

United Nations
Economic Commission for Africa

Population **E**nvironment **D**evelopment **A**griculture **M**ODEL



Users Manual

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1 Installation Instructions

The Population, Environment, Development, Agriculture (PEDA) software is under licence of the United Nations Economic Commission for Africa (ECA). The model may be used for demonstrations but not copied or redistributed without the consent of the ECA.

Since the model is still undergoing sensitivity analysis, the software may still contain bugs and minor inconsistencies.

The model is now in a shell containing nine countries. Namely, Botswana (July 2000), Burkina Faso (June 99), Cameroon (December 99), Ethiopia (July 2000), Madagascar (June 1999), Mali (December 99), Nigeria (July 2000), Uganda (December 99), and Zambia (August 99). In future, more countries will be added to the database in the shell.

PEDA runs under Windows 95/98/NT with Office97 (preferably Office 97, Service Release 2) installed. Microsoft Office 97 Service Release 2 (SR-2) is a free update to Office 97. It contains a series of fixes for each program in Office 97. Details on update can be found at the following address:

<http://officeupdate.microsoft.com/downloadDetails/sr2off97detail.htm>

PRESENTLY, THE SOFTWARE MAY NOT FUNCTION PROPERLY WITH FRENCH VERSIONS OF OFFICE AND OFFICE 2000 INGGENERAL.

The speed of the application will depend on the speed of the computer.

To install the software, follow the steps below:

1. Make sure the PEDA CD-ROM is in the drive
2. Open the folder referring to the PEDA Shell
3. Double click on the 'setup.exe' icon. During the setup some system files are updated and you may need to restart your computer and restart the setup procedure before completing the installation.
4. In the setup screen, change the default directory to 'c:\Program files\PEDA Shell

Any inquiries about the model or its implementation, and comments about the software can be communicated to the Food Security and Sustainable Development Division (FSSDD) of the ECA:

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Addis Ababa
Ethiopia
fax +251 1 51 44 16
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<http://www.un.org/Depts/eca/divis/fssd/>

Additional information on the software can be downloaded from
<http://www.un.org/Depts/eca/divis/fssd/popin/> (click on 'software' in the options bar on the left
and look for PEDA)

2 Input and Output Variables

PEDA is an interactive computer simulation model (developed for a windows environment), demonstrating the medium to long-term impacts of alternative national policies on the food security status of the population. Through the manipulation of scenario variables, the model enables the user to project the proportion of the population that will be food secure and food insecure for a chosen point in time. As food security is a factor of developments in the field of population, agriculture, the environment and socio-economic development, the model demonstrates the relationships between these fields as well. It also includes the results of the first experiments to introduce an HIV/AIDS component and to illustrate its impact on the other variables in the model. As such the PEDA model is able to give answers to a wide range of policy questions regarding the nexus interactions.

This section briefly presents in tabular form the input and output variables of the model. For more details, please refer to the **Technical Manual**.

2.1 Input Variables

The general input variables are summarized in Table 2.1.

Table 2-1 : Parameter and variable definitions of the general model settings

Parameter or variable name	Description
Initial year	The starting year of the projections. This is the year to which the baseline data apply. This value cannot be changed by the user as it is part of the initialization process. It is only presented as a reference.
End of Projection period	The end of the projection period. All simulations will be run in single year steps up to that year and all results will be stored up to the end of the specified period. Although there is no direct limit set to the value of this parameter, projection periods of longer than 50 years will slow down calculations and may become very unreliable (see the Technical Manual for more information).
Production of Kcal per capita in the initial year	Refers to the average daily per capita amount of food produced in the starting year. All the agricultural production variables are treated as indexes to increase or decrease upon this initial volume of production.
Assumed min kcal per capita to be consumed in order to be food secure	In the PEDa model, calorie (energy) requirements are used as a proxy for food requirements. <i>"The minimum energy requirement is the amount of energy that is required on average in a population to satisfy the basic physiological needs and the needs for light activities of adults and the normal energy needs of children and adolescents (including the extra needs for the growth). Two main factors determine the estimation of the energy requirement of a population: the distribution by age and sex; and the body weight."</i> ¹ The value of this variable may thus vary under different national conditions, or the user can set the value to define different thresholds to evaluate its effect on the model interactions.
Land degradation impact factor	This variable reflects the assumed negative impact of population growth on the natural resource stock. See the Technical Manual for more detailed information on the definition of this parameter.
Proportion of the cohort moving from rural to urban areas	This variable enables the user to set net rural-urban migration rates. A value of 0.2 means that of every cohort born in rural areas, 20% will move permanently to urban areas over their lifetime. These movements are distributed over the different ages according to standard age-specific migration schedules (see the Technical Manual for more a more precise definition).

The sub-population variables include fertility (Total Fertility Rate), Mortality (Life Expectancy at Birth), Education (Literacy Rates), and HIV/AIDS Morbidity Rates.

¹ This definition is taken from the African Nutrition Database Initiative (ANDI) web site, at <http://www.africanutrition.net/>

Other input variables include those shown in Table 2.2 (endogenous/exogenous):

Table 2-2: Other Input Variables

Variable name	Description
Size of the rural labour force	Endogenously determined variable
Literacy of the labour force	Endogenously determined variable
Land	Endogenously determined variable
Fertilizer use	The amount and productivity of fertilizer used in agriculture. The user needs to set a value that expresses a relative improvement/worsening with respect to the conditions in the starting year.
Machinery use	The amount and productivity of machinery used in agriculture. The user needs to set a value that expresses a relative improvement/worsening with respect to the conditions in the starting year.
Technical education	In addition to literacy, the user can give value to specific technical capacity of the rural labour force for agricultural purposes. As with Fertilizer and machinery use, one needs to give a value that expresses a relative improvement/worsening of the conditions in a particular year as compared to the starting year.
Water related variables	
Climate	to be completed
Réservoirs	to be completed
Irrigation	to be completed
Loss in transport and storage	Individuals will not consume all the food that is produced. Some of the food will be lost during the treatment of the food, the transport or storage. This variable enables the user to take these effects into account.
Urban bias factor	This variable enables the user to allocate food disproportionately between urban and rural areas (see the Technical Manual for more information).
Food imports and exports	This variable allows the user to take food imports and exports into account. As all other variables influencing the availability of food it is treated as an index that has value 1 for the starting year of the projections.

2.2 Output Variables

Output variables include standard ones shown in Table 2.2.

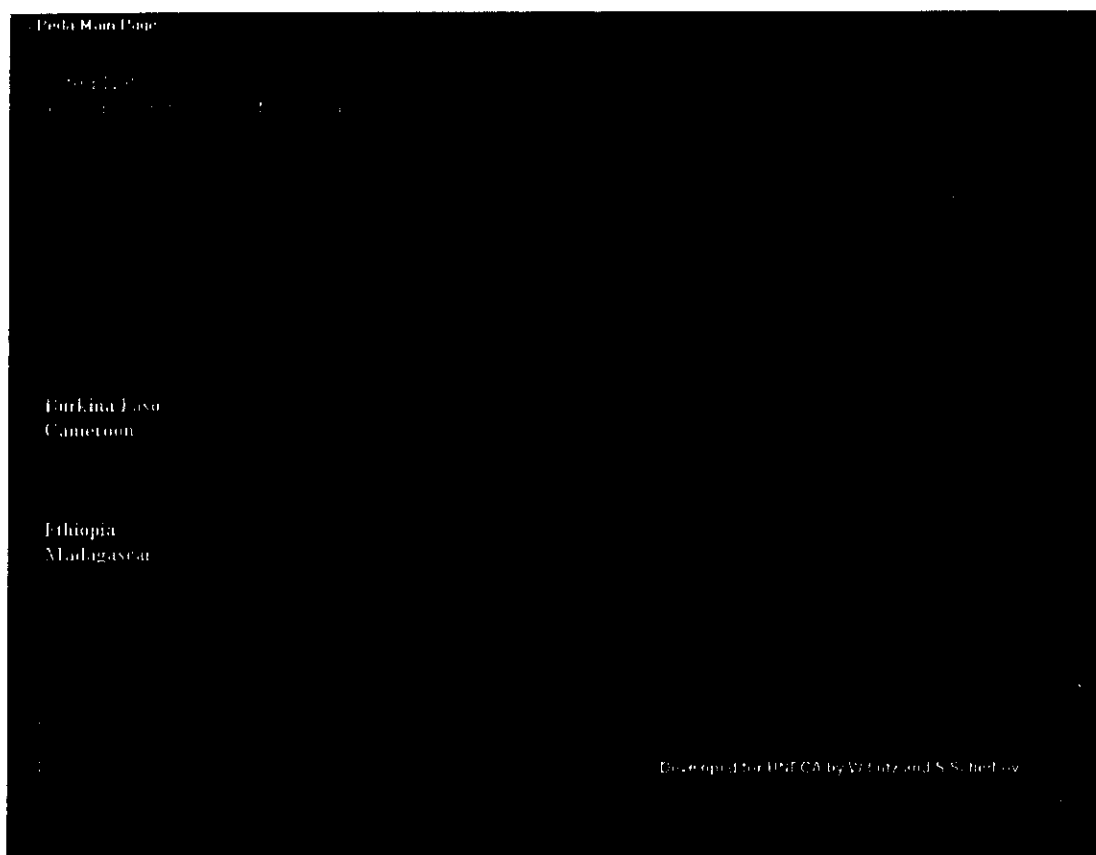
Table 2-3: standard output variables in PEDa

Variable	Variable description
Available food	This is the sum of the total amount of food produced in the country in a particular year minus the loss of food in the harvest, transport and storage, +/- food imports and exports. This indicator is only available for the country as a whole.
Births	Total number of births
Current land	The combination of the quantity and quality of land for each year of the projection period. Index value summing up the effects of land degradation and regeneration. This indicator is only available for the country as a whole.
Deaths	Total number of deaths
Life expectancy (e_0)	When requested for each of the eight sub-groups separately and sex specific, this is the graduated value of the assumptions of the user. At the country level, however, it is also influenced by the relative weights of the subgroups in the population (provided that different life expectancies have been set for the different subgroups). See the Technical Manual for more information).
Literate Life Expectancy (LLE)	See the Technical Manual for more information).
Fertilizer	Is an input variable.
Food import/exports	Is an input variable
Food production	This is the sum of the total amount of food produced in the country in a particular year. This indicator is similar to food availability, but it does not account for loss in the harvest, transport and storage or food imports or exports. This indicator is only available for the country as a whole.
HIV/AIDS morbidity rates	Is an input variable
Irrigation	Is an input variable
Loss in transport/storage	Is an input variable
Machinery	Is an input variable
Proportion food insecure	In addition to the population size that can be generated by urban/rural place of residence, literacy status and food security status; the model has an extra output variable that portrays the proportion food insecure in the country for any year of the projection period. This indicator is only available for the country as a whole.
Total population	Population size. It can be generated for each of the eight subpopulations separately and for both sexes separately. There is also a possibility to extract age specific information from the databases. See the Technical Manual for more information).
Technical education	Is an input variable
TFR	When requested for each of the eight sub-groups separately, this is the graduated value of the assumptions of the user. At the country level, however, it is also influenced by the relative weights of the subgroups in the population (provided that different fertility rates have been set for the different subgroups)
Urban bias factor	Is an input variable
Water	See the Technical Manual for more information

3 How to use the PEDa Software

3.1 General Instructions

The PEDa software runs under Windows, is based on Excel spreadsheets and uses the Access database. PEDa will run on any machine with Windows, but the power of the machine will influence the speed of calculation. When you start the PEDa application, you will see the following welcome screen.



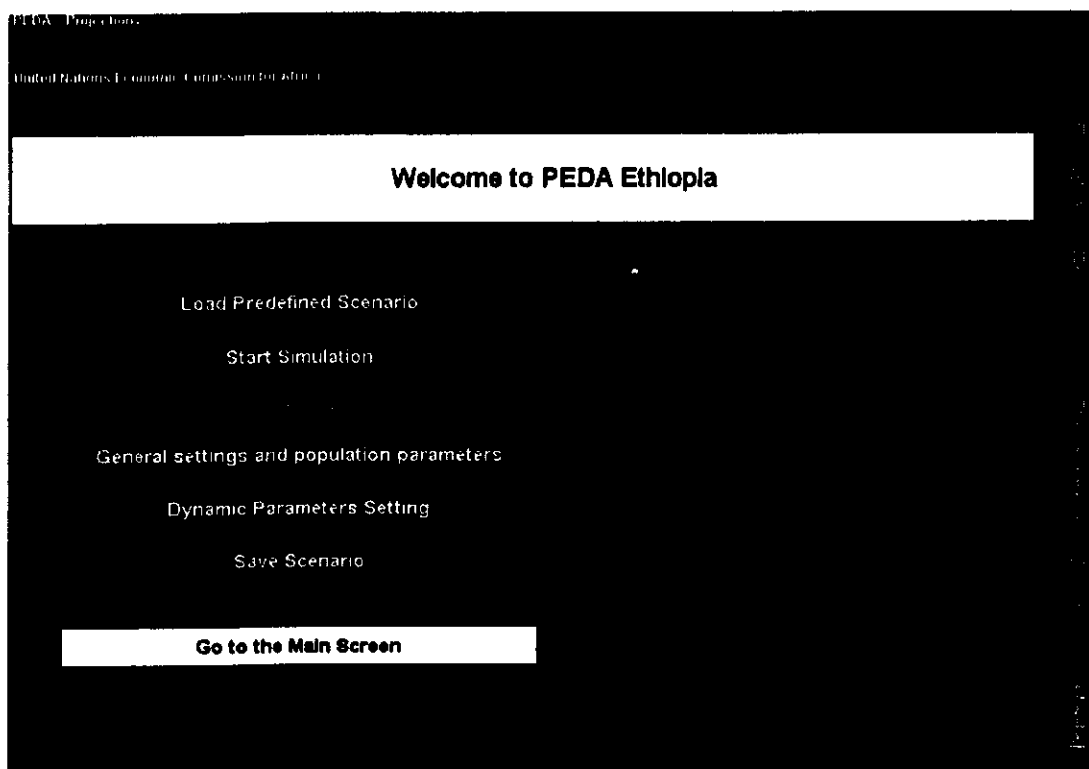
On this screen you can choose among four options:

- "Learn about the model" will give you more information about the structure of PEDa. The most complete description is given in the Technical Manual (Chapter 2).
- "Simulation" will first ask you to choose among one of the countries that has been initialized for PEDa and will then bring you to the country specific simulation screen.

- "Presentation of results" will directly bring you to the results of previously calculated and stored scenarios for the countries indicated.
- "Exit" will end the application.

3.2 Using scenario settings and simulations

If you click on Simulation, e.g. for Ethiopia, you will see the below given country specific screen *Welcome to PEDA Ethiopia*. PEDA can only be run for countries that have been initialized. This means that data on the starting conditions and on certain country-specific settings have already been entered. Initializing the model for a new country is not a trivial task and requires substantive analysis and knowledge about the country as well as sufficient knowledge of Excel. More information about the initialization process is given in the Technical Manual (Chapter 5). Here we only discuss the scenario variables and parameters that can be set on this user surface.



The button on the top allows you to load an already predefined scenario. This is a useful option if you already have a certain baseline scenario that shall be compared to other scenarios in which only a few variables will be changed. Other buttons let you save the current scenario settings for later reference, let you start the simulation (once you are satisfied with all parameter settings for one specific scenario), and let you go back to the main screen.

The next three buttons enable you to change the current scenario settings. The setting of scenarios can be done in two different modes, the General settings and population parameters button allows you to change parameters that are kept constant over the projection period or can be set to change in a piecewise linear fashion over time (like fertility and mortality). For other variables under the Dynamic parameters setting button you can freely define any time path over the simulation period. In order to set those parameters or see what the predefined values of the parameters are, click the appropriate box.

3.2.1 General model settings and population parameters

If you click on the General settings and population parameters button you get the following screen.

The screenshot shows a window titled "Setup of Parameters". It contains a list of parameters with their corresponding values in input boxes:

- 1995
- 2030
- 1830
- 1500
- 0.02
- 0.2

If you choose the folder "General" tab, you will be able to set some of the basic model specifications that cannot be changed over time or across sub-populations.

Among these general parameters you can first specify the initial year of your calculations. This is typically the year for which the specific country application has been initialized, i.e. in most cases the last year for which empirical information is available (but you can also choose other dates if you have specific reasons to do so such as simulating "alternative histories").

Next you can determine the end of the projection period. All simulations will be run in single year steps up to that year and all results will be stored up to the end of the specified period. PEDDA will run scenarios for end points up to the year 2050.

On this general parameter screen you can also enter the calorie production per capita per day in the initial year (in kcal) and the assumed minimum consumption in kcal per capita in order to be considered food secure. This minimum requirement can be chosen according to the definition of malnutrition and food security that you prefer. It will enter the calculations for determining the proportion of the population that will be considered food insecure. This specification will have significant impacts on the results: if the minimum requirement is specified to be rather high then this will result in a greater proportion of the population considered food insecure and vice versa.

On this screen you can also set the "land degradation impact factor" which lets you define the assumed impact of an increase in the food insecure rural illiterate population on the land variable. This factor will enter a non-linear land degradation function (see Technical Manual), which also considers population density and the state of the land resource. The state of current land (which combines quantity and quality aspects) will then enter the food production function. This assumed effect of an increase in the food insecure rural illiterate population is one of the two feed back loops in the model that go from the population to food production. The other one operates through the size and skill level of the population.

Since this model distinguishes between urban and rural areas, migration between the two areas also needs to be considered. This is done by making assumptions on the net movements from rural to urban areas, which is specified here in terms of the proportion of a cohort moving to cities. A value of 0.2 thus means that of every cohort (group of people born in the same year) 20% will move permanently to urban areas over their lifetime. In the actual calculations these movements are distributed over the different ages according to standard age-specific migration schedules.

If you go to the tab "sub-populations" you can set parameters separately for each of the eight sub-populations listed. By cross-classifying food security status, literacy status and rural/urban place of residence eight states are being defined and PEDDA performs population projections by age (single year) and sex for each of the groups also considering movements between the groups in every year. By simply clicking on the field with the name of the sub-population, e.g. the rural/ illiterate/food secure as seen on the screen below, you get a form for defining trends in fertility and mortality of that specific sub-population and educational transition rates for women and men.

For setting future trends fertility, as described by the Total Fertility Rate (TFR), i.e. the mean number of children per woman, and mortality, as described by life expectancy at birth follow a similar scheme. The user has to first enter the values for the starting year of the simulation

Setup of Parameters

Overall Settings for the model

Urban, Literate, Food Secure

1995	4.2820	1995	64.73	60.42
2005	3.5683	2005	70.90	66.46
2015	2.8546	2015	77.05	72.40
2030	2.2837	2030	84.84	79.88

(which is a question of getting empirical data or appropriate estimates). Then scenario assumptions for fertility and female and male life expectancy for three points in the future can be entered. If two subsequently specified values are different, the model will automatically calculate a gradual linear change between the two points in time. Hence the specified fertility and mortality scenarios will be piecewise linear.

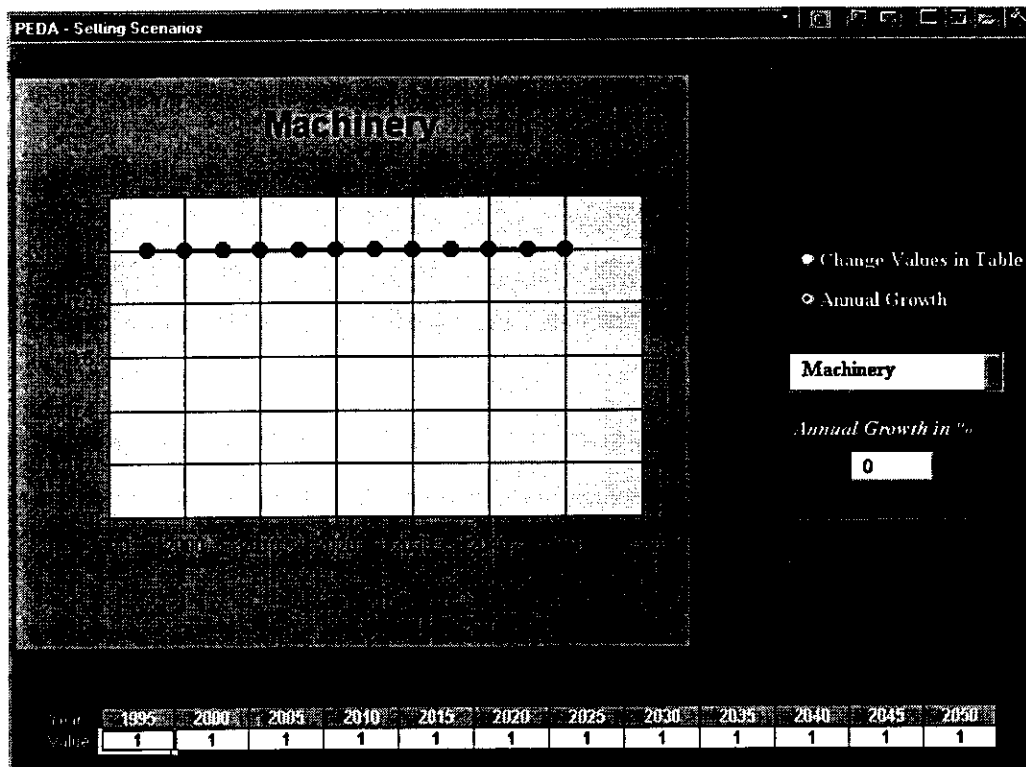
The user has to keep in mind that the resulting trend in the fertility and mortality of the total population does not only follow from the paths specified in this manner but will also be influenced by the changing weights of the various sub-populations. If you assume for instance constant fertility at 4.0 for the illiterate and at 2.0 for the literate population, and over time the female population of reproductive age will become more literate, the aggregate fertility level of the total population will show a declining trend. In this sense the aggregate fertility and mortality levels are already a result of the scenario calculation and cannot be specified as a specific scenario assumption.

Under "Education" you can specify the proportion of women and men in each birth cohort that will move over their lifetime from the illiterate to the literate state. The age pattern of this transition to the literate state can be specified during the initialization process. For sub-groups that are already educated you will see a screen without educational transition because in PEDa there is no movement back to the illiterate state.

3.2.2 Dynamic parameter settings

If on the country specific screen ("Welcome to PEDDA Ethiopia") you choose the button with Dynamic Parameters Setting you will see the following screen on which you can choose from the right hand list (which you get by clicking on the little arrow next to the currently listed variable) which scenario variable you want to set. The exact interpretation of these variables and the functional form in which they enter the model are given in the Technical Manual (Chapter 3). Fertilizer, machinery and technical education will directly enter the food production function with certain elasticities. Food Import/Export and the Urban Bias Factor relate to the distribution of food to the population. Water is essentially a climate variable referring to rainfall and soil moisture. The initial value of water is set during initialization to correspond with the country's climate conditions. The impact of water on food production is modeled in a highly non-linear way with additional water having a strong effect under dry conditions, then coming to saturation where more water brings little change in output and finally moving to flood conditions where more water is destructive. Decreasing or strongly increasing the water variable in certain periods can simulate draughts or floods. The irrigation variable measures the efforts in irrigation but its effect will also depend on the availability of water. AIDS morbidity finally gives an estimate of the proportion of the young adult population that is already symptomatic with AIDS. This specified level will influence the shape of the age-specific mortality curves applied. Its setting should be consistent with the time paths assumed for life expectancy. The Technical Manual gives information of how to do this (Chapter 5).

Except for AIDS morbidity and water, these variables are all treated in index form, which means that their level in the starting year is set to be 1.0 and their levels in all the subsequent years are seen as relative to this starting year. This setting allows you to use the model even if you do not have empirical information about the exact quantitative level of each factor since you only have to specify the relative change as compared to the starting year.



You can change the factors over time either by setting the values numerically in the table below the chart (click on "Change Values in the Table" in upper right corner) or by applying a constant rate of annual growth (click on "Annual Growth").

For practical reasons the options for setting values numerically are limited here to every fifth year with intermediate years being interpolated for the simulations.

It is also possible to combine the automatic application of a growth rate with specific numerically entered deviations from the exponential path in certain periods. For this you must first apply a constant growth rate (do not forget to apply it by clicking the ok button), then switch to the manual setting option and change the values in the table as desired. The graph will always give you a representation of all annual values resulting from that procedure.

3.2.3 Simulation

After you have set all the scenario parameters that you want for a specific simulation run, you click the Return button and go back to the country main screen. There you can either save

the scenario that you have just defined or load another already defined scenario. Then you can click the "Start Simulation" button. This will bring you to the following screen.



Simulation in progress

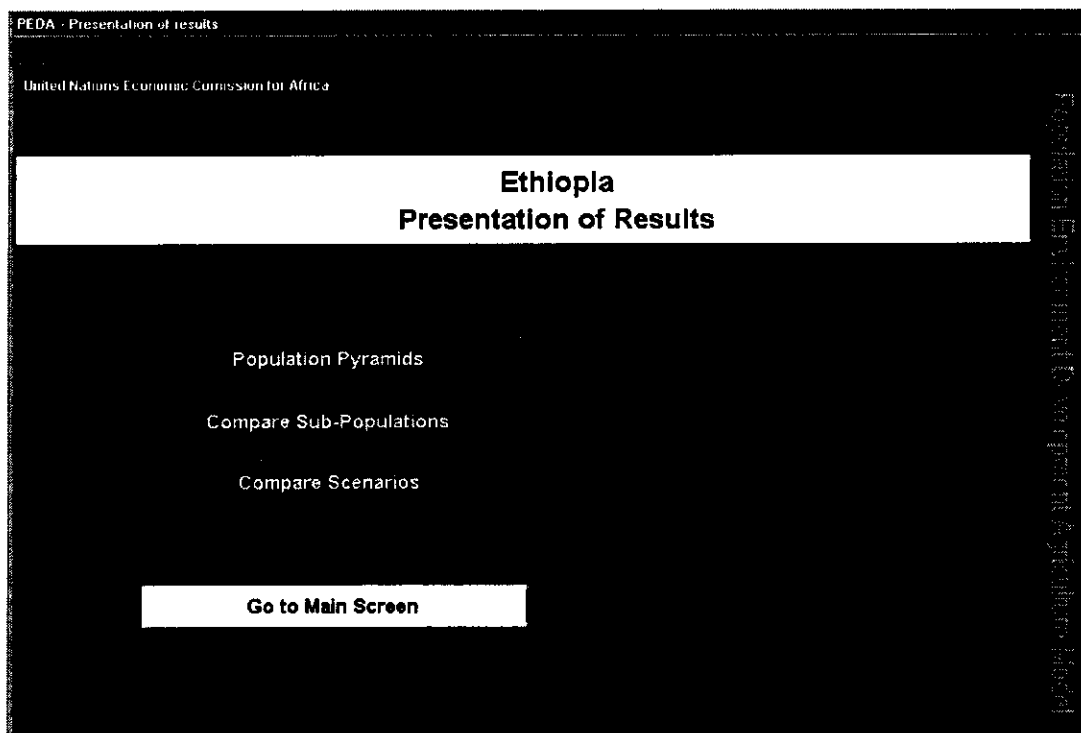
In order to know which scenario you are using, every scenario must be given a name (e.g. "baseline"). In the box below the name you may specify some more detailed information about what you have assumed in the scenario in case you want to have it for future reference. It is not necessary, however, to make notes on individual assumptions because in the case of any doubts the software lets you easily check all specific values assumed for each scenario. This same form will come up whenever you save scenarios or load already existing scenarios.

The "Continue" button will start actual simulation of the model according to the scenario assumptions currently loaded and then bring you back to the country main screen from which you can either specify additional scenarios or exit to the initial screen (the very first one with the PEDDA logo). From there you may enter the presentation of results mode by clicking on the "Presentation of results" button.

3.3 Presentation of results

For the graphical presentation of results you can choose among three different kinds of graphs:

- a) Simple or animated Population Pyramids (by age and sex)
- b) Compare Sub-Populations for any given scenario.
- c) Compare Scenarios for any given sub-population or the whole country.

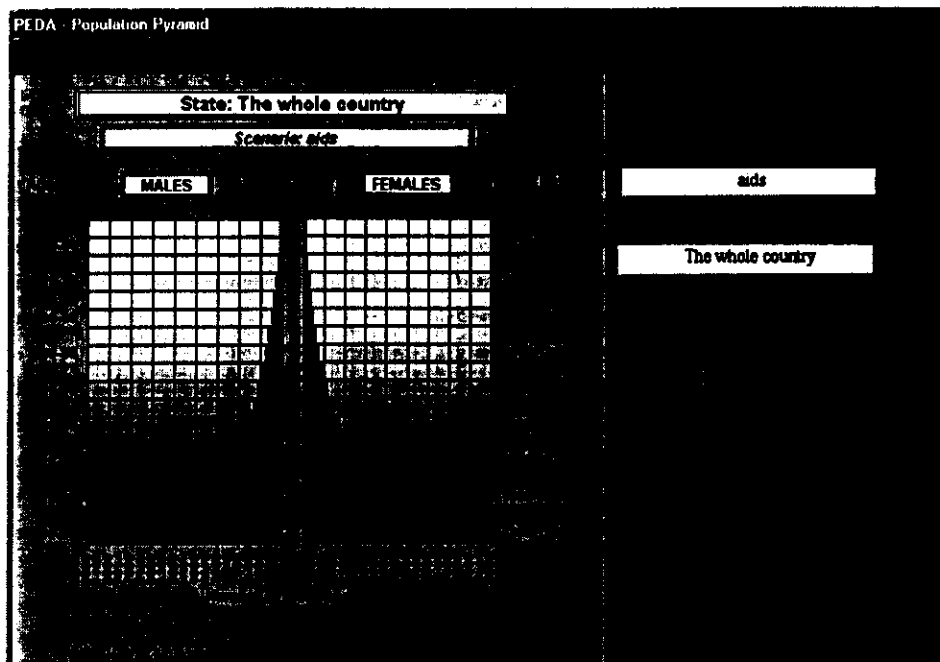


On the graphs, the numerical values corresponding to any point of the line charts will be displayed by moving the mouse to that point.

Since all the results are stored in a database, any table with an appropriate selection of numerical data can be printed on either paper or in a file for further processing.

3.3.1 *Population pyramids*

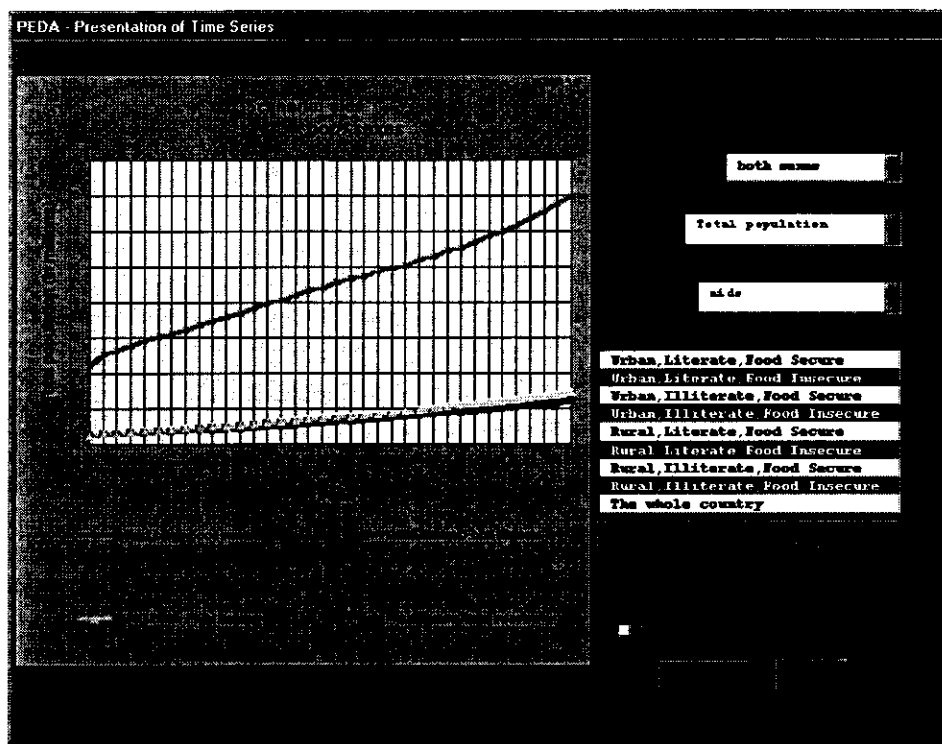
If you click the "Population Pyramids" button, you will see the following screen:



For any scenario or sub-population (here called state due to multi-state population terminology) that you choose, you see the usual age pyramid with men on the left and women on the right sorted by age. For the purpose of display, the single-year age groups of the model have been aggregated into 5-year age groups. By moving the time bar (click on the center piece and move left or right while holding it), you can choose an age pyramid for any simulation year (in a single or 5-year steps). Alternatively, you can choose an animation, which will show the gradual evolution of the age structure over time if you click on "Animate". These animations can give you a better feeling of the dynamics of the system than only looking at static information. The year stated on top of the pyramid always tells you at what year you are looking. Similarly, the name of the scenario and of the sub-population under consideration are indicated.

3.3.2 Compare subpopulations

If you click on the "Compare Sub-Populations" button on the Presentation of Results screen, you get the following picture which compares the trends over time for different sub-populations under one given scenario.



On the right hand side of this presentation screen, you have different options. First, you can choose to plot men or women or both sexes and secondly, you can choose the demographic indicator to be plotted, which is total population in our example. Next, you must select the scenario for which you want to compare the sub-populations.

In the box below, you can click on any of eight sub-populations (called state here) that shall be shown in the graph. You can also choose any number and any combination of sub-populations. Moreover, by clicking on the button "Aggregate" below you can calculate the sum of the chosen sub-populations to be also presented on the graph. To verify your choice you must hit the Click to Confirm Selection button.

As indicated before, you can read the exact numerical value of each point of the graph by moving there with the mouse.

1

3.3.3 Compare scenarios

If you click the third presentation option "Compare Scenarios", you will see a similar screen, which compares different scenarios for any selected output indicator and any specific sub-population or the whole country. To do this again, you can choose the sex, the indicator to be

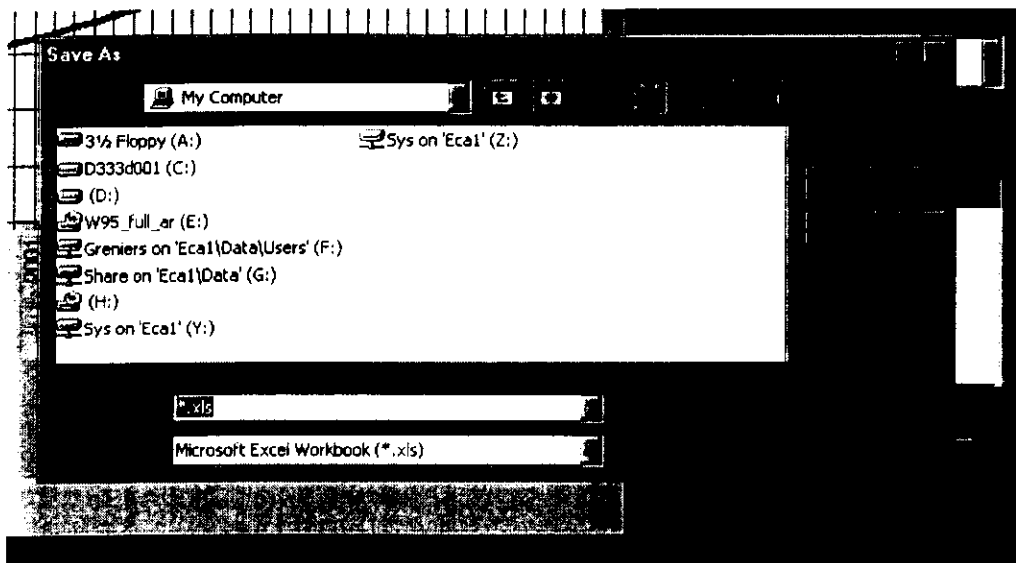
plotted and the state (i.e. the sub-population) to be studied. You will then see line charts over time for all the scenarios that you have defined.

3.4 Additional Useful Features

One very useful option is that under the selection of indicators you can also view some of the most important scenario assumptions that underlie the different scenarios that you examine. Hence, if you do not remember what you assumed in terms of e.g. the machinery production factor in the different scenarios, you can select this indicator on the list and then the graph will display the assumed trends of this parameter for all scenarios. After this, you select again the resulting population size and can compare the assumptions to the results.

On the top line of each of these screens, you find additional options. You can either zoom in, i.e. enlarge the graph, or zoom out, i.e. reduce the graph by clicking on the corresponding boxes on the menu bar.

An important option is the save table button. If you click it, you will get an insert as shown on the following screen print:



On this insert, you can specify the file name under which the table should be stored. These tables can then be formatted and transformed in any way that Excel allows.

Finally, if you want a print out, you can click on the "Print" options and can specify the printer where the graph shall be printed.