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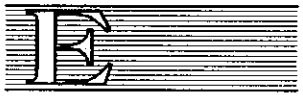

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PEDA: POPULATION, ENVIRONMENT, DEVELOPMENT AND AGRICULTURE

CASE STUDY: BURKINA-FASO

ECONOMIC COMMISSION

FOR AFRICA

PEDA: POPULATION, ENVIRONMENT, DEVELOPMENT AND AGRICULTURE:

A CASE STUDY OF BURKINA-FASO

Introduction

The three major challenges that confront African states, which will largely determine the future prosperity of their people are the high rate of population growth, agricultural stagnation and degradation of the natural resource base. These intertwined challenges impact negatively on the quality of life of the population and have serious implications for the poor especially the youth and women. Although these challenges have been addressed separately by researchers, policy makers, donors and non-governmental organisations in the past, there has been a discerned shift from pre-occupation with sectoral issues to consideration of sectoral linkages in the last few decades. It is within this general context of the new development paradigm that the nexus concept has been advocated by the ECA.

The Nexus concept was first promoted by the World Bank in a publication Reversing the Spiral: The Population Agriculture and Environment Nexus in Sub Saharan Africa. The authors asserted that their findings confirm the hypothesis of strong synergies and causality chains linking rapid population growth, degradation of the environmental resource base and poor agricultural production performance. Although this synergistic relationship can be established at the grassroots level, operationalising the concept in modern economies which are sectorally developed and managed is a daunting challenge. The concept is equally challenging to researchers who are accustomed to addressing these issues from the viewpoints of their different disciplines.

In order to understand the complex interrelationships among the NEXUS issues – rapid population growth, environmental degradation and food security and how changes in one nexus component affect the others a population-based computer model known as PEDA (Population, Environment, Development and Agriculture) has been developed by the Economic Commission for Africa.

What is PEDA

PEDA is a population based interactive computer model intended to be used in understanding within a holistic framework, the interrelationships between population change (P), environment (E) socio-economic development (D) and agriculture (A). It can also be used to demonstrate the impact of different policy options on the achievement of food security and by implication poverty reduction and sustainable development in African countries. The model offers opportunity to deal with cross cutting issues which do not get adequate attention from sectoral ministries. The issue of food security for example, has to do with population, the skills of the labour force, agricultural production technologies and environmental issues such as soil quality and water availability. These diverse aspects do not fall under the responsibility of any ministry. The use of the PEDA model would underline the necessity for several ministries to work together on such cross-cutting issues.

To illustrate the usefulness of the PEDA model, it is applied to Burkina Faso where there is available data and it is therefore possible to project the possible outcomes of various policy options.

The Country Profile: Nexus Issues

Burkina Faso is a landlocked West African country which shares boundaries with Ghana, Togo, Benin, La Cote d'Ivoire and Mali (Fig.1). With an annual per capita income of US$300, Burkina Faso is one of the poorest countries in the world. The human resource indicators are extremely low. The total literacy rate is 19 percent (9 percent for women), the gross primary enrolment rate is only 38 percent. These compared with 57 percent literacy rate and 68 percent primary enrolment for sub-Saharan Africa.

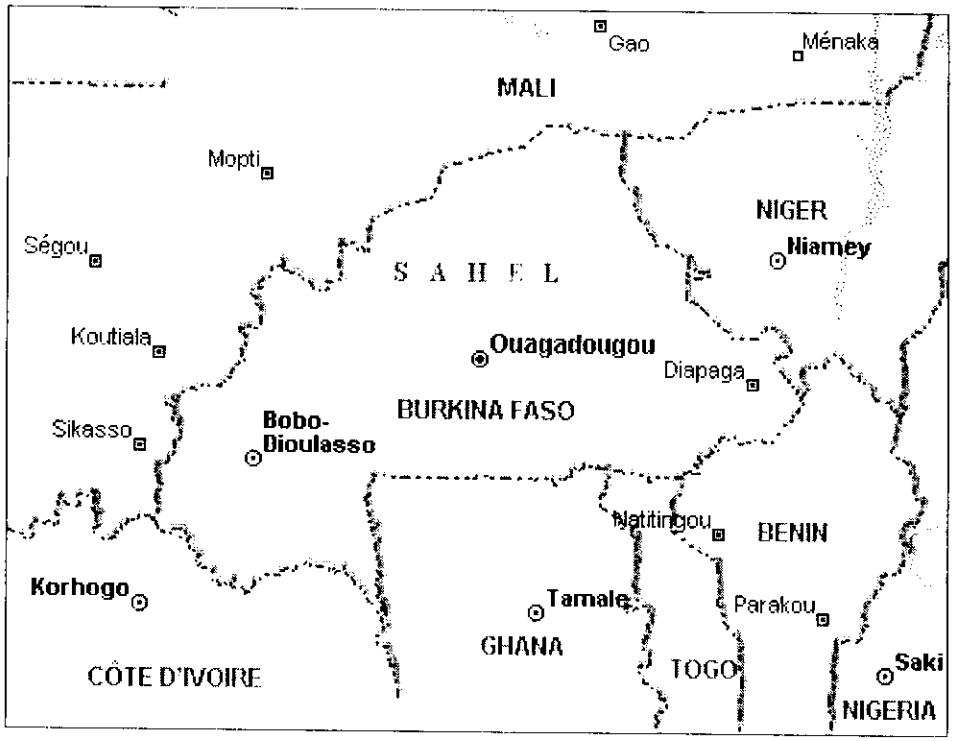


Fig 1. Map of Burkina Faso

Life expectancy is 48 years compared to 52 years for sub-Saharan Africa and infant mortality is 238 per thousand live births as against 92 per thousand for sub-Saharan Africa. Poverty affects 44.5 percent of the population, majority of them are in rural areas. The causes of poverty and food insecurity in Burkina Faso have largely been attributed to the negative synergy of rapid population growth, agricultural stagnation and environmental degradation.

Population

Population of Burkina Faso is estimated at 11.4 million and a growth rate of 2.8%. Females account for 52% of the population. The population is a young one with 47% aged under 15 years of age (Fig.2). The total fertility rate remains at a high level of 6.6 while life expectancy is 46 years with infant mortality rate of 97 per 1000 births.

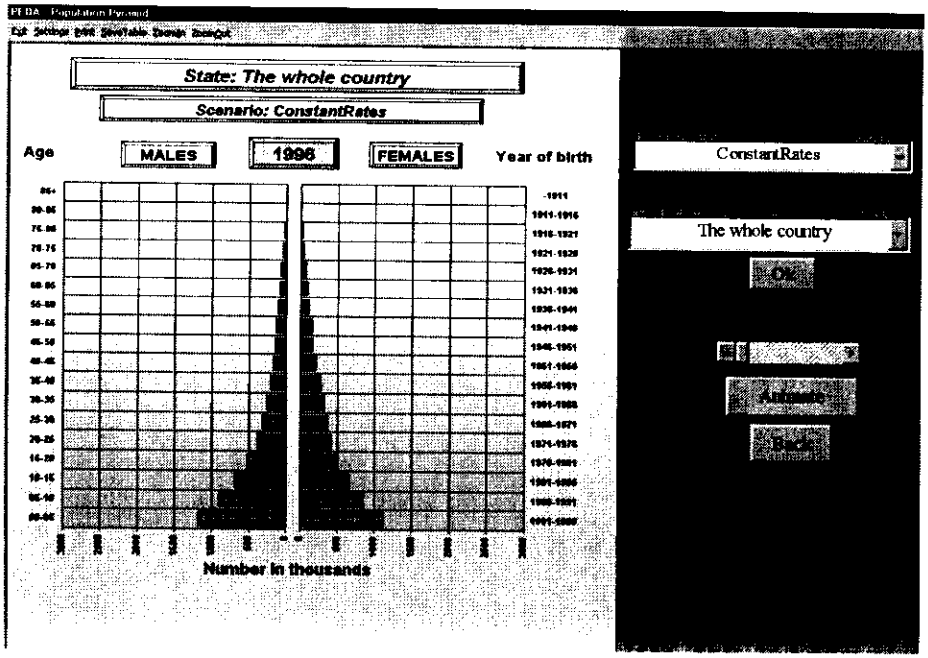


Fig. 2 The population structure of Burkina Faso

The urban population constitutes about 16.4% of the total population. Ouagadougou, the capital, has a population of 824,000 people although it is increasing by 6%. Urban sanitation is not improved. The capital city has no sewerage system with only 32%, 35% and 40% of the population connected to water, electricity and garbage collection respectively.

Environment

Burkina Faso lies in the Sudan-Sahelian zone with variable rainfall, short cropping season and a high risk of drought. Rainfall increases from the north (annual rainfall of 400-650mm) to the south (1000-2000mm a year).

The variation is higher in the north (30%) and decreases to the south (20%). The risk of crop failure follows the same pattern. Following the drought of 1970, more than 1100 dams of various sizes have been built, the largest ones are Kiompieng, Bagre, Camoe and Zia. About 70 of these dams are used for irrigation purposes. The total land area that could be irrigated is about 165,000 hectares. Only 13.6 per cent of this land is now irrigated with an annual increase of 500 hectares.The most important soils are luvisols and regosols. They are generally poor in nutrients and subject to serious erosion on sloping land.

In 1996, the total land area was 27.4 million hectares. with only 12.5% being arable land. Forest and woods in 1994 formed 50.4% of land area. Only 0.7% of arable land is irrigated.

Because of the high population growth and low level of technology, more land was put under cultivation leading to a high rate of deforestation estimated at 0.7% a year between 1980 and 1995. It is estimated that in the 1980s, as much as 80% of fauna habitat was lost due to deforestation.

The other factor contributing to deforestation is fuelwood use (Fig. 3). Fuelwood use is the main energy source in rural areas (90%) due to low incomes of major rural households.

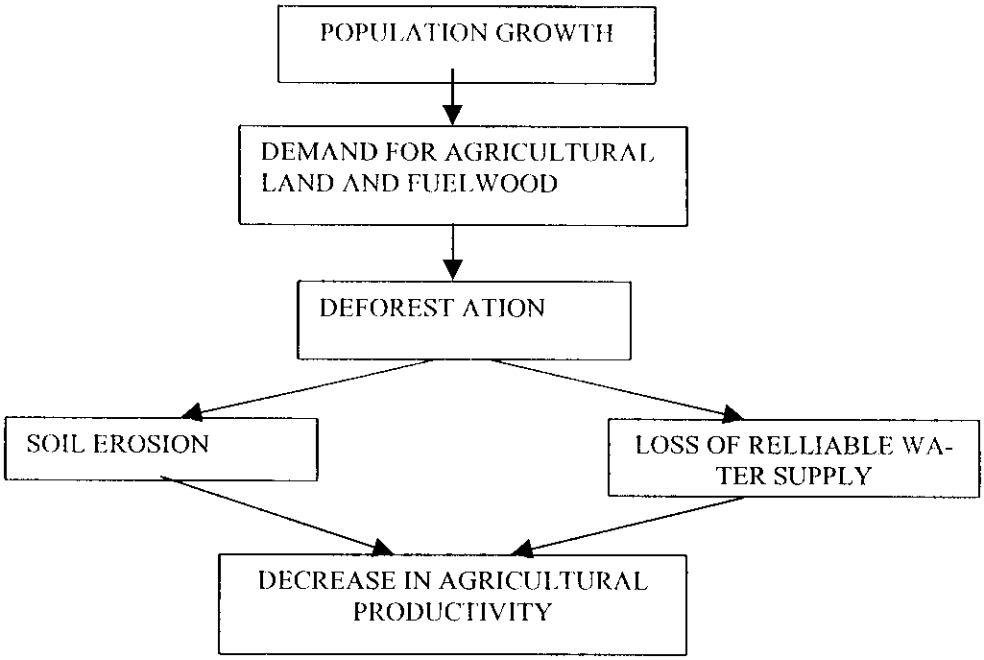
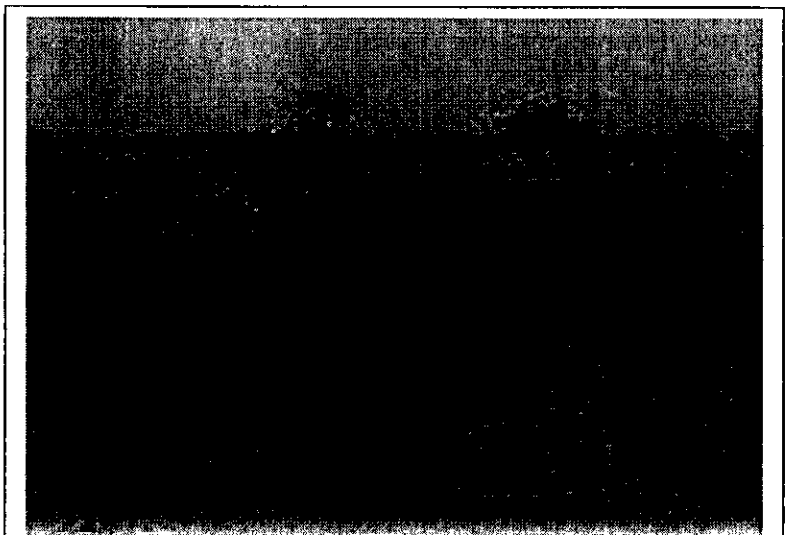


Fig.3: Population and Environment linkages



As a result, environmental degradation typified by land degradation in the form of soil erosion and infertility, desertification and deforestation is serious in Burkina-Faso.

Fig.4: Soil Degradation in Burkina-Faso

Technology and Agriculture

Burkina-Faso's utilization of inputs is very low. The total machinery use in 1996 was 1,950 which is only 4% of that of Morocco while fertilizer use is 24,095 metric tons, a mere 8% of that of Morocco. The application of a comparatively small amount of inputs has resulted in the low productivity of agricultural output of Burkina-Faso. In 1997, the productivity of cereal was 7,050 and this was 59% of Africa's average while that for roots and tubers was 58,644, 74% of Africa's average.

While agricultural productivity has been low, the competitive environment created by trade liberalisation is making the production of most resource-based crops such as cotton and maize uncompetitive in the world market. This is due to the fact that most of the industrialised world subsidises agriculture in terms of inputs and infrastructure such as good roads, uninterrupted supply of electricity, water and telecommunication facilities.

Food Security

With 1989-1991 as base year, per capita food production in Burkina-Faso and Africa as a whole has been lower for 1997 and 1998 although food aid as a whole has reduced. Food aid in Burkina-Faso has reduced from 66,300 metric tons in 1970 to 20,000 in 1997.

Food self-sufficiency has fallen from 98% in 1961 to 78% in 1978 and there has been no improvement since then. Per capita food index has fallen from 112 in 1970 to 101 in 1980, 98.4 in 1990 and 95.2 in 1995. The average daily per capita supply of calories has only improved slightly. For Burkina-Faso, this increased from 2,054 in 1990 to 2,137 in1996. This is still below the recommended minimum of 2,400.

Policy Interventions on NEXUS Issues by Government

Reducing the Rate of Population Growth

Confronted with the challenges posed by a rapidly increasing population and the imbalance between population and resources the Government adopted in 1990 a Population Policy Paper, "Politique de la Population au Burkina Faso" which has the following objectives (i) intensify information on family planning and its advantages (ii) extend family planning services to all rural areas and (iii) provide the supply of contraceptives on community basis or social marketing. The policy is being revised to reflect the recommendations for the 1994 ICPD in Cairo and the Fourth World Conference on Women in Beijing.

The implementation of the population programme is coordinated by the Counseil National de Population, CANOPO which is based in the Ministry of Finance. The country has also developed a strategic plan for Reproductive Health, which covers maternal, and child health, family planning, control of sexually transmitted diseases including HIV/AIDS. A population study was funded in 1994 to determine the impact of migration inside the country and across the border.

Improving Human Resource Capital

The Family Code which was adopted in 1990 aims at protecting the rights of women in traditional society. For instance, the code has shifted the legal age at marriage from 16 to 17 for girls. There is a national strategy to improve women's access to primary health care, agricultural support services and to increase the enrollment ratio of girls to primary education. There is a Ministry of Women's affairs charged with the responsibility of advising Government on issues affecting women. Several structures have been put in place to promote practices that enhance women's status and discourage those that subjugate the rights of women. These include the National Committee for the Promotion of Women (CONAPAF) and Commite National de Lutte Contre la Pratique de l'Excision (CNLPE), i.e., National Committee to Fight Against Excision Practice.

Improving the Environment and Natural Resource Management

The major environmental concerns are deforestation resulting from the extensive nature of farming and bush fires, degradation and erosion of soil and pollution especially in the urban areas. To address these concerns the Government adopted a National Environment Plan of Action (PANE) in 1991. The country also has a National Plan for Soil Management. The PANE serves as a framework for developing programmes in the environmental sector. For example, community-based environ-

mental management schemes have been introduced. In addition to governmental efforts there are several environmental NGOs working in various communities to address environmental problems.

Improving the Economy

Burkina Faso is now involved in Structural Adjustment Programmes with such implications such as budget costs, free market and privatisation. In the framework of the SAP, an Agriculture Sector Programme (ASP) was adjusted in 1995. The main objectives of ASP were:

(i) intensification and modernisation of the agricultural system,

(ii) achievement of food security and

(iii) improvement of natural resource management

a) Among the package of improvements in agricultural productions introduced by the Government are the promotion of high yielding varieties of maize in the south and west of the country and drought tolerant and less nutrients demanding nullet in the north of the country.

b) The implementation of soil and water conservation and nutrient replenishment technologies in the regions where soil degradation is a major constraint to crop production. Other innovations being used by Burkinabe farmers are fixing plants, green manure inorganic fertilizers, animal manure, rock phosphate, (burkina phosphate composition and fallow systems to alleviate nutrient depletion constraint to crop production. Despite the trend in increasing crop yield and crop production, Burkina Faso will not be able to meet its food requirements in 2020 unless the production is doubled.

Reducing Poverty

Government's strategy to reduce poverty aims at protecting the vulnerable segments of the population against the adverse effect of the restructuring within the framework of the Structural Adjustment Programme and the Institutional Support to social dimensions of Structural Adjustment Project. The results of surveys are being used to identify the disadvantaged groups of the population and to design poverty reduction programmes for them. The limited resources available and the unequal distribution of poverty suggest a more selective approach based on regional and rural focus.

It is clear from the above policy interventions and others by the Government of Burkina Faso, donors, non-governmental organisations and local communities that efforts are being made to address the nexus problems of rapid population growth, degrading environment, food insecurity and poverty in the country. It will however be helpful if policy makers in their attempt to deal with these issues had the advantage of knowing the possible outcomes of the various policy options available to them. It is in this respect that the PEDA model offers a rare opportunity.

THE PEDA MODEL

The PEDA model consists of four interlinked modules pertaining to land, water, economy and human development. The last module which is the most complex combines demographic factors, food security status, education and place of residence in a multi-state population projection and it is central to the model. Three important individual characteristics of the population are used in the model namely:

- Place of residence i.e., whether rural or urban
- Literacy status
- Food security status

These sub-groups are further sub-divided into 8 categories as:

i. Rural / Illiterate / Food Insecure
ii. Rural / Illiterate / Food Secure
iii. Rural / Literate / Food Insecure
iv. Rural / Literate / Food Secure
v. Urban / Illiterate / Food Insecure
vi. Urban / Illiterate / Food Secure
vii. Urban / Literate / Food Insecure
viii. Urban / Literate / Food Secure

The land module considers potential soil fertility, actual land use over time and land degradation.

The water module on the other hand, considers theoretical water supply due to the topography and climatic conditions, man made water systems and the availability of water for agricultural and residential use.

A combination of land, water and production of labour force with capital investments in agriculture and technological innovation is expected to indicate an estimate of the proportion of the population that is food secure for each of the eight sub-groups of the population.

The Vicious Cycle

The model assumes that a vicious cycle exists (Fig. 5). In most of Sub-Saharan Africa, population growth has been higher in the rural areas compared to the urban. In a situation of this nature, the food insecure, uneducated population needs to utilise more and more lands in order to continue to produce enough for their sustenance. Alternatively, they may need to continue to cultivate impoverished soils, the end result of which is a degraded landscape and lowering agricultural productivity.

Correspondingly, low agricultural productivity can lead to an increasing number of economically poor and food insecure persons who tend to increase their family sizes through high fertility as the only viable option for them to increase labour in order to provide security for themselves during old age. In the process, the number of food insecure or the poor in the population further increases in this cycle.

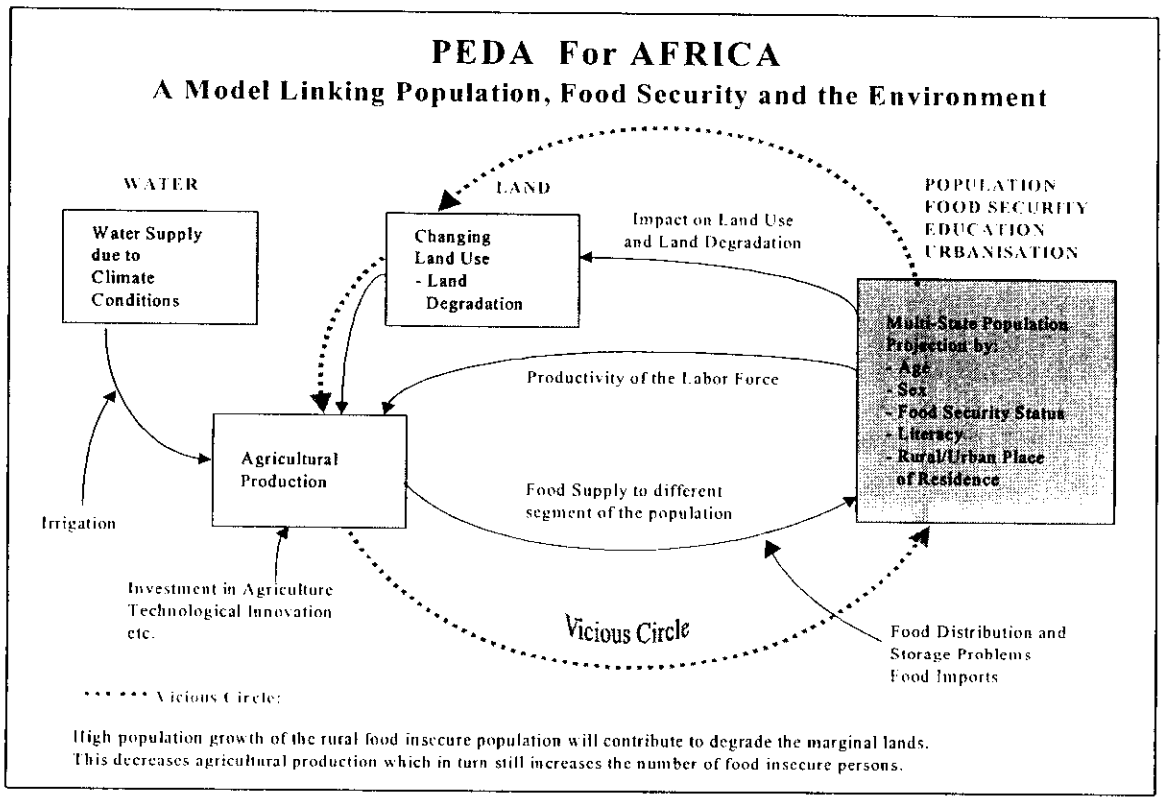


Fig. 5: The PEDA Model – Linking Population, Food security and, the Environment

In using Burkina Faso to illustrate the PEDA Model, 4 scenarios have been compared. These include

1) Constant rates where all parameters including fertility and school enrollment remain at their 1996 levels.

2) Increased technological inputs where fertilizer use, machinery and irrigation increase by 3% per year while holding all other parameters constant.

3) Strong educational efforts under which about 80% of all girls and 90% of all boys learn to read and write, all other parameters being constant.

4) A combination of increased technological inputs, strong education efforts and fertility decline. Under this final scenario, the projection is that fertility levels are expected to decline to half their 1996 values by the year 2030.

In the baseline scenario, we investigate the effect on food security status in 2030 if all parameters remain at their 1966 levels. The other three scenarios look at the impact of technological advancement, educational enhancement and a combination of all these on food security status. We break Burkina- Faso into 8 sub-groups depending on whether they live in an urban or rural area, are educated or non-educated, and are food secure or insecure.

In the case of the first two scenarios, that is, technological advancement and strong educational efforts, the impacts consider only the proportion of total population who are food secure in 2030. In the case of the business-as-usual and the three combined scenarios, the impacts are categorized in terms of residence and educational attainments.

Impacts on Fertility

Before we analyze the food security status in Burkina Faso, it is pertinent to look at the fertility rates in the first place. The reason is that high fertility rates, especially of the rural illiterate would lead to land degradation which could result in poverty and finally to food insecurity as has been argued above.

Fertility levels in respect of the various population sub-groups as at 1996 are also shown in the model and presented in Figures 6 and 7. It shows the highest total fertility rate (TFR) of almost 7 children to a woman to be among rural, not educated women who are either food secure or insecure. These are followed by the urban, not educated whether food secure or otherwise with a TFR of about 5.5. Next in the order are the rural educated irrespective of whether they are food secure or not with a TFR of almost 5.0 while the lowest TFR of about 4.0 is shown among the urban, educated who are either food secure or insecure. The foregoing suggests that education is very important in the reduction of fertility whether one is in the rural or urban area.

To analyze the impacts on fertility levels, the PEDA model is operationalised by using two of the scenarios. The two senarios that are illustrated here include the scenario of constant rates under which all parameters including fertility and school enrolment remain at their 1996 levels. The second scenario combines increased technological inputs, strong educational efforts and low fertility levels projected to half their 1996 values by the year 2030.

The extent of possible changes that could be achieved in fertility between 1996 and 2030 are illustrated. These comparisons are clearly shown in Figures 6 and 7. In Fig. 6, the high levels of fertility that were prevailing in 1996 for all the 8 sub-population categories would remain unchanged even in the year 2030. In contrast, total fertility levels for the various population sub-groups decline by half their 1996 levels by 2030 under the increased technological inputs, strong educational efforts and fertility decline scenario. This is shown in Figure 7. It shows that in PEDA, when technology is increased and educational enrolment is improved, their impact on fertility becomes quite obvious.

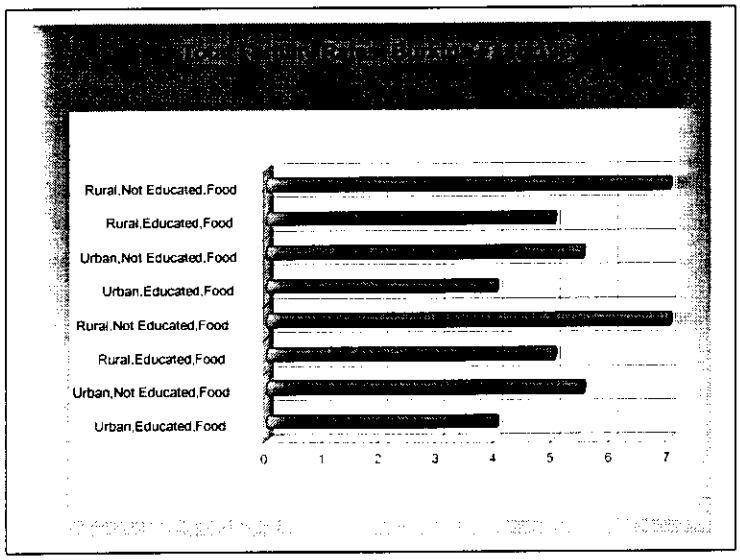


Fig 6: Initial conditions

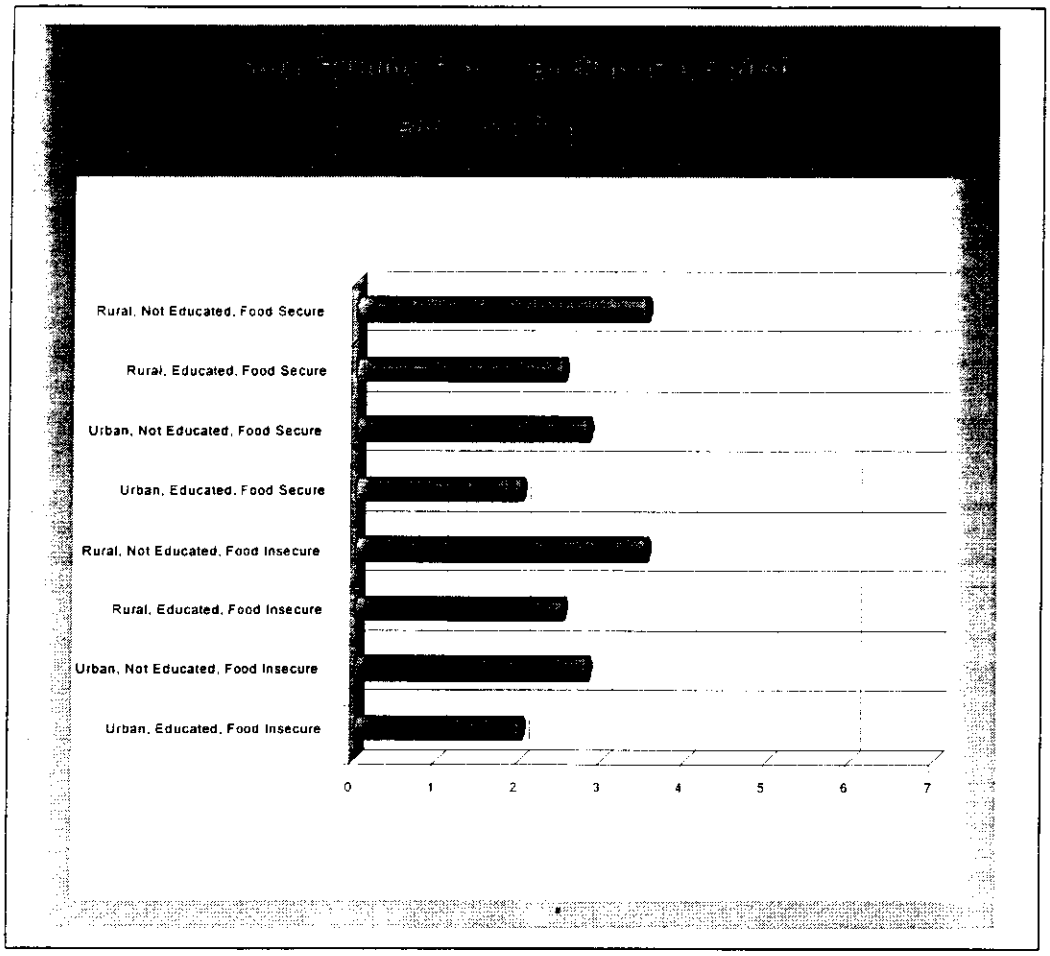


Fig.7: Projected conditions for 2030

Impacts on Food Security Status

The initial food security status is classified as at 1996. From Table 1, we find that as much as 70% of the people in Burkina Faso can be classified as food secure with only 30% being food insecure. Of the food secure people, 51% was rural non-educated. This is against 7% educated, rural residents who were food secure. At the same time, the rural, non-educated category who were food insecure made up 22% while their counterparts who were educated constituted 3% of the Burkina Faso population.

On the other hand, there were 5% educated food secure urban residents compared to 7% of their counterparts who were not educated. In contrast, there were 2% educated, urban residents who were food insecure in comparison with 3% of their counterparts who were not educated (See Figure 8).

As indicated above, food security deals with availability and access to food. The food security status in Burkina Faso in 1996 reveals that while in poor African countries which are predominantly rural, ability to afford food is limited, food security can be achieved if the rural people can have access to land and technology to adopt intensive agriculture. This conclusion is based on the fact that as much as 51% of the food secure are in the rural areas.

Analysis of the Three Scenarios

The second level of illustration is the changes that would occur to the population as a whole in terms of the food security status when the three scenarios are operative. This is illustrated in Table 1 and Fig. 8.

Table 1 also shows the effects of food security if no policy shift occurs and the 1996 parameters are maintained. This can be called business-as-usual scenario. The food security status deteriorates significantly by 2030. The proportion of food secure will drop from 70% in 1996 to 43% in 2030. We find that if technology is improved, the food secure improves to 50%. There is further improvement back to 70%, the level of 1996 food secure people if a strong education is pursued. However, with

the combined policies of strong education, technology and declining fertility there would be as hign as 96% food secure persons in Burkina Faso.

Population Sub-Group	Constant Rates (1996) (%)	Constant Rates (2030) (%)	Strong Educ., TI, Low Fert (2030) (%)
Urban, Literate, Food Secure	5	4	15
Urban, Illiterate, Food Secure	7	8	8
Rural, Literate, Food Secure	7	4	40
Rural Illiterate, Food Secure	51	27	33
Urban, Literate, Food Insecure	2	3	2
Urban, Illiterate, Food Insecure	3	9	1
Rural, Literate, Food Insecure	3	6	1
Rural, Illiterate, Food Insecure	22	39	0

Table 1: Food Security Status with two scenarios

Source: Compiled from the PEDA Model

This level of illustration is very instructive. The type of improvements that are needed to achieve these results are not very restrictive. It is the strong educational push, which is likely to be more expensive. Yet, what is required is ability of the 80% of girls and 90% of boys to read and write. This requirement can be achieved at 6 years of primary if the motivation and improvement of resources at that level are pursued.

The third level of illustration is the changes that would be observed regarding the sizes of the 8 subgroups of the population between the scenario of constant rates on one hand, and the strong education, technology and declining fertility scenario on the other hand. From Figures 8 and 9, it can be observed that while the food insecure sub groups decline in size between 1996 and 2030, the food secure categories increase depicting the positive impact of education, technology and fertility decline on the welfare of the population.

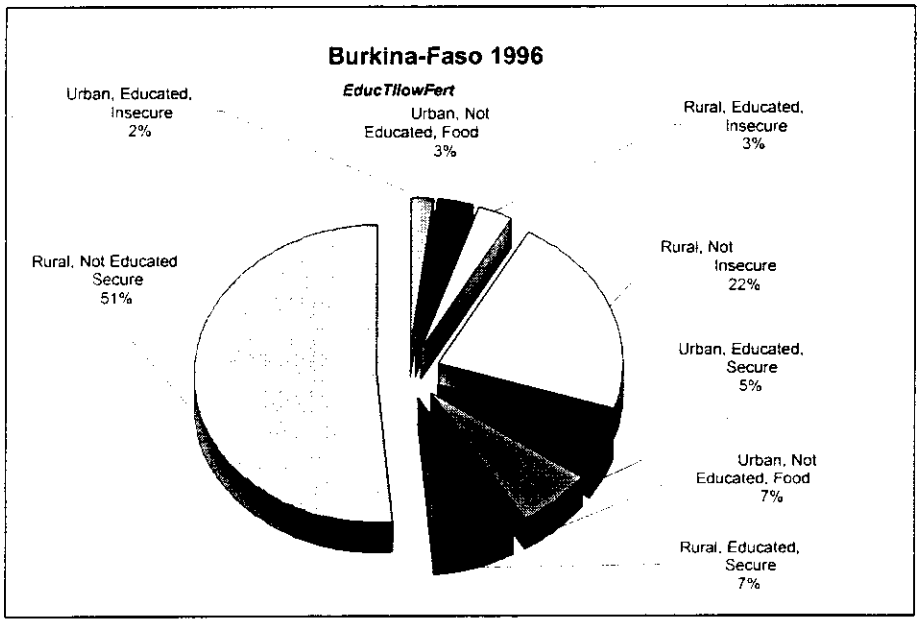


Fig.8 The food security scenario in 1996

A comparison of Table 1 or Figures 8 and 9 shows for example that when nothing is done and all rates for 1996 are left to remain unchanged the rural, not educated food insecure component of the population will be as high as 39% in 2030 compared to 0% in the face of increasing education and technology, amidst declining fertility. It is also striking to notice that the size of the rural, educated food secure component which is shown in Figure 8 to be 4% is as high as 40% in Figure 9 with improvements in education and technology. Similar observations can be made in respect of the urban sub-population components between the two scenarios that have been described in this illustration

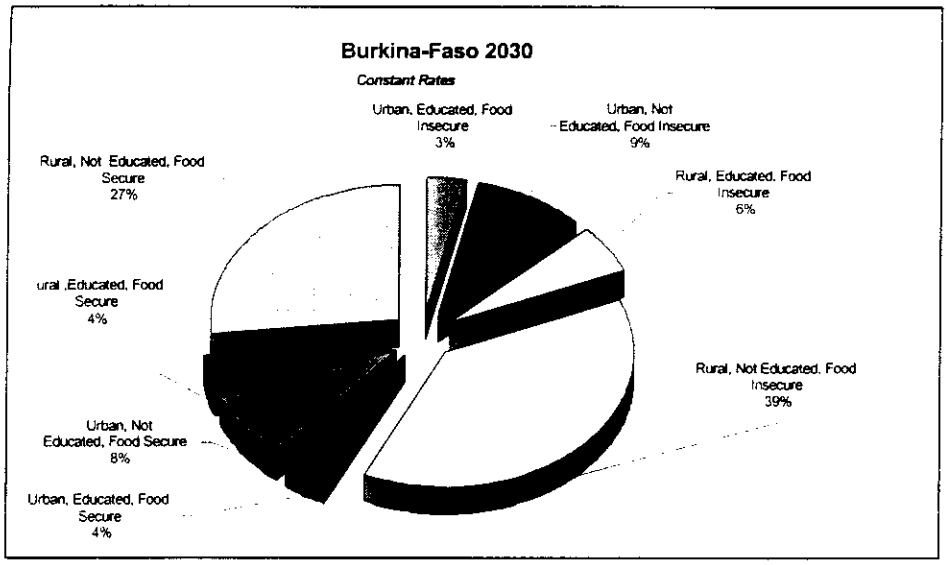


Fig.-9: the projected situation for 2030.

The foregoing shifts in the sizes of the various population subgroups indicate the capability of the PEDA model to show changes that occur in the population as far as their levels of food security are concerned as their education, technology, fertility and other variables are varied from time to time. Thus, when education increases, there is a tendency for fertility to decline and consequently, positively impact on the food security status of the population.

In short, the PEDA model has the advantage of indicating which variable policy makers in Africa need to influence and in what direction at any given point in time. This is, however, dependent very much on availability of data that are required by the model.

Conclusion

Burkina Faso is one of the poorest countries in the world. The Government has made the eradication of poverty a priority policy objective. To achieve this goal calls for a multi-sectoral approach to tackling problematic rapid population growth, environmental degradation, and food insecurity which are interrelated. The application of the PEDA model would make planning for the future easier since it offers a rare opportunity for policy makers to know of the possible outcomes of the various policy options available to them.