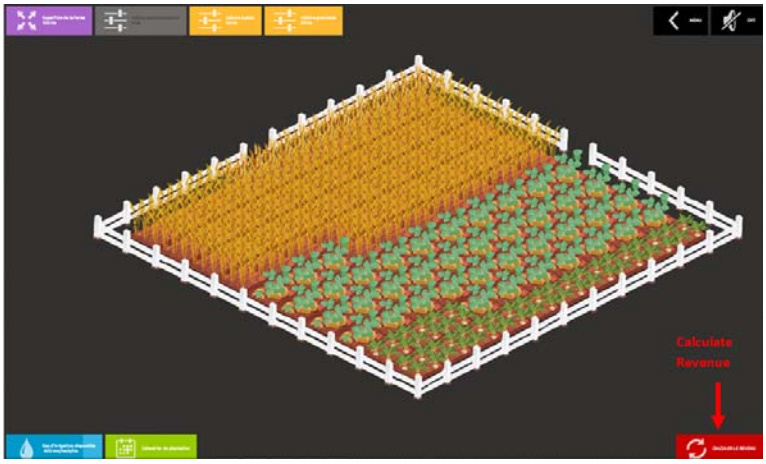
The bottom left corner of the interface has two buttons: "Eau d'irrigation disponible" (irrigated water available), and "Calendrier de plantation" (planting schedule).

Clicking the Irrigated Water Available button allows the user to adjust the amount of water available per month. This water will be divided among the different types of irrigated plots of farmland.

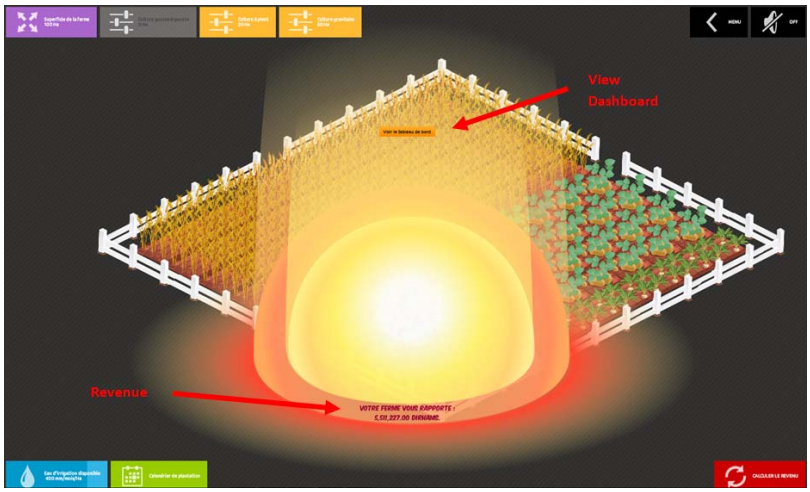
Clicking the Planting Schedule button allows the user to select the planting month for each crop. This will influence the water requirements and expected price at harvest.

When the farm has been populated with crops and water available, and the planting schedule has been made, the user is ready to calculate the profits.

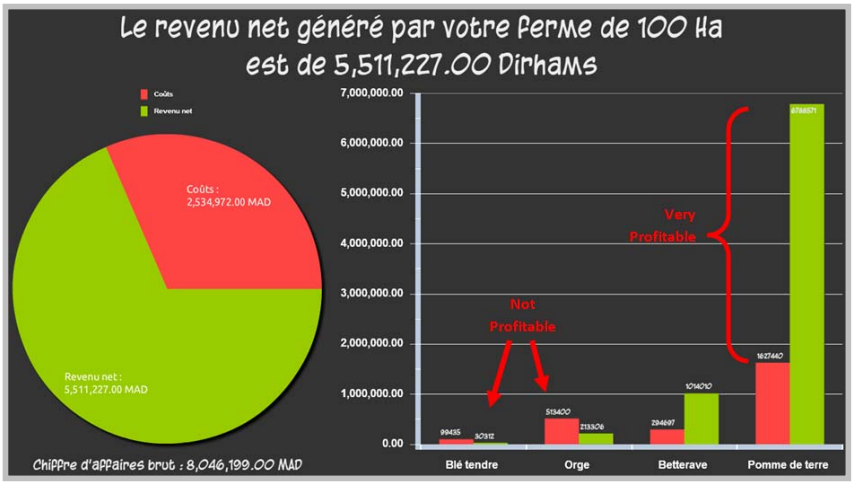
The button at the bottom right corner of the user interface, “Calculer le revenue” (calculate revenue), takes the user to the screen shown below.



Once revenue is calculated, the revenue is displayed on the bottom, and a button appears, “voir le tableau de bord” (view dashboard), which allows the user to see the details of the revenues and expenses of the crop mix.



The dashboard displays the revenues in green and costs in red, so the user can easily determine the most profitable crops to plant.



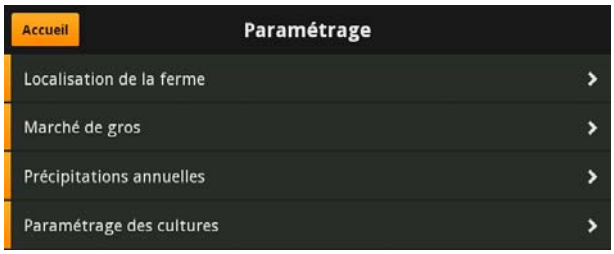
The data entered remains in the Farm Simulator, allowing the user to make minor adjustments to see how each change impacts the bottom line.

PARAMETERS

The Parameters section of the Farm Simulator allows the user to change the underlying assumptions of the calculations. This includes everythings from wholesale market prices to rainfall and temperature data of the geographic location.

After entering the Parameters section from the home screen, the user is presented with four categories of parameters to choose from:

1. Farm Location
2. Wholesale Market
3. Annual Rainfall
4. Crop Settings
5.



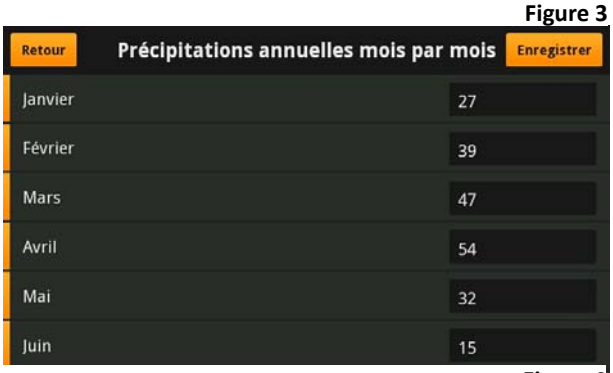
The **Farm Location** (figure 1) and **Wholesale Market** (figure 2) menus allow the user to select the location of the farm and market at which the crops will be sold. Both menus present the user with two options: (1) detect the nearest market location using the device's GPS, or (2) choose the nearest market from a dropdown list of several locations.

Figure 1

Figure 2

The Annual Rainfall menu (figure 3) allows the user to adjust the monthly rainfall in millimeters. These figures are used to determine the amount of water needed each month for the crops' water requirements.

Figure 3



The Crop Settings menu (figure 4) lets the user change the data behind each crop: Wheat, Barley, Sugar Beets, and Potatoes. Here, the user is presented with four categories of data for each crop:

1. Characteristics of [crop]
2. Water Requirements
3. Selling Price
4. Production Costs

Figure 4

The Characteristics menu (figure 5) displays and allows the user to make adjustments to the following information

1. The days needed to harvest
2. The reaction to a lack of water
3. Toggles for each type of irrigation permitted
4. The yield for each type of irrigation

Figure 5

The Water Requirements menu (figure 6) lists the monthly water requirements for a crop, in millimeters, based on the planting month. These take into account the monthly rainfall and temperature for the farm location (this is explained in more detail in the formulae section of this user guide).

Figure 6

The Selling Price menu (figure 7) provides the monthly selling price the farmer can expect for the location selected in the Wholesale Market menu. The user may change these prices, but default values are calculated based on historical price data for the location (explained in more detail in the formulae section of this user guide).

Figure 7

The Production Costs menu (figure 8), lists and lets the user manipulate numerous costs associated with production:

1. Rent
2. Labor
3. Fuel
4. Butane
5. Electricity
6. Equipment
7. Fertilizer
8. Pesticides, Herbicides, Fungicides
9. Seeds
10. Bags
11. Cartons

These represent the total costs associated with harvesting the crop, and will vary from farm to farm, depending on the crop as well as the farmer's reliance on farming equipment, property ownership status, and magnitude of operations.

BACKGROUND FORMULAE & UNDERLYING DATA

All of the underlying data can be adjusted in the parameters section of the Farm Simulator application. The default values are calculated using the methodology explained in this section.

CROP PRICE SEASONALITY FORECAST

Crop prices can be forecast using regression analysis. A regression of the historical price data, combined with sine and cosine functions to account for seasonality, can be used to make predictions of crop prices a few months into the future.

Due to lack of historical data, the Farm Simulator does not currently use regression to forecast prices; instead, predictions are made from 2011 price data for wheat, barley, sugar beet, and potato obtained from the Ministry of Agriculture's website[1].

Regression-based price forecasts can easily be incorporated into the Farm Simulator. The Ministry of Agriculture has historical price data for many markets across Morocco, which can be used as input for the regression-based price forecasts.

CROP WATER REQUIREMENTS

Water requirements for crops are calculated using the California Irrigation Management Information System, or CIMIS. An Excel-based tool published by CIMIS is used to obtain water requirements based on the type of crop, rainfall, and temperature of the region throughout the year. CIMIS also provides the time-to-harvest for different crops, which the Farm Simulator uses to determine the harvest month.

Rainfall and temperature data from the Slimania and Boughriba regions were used as input to CIMIS to obtain water requirements for each crop. As new geographic regions are introduced to the Farm Simulator, rainfall and temperature data can be input to CIMIS to accurately calculate the water requirements for different crops in those regions.

IRRIGATION TYPES

Different types of irrigation are more effective than others. The Farm Simulator makes the following assumptions about water absorption:

[1] http://www.prixagriculture.org/asaar/

Irrigation Type	Water Absorbed
Drip	90%
Pivot	75%
Gravity	50%

This is used to determine how much water is required for each crop and irrigation type. A crop requiring 50mm of water in January, for example, would need only 56mm of water with drip irrigation, but would require 100mm of water for gravity irrigation.

In addition to irrigation, rainfall must be taken into account. For this, the effective rainfall is determined using methodology from the Food and Agriculture Organization of the United Nations (FAO) which accounts for runoff, evaporation, and water that falls below soil levels where roots can absorb it[2].

YIELDS

Expected yields are estimated using formulae provided by the FAO[3]. The Farm Simulator approximates the relative water reduction impact on yield reduction. The complexity of such correlation is captured by a yield response factor, K_y, estimated for each crop through biological, physical and chemical processes. The relationship has shown a remarkable validity and allowed a workable procedure to quantify the effects of water deficits on yield.

$$Y_a = Y_x - (Y_x * K_y * (1 - (ET_a / ET_x)))$$

Y_a and Y_x are the actual yield and maximum yield under ideal conditions.

K_y is the yield response factor representing the effect of a reduction in evapotranspiration on yield losses. This value differs by crop and is obtained from FAO databases and shown in Table 1 below.

ET_a and ET_x are the actual and maximum evapotranspiration, respectively.

[2] http://www.fao.org/docrep/S2022E/s2022e08.htm#4.2%20determination%20of%20the%20effective%20rainfall*

[3] http://www.fao.org/docrep/016/i2800e/i2800e02.pdf

Table 1: Seasonal K_y values from FAO Irrigation and Drainage Paper No 33

Crop	K_y	Crop	K_y
Alfalfa	1.1	Safflower	0.8
Banana	1.2-1.35	Sorghum	0.9
Beans	1.15	Soybean	0.85
Cabbage	0.95	Spring wheat	1.15
Cotton	0.85	Sugarbeet	1.0
Groundnuts	0.70	Sugarcane	1.2
Maize	1.25	Sunflower	0.95
Onion	1.1	Tomato	1.05
Peas	1,15	Watermelon	1.1
Pepper	1.1	Winter wheat	1.05
Potato	1.1		

COST OF PRODUCTION (COP) ESTIMATES

The COP estimates used in the Farm Simulator were captured by surveying all inputs, both tradable and non-tradable, throughout the course of agricultural production in the Doukkala-Abda region of Morocco.

A chronology-based survey was used to estimate the cost of production for selected products. This type of survey retrospectively examines each step of the production process for a given product and, for each stage of production, asks the producer to recount the quantities and prices of inputs used for that stage of production.

A team of three field surveyors

Table 1: Domestic Resource Cost Ratio Estimates for Agricultural Products

	Wheat	Barley	Sugar Beets	Potatoes
Nontraded inputs per ha	8,206	7,614	13,425	10,097
Traded inputs per ha	6,683	5,197	10,425	31,557

Table 2: Domestic Resource Cost Ratio Estimates for Agricultural Products

Nontraded inputs per kg of output	2.05	3.13	0.25	0.45
Traded inputs per kg of output (at field)	1.67	2.14	0.19	1.39
Cost to get to Casa port per kg	0.16	0.16	0.36	0.16
Traded inputs per kg of output (at Casa port)	1.83	2.30	0.55	1.55
Adjusted border price per kg	2.91	2.56	0.85	3.34
DRC ratio	**1.90**	**11.93**	**0.82**	**0.25**

conducted the cost of production surveys for agricultural products in Zmamra, Sidi Bennour, Hed Oulad Frej, and Khmiss Metouh.

Table 2 displays the traded and non-traded inputs for each of the four crops used in the Farm Simulator.

Costs, therefore, are simply calculated by multiplying the total cost per hectare by the number of hectares dedicated to each crop.

Cost = Number of hectares (ha) X Total cost per hectare (Dirham / ha)

Revenue is calculated as follows:

Revenue = Yield (kg) X Price (Dirham/kg)

Profits are calculated using the basic formula:

Profit = Revenues – Costs.

MORE INFORMATION

For more information or questions contact the Morocco Economic Competitiveness project (http://www.programmemec.ma).