UNIVERSITÀ CATTOLICA DEL SACRO CUORE
Sede di Piacenza

Scuola di Dottorato per il Sistema Agro-alimentare

Doctoral School on the Agro-Food System

cycle XXV

S.S.D: AGR/01

Poverty Reduction in rural areas of low-income countries in Sub-Saharan Africa: Assessing the role of agricultural productivity and socio-economic environment.

Coordinator: Ch.mo Prof. Romeo Astorri

Candidate: Alexandre Godinho Bertoncello
Matriculation n. : 3810656

Tutor: Prof. Gabriele Canali

Academic Year 2011/2012

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"….God! Give us the power to help progress that we may rise up to You; Give us pure charity, give us faith and reason, give us simplicity that will make our souls a mirror on which Your image should reflect!" Caritas

"…Don't worry about a thing,
'Cause every little thing gonna be all right…" Bob Marley

"…É preciso amar as pessoas, como se não houvesse amanhã
Porque se você parar pra pensar, na verdade não há…" Legião Urbana

"…è per te il dubbio e la certezza, la forza e la dolcezza, è per te che il mare sa di sale
è per te la notte di natale, è per te ogni cosa che c'è, ninna na ninna e…" Jovanotti

Declaration

This thesis is the result of my own work carried out at the Agrisystem doctorate, Università Cattolica del Sacro Cuore, supported by the Faculty of Agriculture in Piacenza. The thesis has been submitted to two other institutes; the International Cocoa Organization – Commonwealth House, 1-19New Oxford Street London WC1A1NU United Kingdom as referee Dr. Michele Nardella and the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca – Str. Manastur 3-5, Cluj-Napoca, 400372, Cluj Romania as referee Professor Felix Arion.

Abstract

Nowadays, agricultural prices are highlighted around the world combined with, as alleged collateral effects, hunger and malnutrition in Sub-Saharan Africa (SSA). However, today SSA has around 47,5 percent of rural population in extreme poverty while between 1990 and 2005 when food prices were stable and low, extreme rural poverty in SSA involved around 64.6 percent of population.

We assume that the undernourishment or starvation continued in SSA because there the misery persisted. Poverty reduction is the only way to the end hunger in Africa. Also, for an agricultural country in SSA the best way to solve the problem of poverty is through agricultural development.

By "agricultural country" we mean a country that have no significant reserves of mineral resources, thereunto the development should happen through agricultural development.

Our analysis is based upon a sample of nine countries in SSA – Burundi, Ghana, Malawi, Mozambique, Rwanda, Uganda, United Republic of Tanzania, Zambia and Zimbabwe – the so called SSA – 9.

Thus, we have built up a model trying to answer to the question of how the agricultural gears in SSA – 9 were moving between 1990 and 2005, and assess how the agricultural growth could reduce rural poverty. We used a system of recursive rather than simultaneous equations: a recursive model is a special case of an equation system where the endogenous variables are determined one at a time in sequence.

The most important result is that the main tools that had a strong relation with poverty reduction in SSA – 9 were legislation on property rights (PR), access to the credit system, Human capital and infrastructure.

The debate about policies implication is very important since our timeline is between 1990 and 2005, i.e. a period characterized by relatively stable international agricultural prices . So, excluding this very important element, price, we could analyze what the low-income countries in SSA may do to develop their agriculture.

One of the conclusion is that an excessive and somehow "artificial" stress may have been attributed to the education level in the past (World Bank 1998, Easterly et al. 2001) and this may continue not to help poverty reduction. Our model shows that there is a hierarchy among policies that may reduce rural poverty.

Firstly, property rights or land tenure (PR) together with political stability (PS) have always started or destroyed the progression of rural poverty reduction.

Secondly, the macroeconomic context, mainly the development of an efficient credit system (DCPS), should go together with the improvement of education level (HCPRI).

Thirdly, the endowment in terms of infrastructure installed and its evolution over time play an important rolein supporting the economic evolution of rural population.

The better the answers, the more efficient the country was (and will be) in reducing poverty.

1. INTRODUCTION

I use “we" and “our" in my thesis as a gesture of respect to the research community. This convention is part of my attitude towards that community. He, She and They are used as a reference of the context without any gender discrimination.

Learning how poverty reduction in rural areas can be optimized was motivated by many goals, such as: academic, intellectual and personal reasons.

After this introduction, in the second chapter of this thesis we start describing the context that we were placed in when this research began and the motivations of the research; in the same chapter we explain the definition of rural poverty and the different situations around the world; subsequently we describe the main economic agents in rural areas, agriculture and its principal actors like farmers, governments and international traders; finally we explained how the agriculture can reduce poverty and the thoughts of most important authors in this area.

In the third chapter we outline the aim of our research, and we explain the choice of the sample for the econometric analysis; in other word we explain why we decided to deal with a selection of SSA countries and we explain why, in our opinion, it is not a good choice trying to assess the effectiveness of poverty reduction policies in countries that have contradictory profiles and lack of data..

In the next chapter we describe shortly the main social, economic and politic characteristics of the nine low-income countries in SSA selected for the econometric analysis. In the fifth chapter we have decided to make a special report about the Ghana case; this analysis has been possible thanks to the availability of regional data and a specific paragraph describing Ghana’s poverty trap case. We believe that an econometric model like our, always needs a field check in order to better evaluate if assumptions and implication do really make sense in the real world. And this paragraph has proven to be useful to this aim.

The most important part of this thesis is the sixth chapter, where we highlight the main points of the existing theories, we explain our proposal of a new model and we describe all the steps connecting agricultural development and policies to poverty reduction. Finally we present the econometric results of the new complete model.

In the seventh chapter we describe more in dept all results for every single country considered in the complete analysis, i.e. the nine SSA countries, and we discuss the results indicating which one of the so called "agricultural linkages" in SSA could happen and when these linkages are more important than agricultural growth to poverty reduction. Furthermore these linkages can be optimized with policy implications as property rights (PR), access to credit (DCPS) and infrastructure (INFR).

Major conclusions are supported also with three empirical cases: the United Republic of Tanzania's case, Uganda's case and Ghana's case. In the final section of this chapter we talked about possible paths to develop agriculture in SSA – 9.

In the final chapter we conclude with a few words on the best route to agricultural development and poverty reduction for the low-income countries in Sub-Saharan Africa, and we indicate the limits of the model and suggest paths for future research.

2. THE ISSUE OF AGRICULTURE AND POVERTY REDUCTION: A SHORT REVIEW

2.1 The modernity of a traditional issue

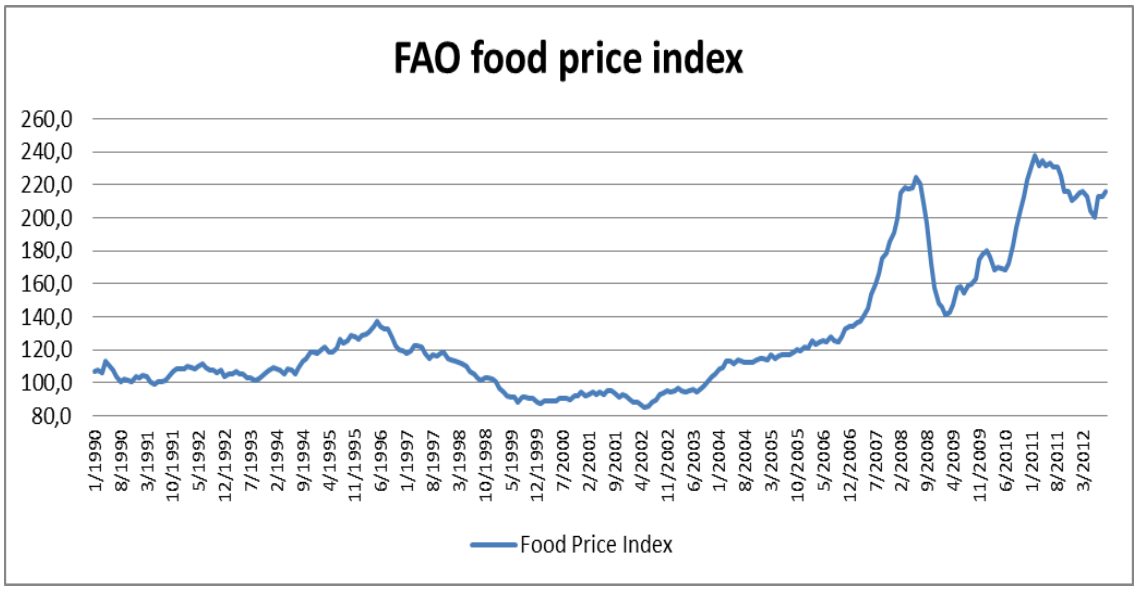
This research started in 2010; we were living a scenario similar to that of the 1970s, with all commodities prices, such as oil, soybean, maize and wheat, soaring. But there was a different relationship between cause and effect.

The oil crisis or "the shock oil prices" in 1973 had “one beginning” when the members of the Organization of Arab Petroleum Exporting Countries (OPEC) took one political decision that made the oil price shoot from around USD 3 in 1973 to USD 12 in 1974. The world economy was largely dependent on petroleum and, as a main consequence; we saw high inflation and low growth of GDP around the world.

The high commodities prices in 2008, instead, were caused by a pool of factors that had triggered the process as the strong GDP growth of emerging markets, the decline in the value of the dollar, low stocks of commodities, huge foreign exchange reserves in emerging countries like China and so forth.

As a result, in 2008 prices brought up many concerns in the agriculture environment: among the main anxieties there were farms costs, the shortage of new agriculture frontiers and price volatility. The food prices rocketed between 2007 and 2008 but plummeted after that, and soared again on 2011 (chart 2.1).

Chart 2.1: FAO food price index.



Source: FAOstat

However, with the high costs of intensification of agriculture techniques, the western institutions realized that there did not exist more land to increase agriculture activity in developed countries; hence to feed the world agriculture had to be developed in other sites. But also the so called emerging countries in Asia do not have "stocks of land" either; that is why food demand in Asia is growing more than food supply.

The increase of the purchasing power not only in Asia but also in Latin America raised the demand for meat; moreover, developed countries and emerging markets began to introduce and develop many biofuels policies, stressing even more the debate about land resources, food, feed and biofuels.

The increase of demand for commodities mainly by Asian countries and the information about new biofuels policies stimulated commodities prices, according to many authors.

But as we said, the world in 2010 was different from the world in 1970, with the transmission of information made easy by internet, politicians receive more pressures from public opinion and, on the other hand, the public opinion could be lead to draw hasty conclusions, because we now live in the "over info phenomenon".

Information was supplied by the media and also the academic world. The public opinion was divided into several groups: those in favour of agricultural subsidies, price-fixing of agricultural commodities, reduced consumption of meat and those against biofuels policies. On the other hand we have groups against of agricultural subsides, the environmentalists, who are in favour of renewable energy policies, and so on. But curiously they all pointed out that their ideas would lead to the reduction of hunger in Africa.

The hunger problem in Africa has always been described from a western point of view and the following stylized facts have been identified by major sources:

- The African people were benefited by the importation of cheap food due to farm's subsidies of many OECD countries (FAO 2009).
- The African countries were the most prejudiced by agricultural prices volatility (FAO 2011).
- WWF on line report, recommends lowering meat and dairy consumption because that can help to balance food and feed demands.

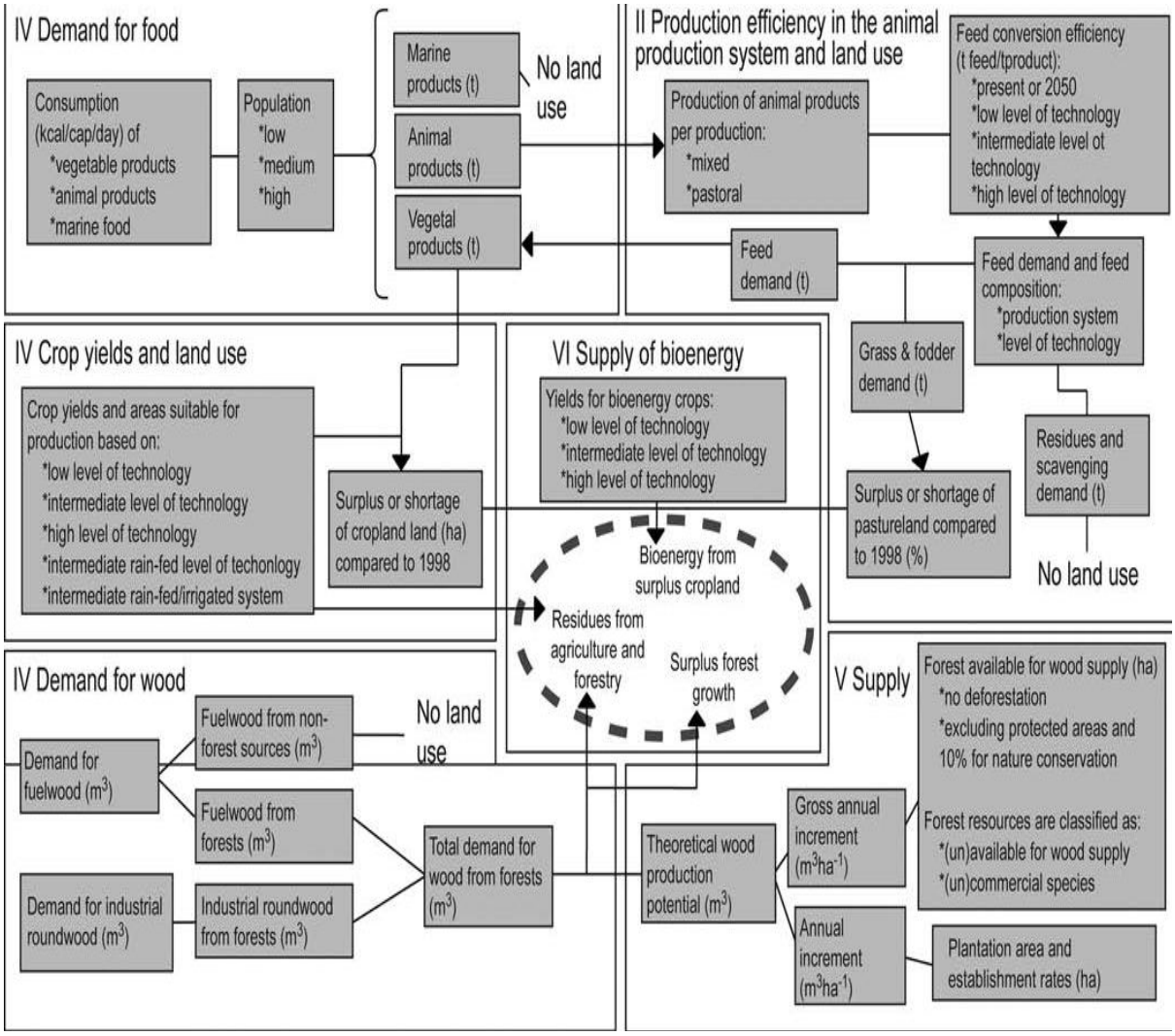
- The experience of the 2007-08 food price crisis and the current price volatility in many international food markets have showed a number of weaknesses in relation to biofuel policies (G-20 meeting, 2010).
- The agricultural subsidies coming from developed countries did not allow African farmers to compete and develop their domestic market (FAO 2009).
- Renewable energy policies are the best tools to develop the marginal land in developing countries (IEA 2009).

But, in particular, this delicate roundabout among food, feed and biofuel in SSA was faced very well by the International Assessment of Agricultural Knowledge, Science and Technology of Development (IAASTD 2009), that showed a series of problems in SSA. An assessment concludes that many questions remain unresolved as far as poverty and food security are concerned (figure 2.1), but they will continue working to find points of synergy between bioenergy, development and agricultural sustainability in SSA.

The other line of thinking confronted the hunger in Africa with a less ideological and more pragmatic point of view. The undernourishment or starvation continue in SSA because there, the misery persists. Poverty reduction is the only way to the end the hunger in Africa (Lipton 1977, Lipton and Ravallion 1993, Roemer and Gugerty 1997, Delgado et al 1998, Mellor 1999 and 2001, Quibria 2002, Thirtle 2003, Timmer 2005, Ravallion and Chen 2007, Janvry and Sadoulet 2009), Anderson 2009 and Heady et al 2010).

Also all authors agree that for an agricultural country the best way to resolve problem of poverty is through agricultural development. Hence, we started this research looking for data about poverty, development of the agriculture sector and the linkage between them.

Figure 2.1: SSA food, feed and biofuel.



Source IAASTD page 88

2.2 Rural Poverty: measurement and issues

Poverty implies a state of privation and lack of necessities for a person which subsequently reduces the possibility of fulfilling basic needs in modern society for food, health, education and housing. When poverty is widespread in a society or country, with chronic intensity or for a long time, it produces costs in all areas of the economy and makes growth performance unfeasible. In other words a country with chronic poverty or prolonged poverty could have social instability, shortage of skilled labour, poor quality of life and low health status (Barro 1998).

The World Bank has been working to define the concept of poverty since 1979. In 1985, they created a system to compare purchasing power across countries and therefore also to measure poverty in a comparable way: the Purchasing Power Parity (PPP) exchange rates used to convert the international line into local currencies. Furthermore, the poverty line from 1985 was of USD 1,00 a day while since 2005 the average daily income measuring extreme poverty has been USD 1,25 a day. Thus, when identified the poverty line refers to those people who would still not be able to eat the minimum amount of nutrition necessary for their daily life, if they were to use their entire budget to buy food (World Bank).

The number of people worldwide living below the line of extreme poverty was reduced in absolute numbers from 1.815 billion people in 1990 to 1.371 billion people in 2005, representing a reduction from 41.6 per cent of the population in 1990 to 25.2 per cent in 2005 (World Bank).

Focusing on the poverty distribution in 2005, statistics show that 71 per cent of these people living below the extreme poverty line in the world were living in rural areas against 80 per cent in 1990. Despite this historic shift towards urbanization, in 1990 around 57 per cent of the world population was living in rural areas, against 51 per cent in 2005, thus a half of population still lives in rural areas.

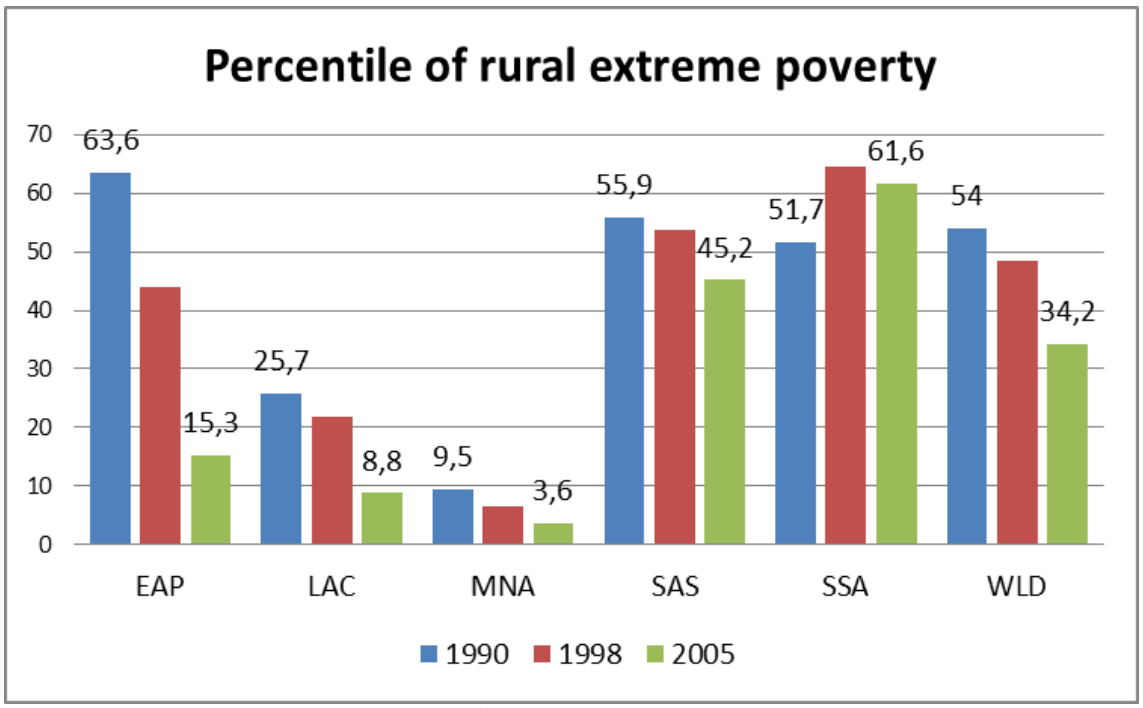
Despite the positive results in poverty reduction in rural areas, searching the tools which contributes with rural poverty reduction can be useful. First of all, poverty mostly concentrates in rural areas and its reduction can prevent or reduce the social instability in developing countries. Secondly, developing countries suffer terrible collateral effect of poverty, like, for example, shortage of skilled labour; if rural poverty is reduced, the education level will improvement, thus, breaking down this paradigms. Finally, poverty reduction in rural areas also means an improvement for urban areas, as suggested by the dualism theory.

Comparing the incidence of world poverty in rural areas, we noticed a different geographical distribution. Sub-Saharan Africa (SSA) has the worst performance in comparison with other traditional poor areas (Chart 2.2). Rural poverty in SSA has increased in absolute numbers from 172 million people in 1990 to 306 million in 2005, and the percentile of poverty in rural population also increased, bouncing from 51 per cent in 1990 to 61 per cent in 2005.

The second region with lowest performance is South Asia (SAS); here, between the same sixteen years, poverty grew, in absolute numbers, of 35 millions of people, but the percentage of poor populations in rural areas decreased from 55.9 per cent to 45.2 per cent.

SSA is also distinguished from the rest of the world by the forecast for the rural population. In current projections (FAOstat), the population in SSA rural areas will still rise while all others regions will decrease their rural population. The SSA rural population will not decline until 2050 (chart 2.3); at the same time SSA has an enormous quantity of arable land which is underused: FAO (2001) estimated that SSA has 2,4 billion hectares of land and in 2000 roughly 20 per cent of this potential arable land was cultivated.

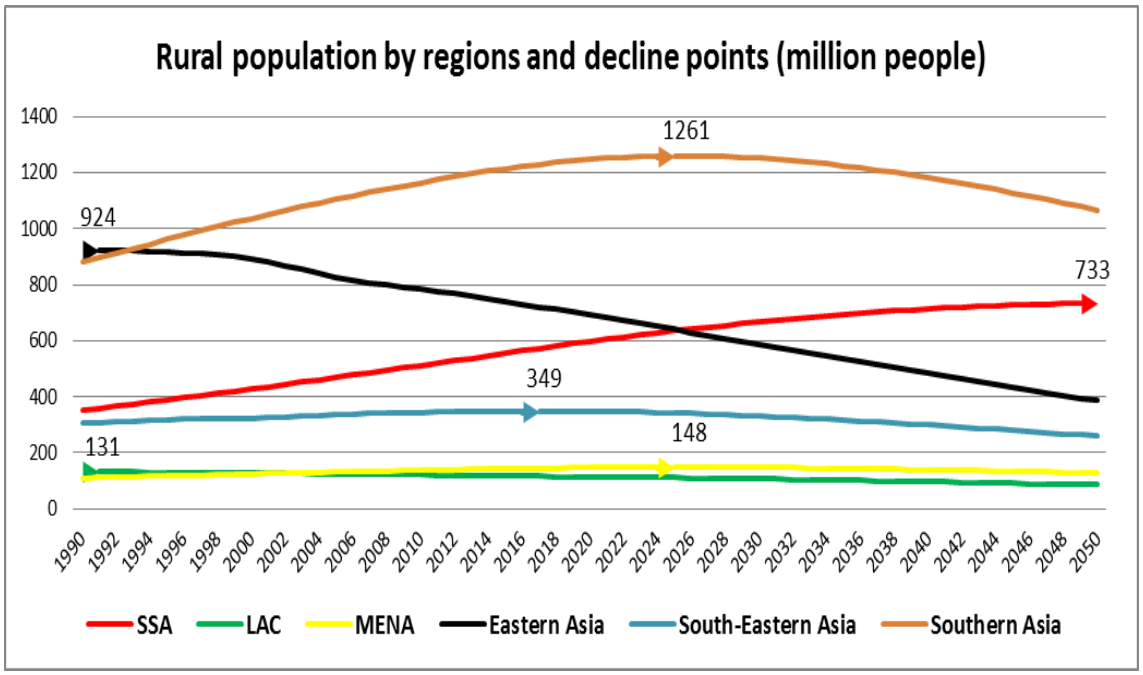
Chart 2.2: Percentile of rural extreme poverty



Source World Bank where: EAP is East Asia and Pacific, LAC is Latin America and Caribbean, MNA is Median East and North African, SAS is South Asia, SSA is Sub-Saharan Africa and WLD Developing World.

In other words, SSA is the singular set region in the world, it has the higher level of rural poverty in the world, a huge amount of arable land stock, and the demographics rural data will have provoked strong stress in the socio-economic environment.

Chart 2.3: Rural population by regions and decline points (million people)



Source FAOstat ; SSA is Sub-Saharan Africa, LAC is Latin American and Caribian, MENA is Median East and north Africa, Eastern Asia include China, Southern Asia include India.

2.3 Agriculture: different developments paths

The winning agricultural policy for a country in the 18th and 19th century was to protect local agriculture, because it guaranteed urban development and, consequently, the country began to develop. Here is the last great example: during Japan's "take off" (1877- 1905) its agriculture policy assurance farm product rose 31 per cent faster than farm input price from non-agriculture (Lipton 1977).

In the 21th century, efficiency has become a prerequisite of agricultural business, and agriculture chains involved a complex network. Agro-industrial enterprises, to compete, have reduced the costs and have improved the quality of their products, with a new and strong infrastructure[1] such as: competition between markets and others distributions channels, the issues of long-term viability as the markets related with the cities (chain of kilometer zero) and, mainly with wholesale markets and cities with a population of less than half a million people.

[1] See Suply Chain Management (SCM) with particular reference to the agro-industrial domain FAO 2007

In the others words, the old political winner, with subsidies and protectionism, could lose in this century: the world is changing, and therefore developed countries, as well as emerging countries and developing countries should also change. Between the two biggest agricultural markets, the US and the EU, the last is the most closed and protected but it is changing. European agriculture is not as heavily protected and isolated from the international markets as it once was (Canali 2008).

Many interactive processes determine the agricultural dynamics of the world food demand and supply: land resources, agro-climatic conditions and socio-economic pressures as population growth, availability access to technology and development. In the last four decades the world has changed its own average growth in terms of: aggregate yield, arable land, production, population and, as a consequence, per capita production (table 2.1).

The agricultural per capita production had a trend shift in the 2005/06 harvest: for the first time after the Second World War, the gross production agricultural index in the world overtook the gross per capita production index in the world (FAOstat).

Table 2.1: Exponential trend growth rates of the world.

Exponential Trend Growth Rates	1970 – 90	1990 – 2007	2007 – 17
Production	2.20	1.30	1.20
Yield	2.00	1.10	0.80
Area	0.15	0.14	0.39
Population	1.70	1.40	1.10
Per Capita Production	0.56	0.11	0.02

Source: USDA Agricultural Projections to 2017, calculated by Interagency Agricultural Projections Committee see http://www.ers.usda.gov/media/274758/oce20081a_1_.pdf

The main players of agriculture, the US and the EU, reduced agricultural research and development, thus contributing to the slowing growth in crop yields. Governments and international institutions maybe have neglected the effects of economic growth in emerging markets and in developing countries (USDA 2008).

So while on one side (developed countries) agricultural production showed a slow, on the other side (developing countries) while production was not increasing because of the lack of investments in this sector, demand was steadily increasing due to continuous increase in population and improvements in per-capita income in many big countries (like China, India, Brazil, etc).

With a simple subject-matter, either reducing the agricultural subsidies, decreasing the agricultural research and continuing to raise the demand, the commodities price will increase. This scenario happened and created opportunities to new players, who, thanks to the intensification of the supply and low-cost production, contributed to rebalance the agricultural market, i.e. Brazil leaped from the 10th at the rank in 1999 to the 3th, largest agriculture exporter in the world in 2009 (WTO 2010).

New agricultural players were not the only novelty in these recent years: the agricultural globalization process was too; it also accelerated by the opening of agricultural markets. The final result was a phenomenon similar to the one of the 1970s-, i.e. commodity prices rocketed and caused inflation around the world.

But as we said in – paragraph 2.1 – this current trend had different links between cause and effect. In the 1970s, the imbalance among traditional supply countries and new importers countries of agricultural goods led to this scenario.

Developed countries contributed indeed little in population growth rates, less than 8 per cent between 1990 – 2005, and then economic growth was half of the developing countries, besides the kcal consumption per capita rose 3 per cent compared to 8 per cent in the developing countries; however the developed countries, historically, had been developing almost all agriculture technologies.

Without new global leaders to develop agricultural technologies, and conjunctural factors such as the declining global demand for stocks, rising oil prices, changes biofuel policies, the declining value of the dollar and the foreign accumulation of foreign exchange reserves (USD), some countries have been able to increase food commodity imports. These created conditions have set the stage for the increase in food commodity prices since 2006/07 (table 2.2) and to the following price bubble.

Thereby a window of opportunities was created and some emerging countries grabbed it, but most of developing countries did not. Since the demand was increasing more than supply in non-developed countries, many local and international companies here have invested in research. As a result the global average rates of yield grew more rapidly in these countries between 1990 and 2005 (table 2.3).

As to the four most important agricultural commodities such as maize, wheat, rice and soybeans, traditional producing countries, mostly developed countries, had unrecognizably low performances (in few cases they were half of the average global growth). These differences, however, were also due to the completely different level, in absolute terms, of the average yields (table 2.4).

Table 2.2: Causes leading to the last price bubble of 2007/2008.

Causes leading to the last price bubble																
Factors	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05
Demand	Increasing population + economic growth + rising per capital consumption															
Supply									Slowing growth in agricultural production							
Demand												Declining stocks of food commodities				
Supply													Rising crude oil price			
Demand													Dollar devaluation			
Demand														Large foreign exchange reserves		
Demand															Biofuels policies	
Supply																Rising farm costs

Source USDA Agricultural Projections to 2017

Table 2.3: Yield growth rates for selected crops by 1990 – 2005.

Group	Maize	Wheat	Rice	Soybeans
World*	1,84	0,73	0,99	1,34
All countries**	1,51	0,36	0,93	0,75
Low developing countries***	0,65	2,15	2,16	0,00
Developing countries***	2,10	0,82	0,81	2,08
Developed countries***	1,48	0,06	0,54	0,00

Source FAOSTAT 2012 * worldwide, calculated by author: ** Sum of, low developing countries, developing countries and developed countries. *** low developing countries with income per capita (PPP) USD 980,00 or less that have entire time series, developing countries with income per capita (PPP) between USD 981,00 and USD 11.900,00 that have entire time series and developed countries whit income per capita (PPP) more than USD 11.901,00 in 2005 that have entire time series.

Most of this increase in yields had been implemented by the so called "developing countries", from Latin American to South-Eastern Asia. In Latin American the improvement of productivity come mainly from Argentina, Brazil and Paraguay, on the other hand South-Eastern Asia brought up countries as China, Malaysia and Vietnam.
The first block, the Latin countries, have used the improvement to increase the surplus and consequently the exportation, while the second one, South-Eastern Asian countries have used it mostly to benefit the domestic market, because consumption in these countries increased as well as agricultural goods production.

Table 2.4: Yield ton/hectare for selected crops in 1990 and 2005

Group	Maize		Wheat		Rice		Soybeans	
Year	1990	2005	1990	2005	1990	2005	1990	2005
World*	3,68	4,84	2,56	2,85	3,53	4,09	1,90	2,32
All countries summed**	3,66	4,59	2,87	3,03	3,55	4,08	1,62	1,82
Low developing countries***	1,70	1,87	1,90	2,05	1,82	2,51	0,98	0,98
Developing countries***	2,58	3,52	2,19	2,48	3,48	3,93	1,47	2,01
Developed countries***	6,72	8,37	4,52	4,56	5,35	5,80	2,46	2,47

Source FAOSTAT 2012 * worldwide, calculated by author: ** Sum of, low developing countries, developing countries and developed countries. *** low developing countries with income per capita (PPP) USD 980,00 or less that have entire time series, developing countries with income per capita (PPP) between USD 981,00 and USD 11.900,00 that have entire time series and developed countries whit income per capita (PPP) more than USD 11.901,00 in 2005 that have entire time series.

Finally, the so called low developing countries were the ones that lost the window of opportunities between 1990 and 2005. This group was represented principally by SSA countries, which cannot carry out agricultural developments to international and domestic market either.

2.4 Rural poverty reduction: evidences and issues

In all the history of humankind agricultural developments led to the improvement of welfare, social development and poverty reduction: Egypt in 2000 BC, India and China in the 17th century and the western countries after 1800. Adam Smith wrote in 1776 "The Wealth of Nations", which described the capitalist transformation of English agriculture through the division of labour and increased productivity, thus driving the earliest stages of urban-industrial transformation.

Modern literature confirms the importance of agriculture: agriculture is the most cost effective investment a developing country can do, thus we assume that the support of agriculture is the better strategy for poverty reduction (Timmer 2005), (Lipton and Ravallion 1993), (Mellor 2001 and 1999), (Quibria 2002), (Roemer and Gugerty 1997), (Janvry and Sadoulet 2009), (Anderson 2009), (Headey et al 2010) and (Thirtle 2003).

Paradoxically, economic growth and poverty reduction lead to declining relative importance of the agricultural sector. However the links between different activities within rural economies allow the exploration of the effects that growth. In others words, agricultural investments are the main tools to reduce the poverty, rural economies depend on local demand and the characteristics goods, and these are affected by price or productivity changes and finally their tradability and local production.

Factors like supply elasticities and labour inputs are affected by and improve the distribution of income within the rural urban economies. In a logical reasoning the growth of urban output depended on the growing transfer of food from rural areas for the increasing urban workforce; this urban labor force reduced the proportion of income that was spent on food when rural productivity increased, and the fall of food prices did not affect landlords profit because they earned on the scale of production.

Absolute poverty, i.e. people that live with an average income equal or less than USD 1,25 a day, would refer to people who have receive the most direct benefits from the development of agriculture, because of the straightforward relationship between food price and workforce developed. This means that who has a tight budget can eat better if the price of food declines and wellbeing will rocket indeed if earning improves.

The government of Nepal has instituted the "Agricultural Perspective Plan" (APP) whit a great result: the percent of the rural population falling under the poverty line declined from 49 percent to 14 percent in the 20 years (Mellor, 1999). Timmer (2005) argued that ..."*no country has been able to sustain a rapid transition out of poverty without raising productivity in its agriculture sector*"....

So we assume that the development of agriculture is the best way to reduce rural poverty, but political stability, macroeconomic policies, natural resources and human capital, are affecting the whole social-economic environment. Thus, differences in rural population, as density, GDP per capita, availability of credit and rural framework, lead to different outcomes.

First of all, although agriculture growth demonstrably reduces misery, it cannot guarantee social equality. Roemer and Gugerty (1997) found an increased social inequality in Latin America while developing agriculture in the 70s and 80s, and showed the elasticity of poverty reduction declined over the years, proving Kuznet's (1955) and Barro's theories (1998).

Kuznet's curve has been based on cross-country estimates of the relationship between inequality and per capita national income. These empirical studies showed the countries which have low incomes have inequality indices low too; when average incomes are higher, the indicator of inequality increases too, to a certain point, but the sign of the relationship is reversed and indicators of inequality decrease and growth continues, forming an inverted U.

Barro argued that inequality, when prolonged, hinders or makes growth performance unfeasible, in other worlds keeping inequality high could translate into: social instability, shortage of skilled labor, poor quality of life and low health status. Governments must manage the surplus resources produced by economic growth and apply in better conditions of health, education and infrastructure, to maintain the levels of growth.

Another important factor is the link between productivity and poverty. Janvry and Sodoulet (2009) found relevant differences, between productivity and poverty reduction, among the three big players in the 20th century; during the so called "green revolution". As to the elasticity of rural poverty reduction with respect to cereal yield, there was an increase of 1 percent equal to – 5,1 per cent of rural poverty in China, - 1.2 percent in India, and – 0,6 percent in Brazil in 1990s (figure 2.2). At the same time, in China inequality soared, in India, instead, have improved their inequality index and Brazil the inequality remain stable [2] in 1990s.

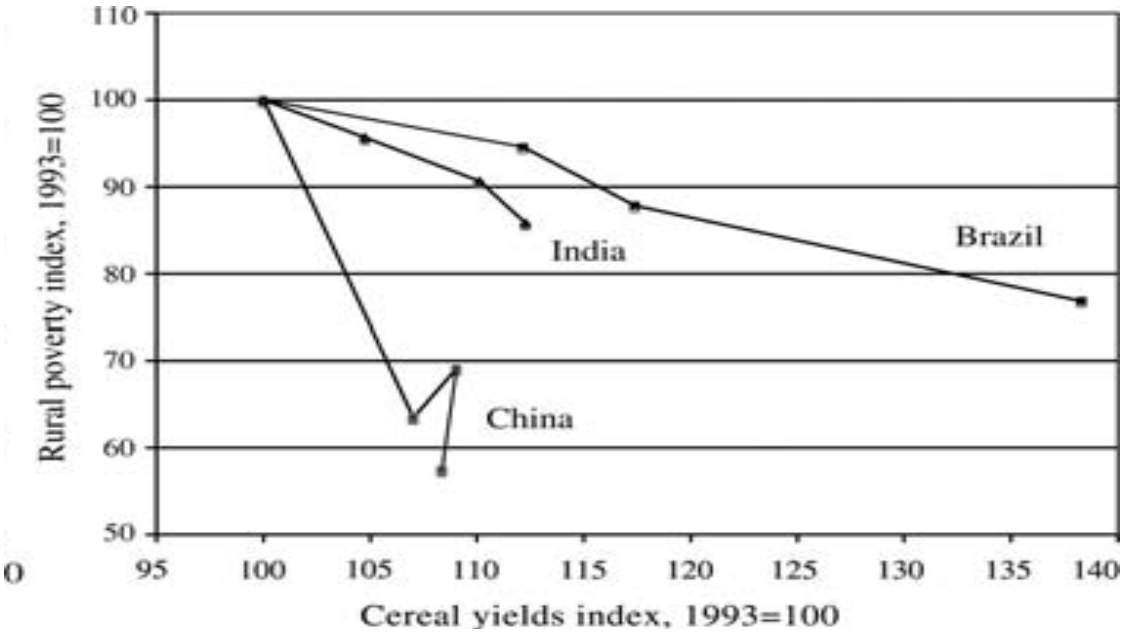
Another aspect of rural poverty reduction is the regional level or the so called agro-ecological zone (AEZ). The three big agricultural countries – Brazil, China and India – have great dimensions and some states or provinces have particular settings and cannot reduce rural poverty at the same level of national performances.

[2] Sources: Brazil inequality by U.N. website, India inequality by Fan, Hazell and Thorat (1998), China inequality by Ravallion and Chen (2007)

The geographic position or few natural resources, which offer low potential for agriculture, are the main hindrances to develop agriculture and reduce the poverty in some places as: *Maranhão* north-east Brazil (Lipton, 1977), Guangxi central China (Ravallion and Chen, 2007) and Bihar north-east India (Fan, Hazell and Thorat, 1998). These areas are suffering from the so called "poverty traps".

When a region has the poverty traps, it cannot develop at the same speed as the rest of the country: geographic position or shortage of natural resource reduce the development capacity, and also interfere negatively in the socio-economic environment and as a consequence, rural poverty reduction has not happened.

Figure 2.2: Cereal Yields and Rural Poverty



Sources Janvry and Sadoulet (2009) pg 3. Poverty date from Ravallion, Chen and Sangraula (2007) using a $ 1.08/day poverty line in 1993 PPP; yield data from FAO (2006) Note: Observation are for 1993, 1996, 1999 and 2002

To summarize, rural poverty reduction depend on many factors working together, such as, the linkage capacity between farmers and all the rural population, links between rural and urban areas, agricultural productivity, income distribution policies, geographic position and natural resources , thus there does not exist a panacea.

3. THE FOCUS OF THE RESEARCH

As we saw in the previous paragraphs – 2.1, 2.2, 2.3 and 2.4 – SSA is the only region in the world that has all these features: fragile food security system, increased extreme rural poverty, undeveloped agricultural environment with low productivity and weak linkages between farms and non-farm business and constant growth of rural population.

This research has, as its main goal, to assess the relationship between poverty reduction, agricultural productivity and socio-economic environment in Sub-Saharan Africa.

The first hard decision was about the database; in general African countries have a shortage of statistical information produced by themselves; their national statistical offices have often many problems and their data are generally quite poor. But also western and international institutions have asymmetric information about African countries.

Perhaps that is because they use different methodologies; for example between 1990 and 2010, the simple data about per capita GDP were different when coming from the UN, FAO and the World Bank.

However we decided not to enter in this debate, thus we used the database of various institutions, but only the data that we consider as their core business, as follows': for the World Bank and IMF, macroeconomic data; for FAO and IFDA, rural data; for the UN, health and education data. In case two institutions had the same core business, but different data, we always consider the first option i.e. World Bank and FAO.

Secondly, the important decision was about the time series; we were aware that the 2008 price bubbles could have "contaminated" our results Hence, we considered that "permanent changes" or structural changes should be measured, because they changed the entire agricultural global scenario and can be perennial; on the other hand when we talk about "temporary changes" or cyclic movements, as 2008 bubble prices, this effect should be considered in a different way.

Thereby, while attempting to leave the model "more pure or less contaminated", we used the time series 1990 – 2005, between these sixteen years, the agricultural prices were quite stable and the globalization was already in place and increasing with all its consequences. On the other hand, when a price bubble needs to be analyzed using econometric tools, a completely different database is needed, and the main issues are necessarily different from the one that we address here.

3.1 The aim of the research

SSA followed different paths from the others areas in developing, it showed weakness to build links between farming and non-farms economies and urban areas, many authors[3] assume that the SSA non-tradable goods, like services, cannot increase the productivity, consequently they are not widely consumed and they do not produced welfare.

The statements are true, the SSA data show that the links between agriculture growth and rural poverty reduction have been worse worsen than in the rest of the world. Why does not SSA only develop agriculture sector? Perhaps the current literature has made the same mistake in SSA that did it in Latin American countries in the past, "mixing apples and oranges".

Nowadays it is clear that Mexico has a different socio-economic environment from Central American countries as Guatemala, Honduras or El Salvador, as much as Peru, Ecuador and Bolivia are very different from Chile, Argentina and Uruguay.

Following this idea, we dealt with the problem and looked for three answers: What are the agro-business and socio-economic environment like in SSA? What does agricultural growth mean? And which is the profile of poverty that the agricultural sector is not reducing?

First of all, many problems remain in SSA, like land tenure, labour and credit, severe difficulties in raising the agricultural market. Meanwhile, the agro-business is directly affected by agro-climatic conditions, population density, human capital and infrastructure; all these factors can have positive or negative influences. Exogenous factors too, like international prices, can or cannot have a low impact if the internal environment does not have appropriate stimuli.

This complex environment, rule out the possibility to agree with "western institutions" that continue saying: The roots of the low performance of SSA agriculture are also well known: monopolistic and monopsonistic government positions, lack of incentives to perform, political interference, overstaffing and patronage, contradictory objectives, poor staff management and training, poor capital of investment corruption and so on.

[3] (Timmer 2005), (Lipton and Ravallion 1993), (Mellor 2001 and 1999), (Quibria 2002), (Roemer and Gugerty 1997), (Janvry and Sadoulet 2009), (Anderson 2009).

Between the 49 countries in SSA it is relativity easy to find out facts that contradict these statements: the monopsonistic government position have worked well in Ghana's cocoa market and helped to reduce the rural poverty from 48 per cent in 1990 to 20 per cent in 2005, moreover the agricultural free market of Nigeria has shown an increase in rural poverty from 50 per cent to 64 per cent.

On the other hand, South Africa had an agricultural production per capita with a performance worse than average African countries. Between 1990 and 2005 it fell four percent, while the average African countries growth was 12 per cent (FAOstat). However, South African indexes – capital of investment, corruption level and human capital level – are much better than in average African countries.

As a result of this conundrum, we assumed that, to find the way to develop the agricultural sector, we cannot put together countries with great differences of mineral resources and GDP per capita income.

Abundance of mineral resources led African countries to "mineral diseases" like the Dutch disease, according to Ndulu and al. (2008 page 26), thus these countries have a lower interest in agricultural development.

On the other hand, the huge different of GDP per capita income implies the use of different tools for agricultural development or agricultural supply, because the agricultural sector has different weight and function in different countries, like Burundi which, in 2005, had a GDP per capita income of USD 154,00 or Equatorial Guinea, with USD 13.521,00 per capita the same year; it is obvious that the macroeconomic environment is something else.

SSA has 49 countries, of which 47 have fairly good record data in international institutions like the Word Bank, FAO, UN and IMF. It has an area of 24.300.000 sq. kilometers and around 1000 languages spoken, 29 different eco regions (Peel et al 2007) and natural and mineral resources distributed in a non-uniform way. All these aspects and many others items, as the demographic situation, prevent us from talking about SSA as a homogeneous region.

Therefore we cannot use the same tools or models, for all the countries together, to explain the agricultural sector and its developments, because agro-business and socio-economic environment among these countries are very diverse.

Secondly, agricultural growth means whether a country is able to increase its agricultural output. Currently, there are many ways to measure it, those that are more widely accepted are; gross or net agricultural productions, gross or net agricultural productions per capita and total factor productivity (TFP).

The gross or net agricultural productions, is the FAO index of agricultural production, that ...“*show the relative level of the aggregate volume of agricultural production for each year in comparison with the base period 1999-2001. They are based on the sum of price-weighted quantities of different agricultural commodities produced after deductions of quantities used as seed and feed weighted in a similar manner*...”[4] The so called “gross” represents all agricultural production and so called “net” represent all agricultural production without feed production.

The gross or net agricultural productions per capita used the same methodologies, but to obtain per capita index you divide the production index by the local population. For a country that depends of the agricultural sector or has a high fertility of population or yet has a delicate scenario about food balance trades, the gross agricultural production per capita is more appropriate.

All the indices of the country, regional and world levels are calculated by the Laspeyres formula[4]. Production quantities of each commodity are weighted by 1999-2001 average international commodity prices and added for each year. To obtain the index, the aggregate for a given year is divided by the average aggregate for the base period 1999-2001.

The agricultural TFP growth, measured by Solow (1956) and/or Bauer (1988), is the portion of output explained by the amount of inputs used in a production. Its level is determined by how efficiently the inputs are utilized in production. The decompositions of TFP could be added to the system of equations to be estimated, this equation provides information as to productions or costs function.

However, all these methodologies are not necessarily connected with implications in terms of food safety and food security, expecially in SSA. Although in computable general equilibrium model (CGE) many simplifications are often considered acceptable; one of these states that, with agriculture growth, the food security will be resolved,

[4] See FAOstat methodologies

because these agriculture goods will be consumed or exported, the exportation creates the possibility to import other goods or foods that the country need. However it is quite clear that in many cases agricultural growth does not mean improvement of food security or food safety; for example, in SSA food security improved between 1990 – 2005, while the productivity did not; on the other side, agricultural productivity increased very fast in Asia but food safety did not.

But in small economies, mainly the agricultural African countries, are not fit for the CGE and its logics of equilibrium for goods (De Melo and Robinson 1989), Furthermore, after ten years this thesis was confirmed by Delgado et al (1998), who said that SSA countries usually show a mismatch between the income of export and domestic consumption, the so called "linkages paradigm".

In the others words, agriculture growth is the increase of any outputs of agricultural goods, used for food, feed or energetic market as biofuel, in one country. However it seems, agricultural productivity growth *per se* is not sufficient to resolve food security in SSA countries.

To resolve the issue of food security it is often necessary also to change the behaviors of governments, like Brazil or China showed. Hence, the aim of this research is to find out whether agricultural growth can help farmers and rural population to overtake the poverty line, and/or what else is needed.

However, both previous issues are great importance in this case, because almost all SSA countries have problems with food safety and many have troubles also with food security. Among the two, we believe that food security is the most important issue.

But again, for a country that depends of the agricultural sector or has a high fertility rate of its population or yet has a delicate scenario about food balance trade, the gross per capita agricultural production (API) is a useful index to be evaluated and therefore we use API in this research.

Finally, our aim was to match our main concern, food security, and the profile of poverty researched. The World Bank defined and classified two profiles of poverty. The first one is the poverty line; this represents people that have an income until up to USD 2,25 a day (PPP 2005), according to this line people are able to eat every day if use all their budget to buy food.

But in the extreme poverty line there are people with an income below USD 1.25 a day (PPP 2005): whether or not those people use their entire budget to buy food, they are still unable to eat the minimum amount of nutrition necessary; in others words, for these people the food security does not exist.

Thus, our research focuses on the extreme poverty line problems, and how agricultural growth can help people improve their earnings and overtake the extreme poverty line.

3.2 The objective of the empirical analysis

In order to build up a model that may work well with reference to SSA countries we must follow three premises:

- We cannot use the same model to explain the agricultural sector and its development, with all SSA countries together.
- The agricultural growth means increase of any agriculture goods output – food, feed and biofuels – but in a country with high demographic expansion the gross agricultural per capita production index (API) is more appropriate.
- We should define the profile of poverty, because each poverty line group has different needs.

As we are aware, to build a model that works well in SSA, we should have countries with very similar GDP per capita income and mineral resources, because governmental tools will be similar. At the same time these countries should have the minimal socio-economic environment conditions allowing agricultural activities to develop well.

In the second precondition we used one non-academic and unorthodox but very simple indicator with empirical results: the attracting power of western enterprise of agro-foods in SSA countries and we created an index[5] from 0 to 5 (table 3.1) and (figure 3.1).

While western institutions have problems to understand SSA environment and have had limited success, instead the westerns companies have had great performances in their investments there (OECD 2008).

Therefore, if private capital is more flexible about rules and has more ability to forecast the development and earn profit, the analysis of private capital movements is useful to show where the agricultural environment is more favorable.

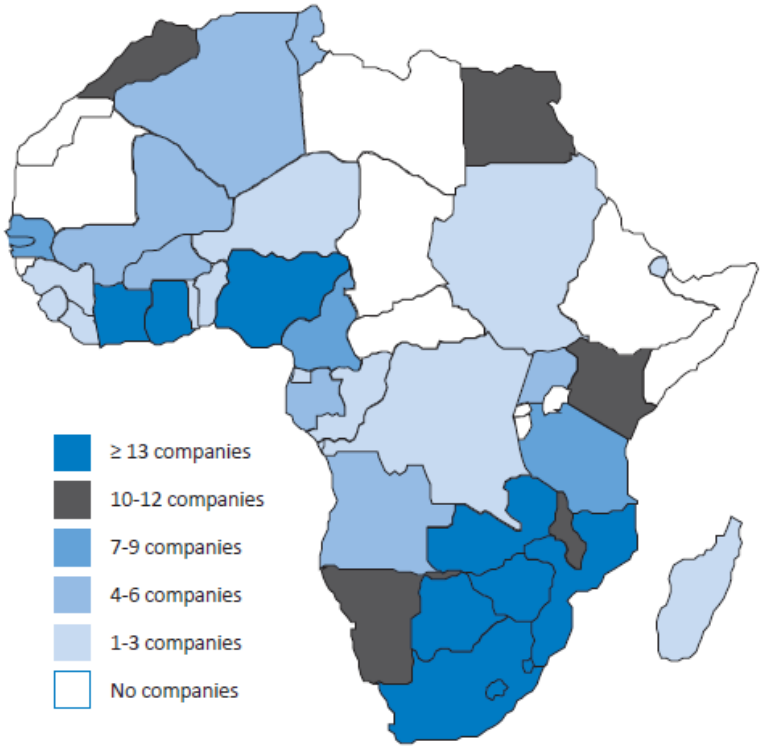
[5] Countries with more than 500 thousand people.

Table 3.1: The SSA attracting power.

The SSA attracting power	
5	Cote d'Ivoire, Ghana, Nigeria, Zambia, Mozambique, Zimbabwe, Botswana, Swaziland, Lesotho and South Africa
4	Kenya, Malawi, and Namibia
3	Senegal, The Gambia, Cameroun, Uganda and United Republic of Tanzania
2	Madagascar, Angola, Gabon and Burkina Faso
1	Guinea, Sierra Leone, Liberia, Togo, Benin, Equatorial Guinea, Congo, Democratic Republic of Congo and Eritrea
0	Guinea Bissau, Central African Republic, Rwanda, Burundi, Somalia and Ethiopia

Source author

Figure 3.1: The SSA attracting power



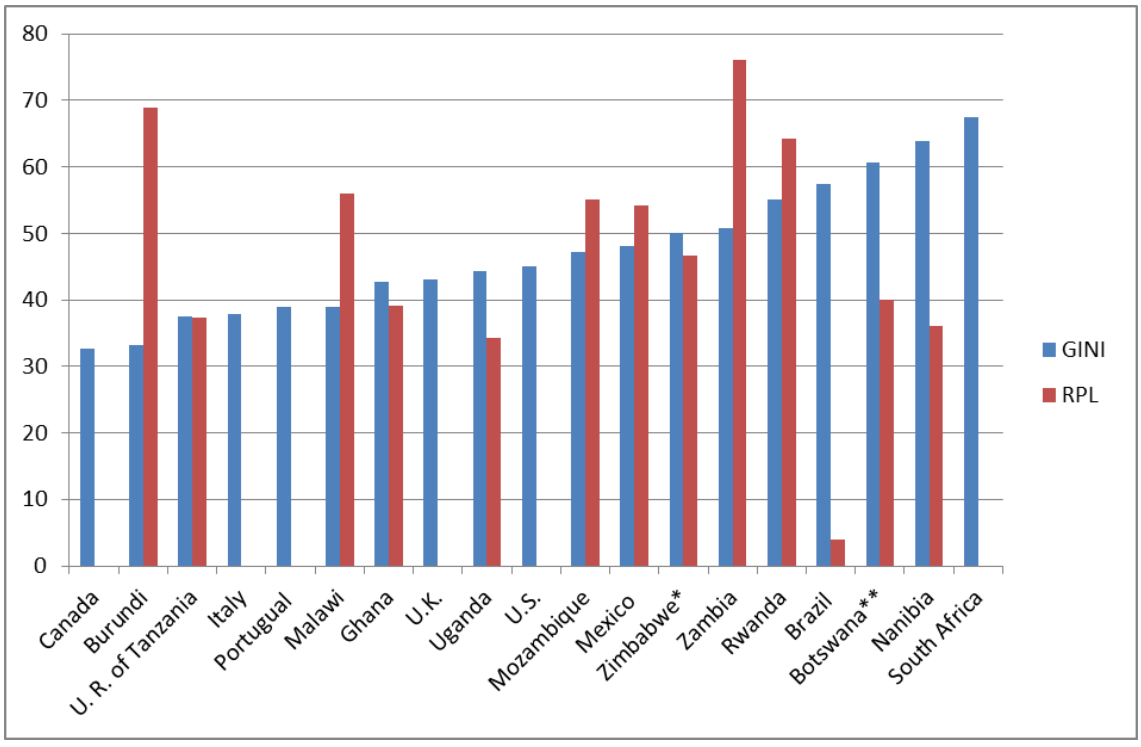
Source: OECD Development Center (2008) based on Jeune Afrique (2007).

Hence, we followed these three criteria; first, good socio-economic agricultural environment, second non abundant mineral resources and finally similar income GDP per capita; we thus found the following countries: South Africa, Botswana and Namibia because in 1990 they had GDP per capita higher than USD 1000,00.

Other criteria that we thought in the begain of this research was GINI index, the index is named after its developer, Corrado Gini an Italian statistician. GINI measures the area between the Lorenz curve and the hypothetical line of absolute equality, a society that scores 0.0 or 0 on the GINI scale has perfect equality in income distribution, on the other hand the score 1.0 or 100 indicates the total inequality in other words in this hypostatical country only one person corners all the income.

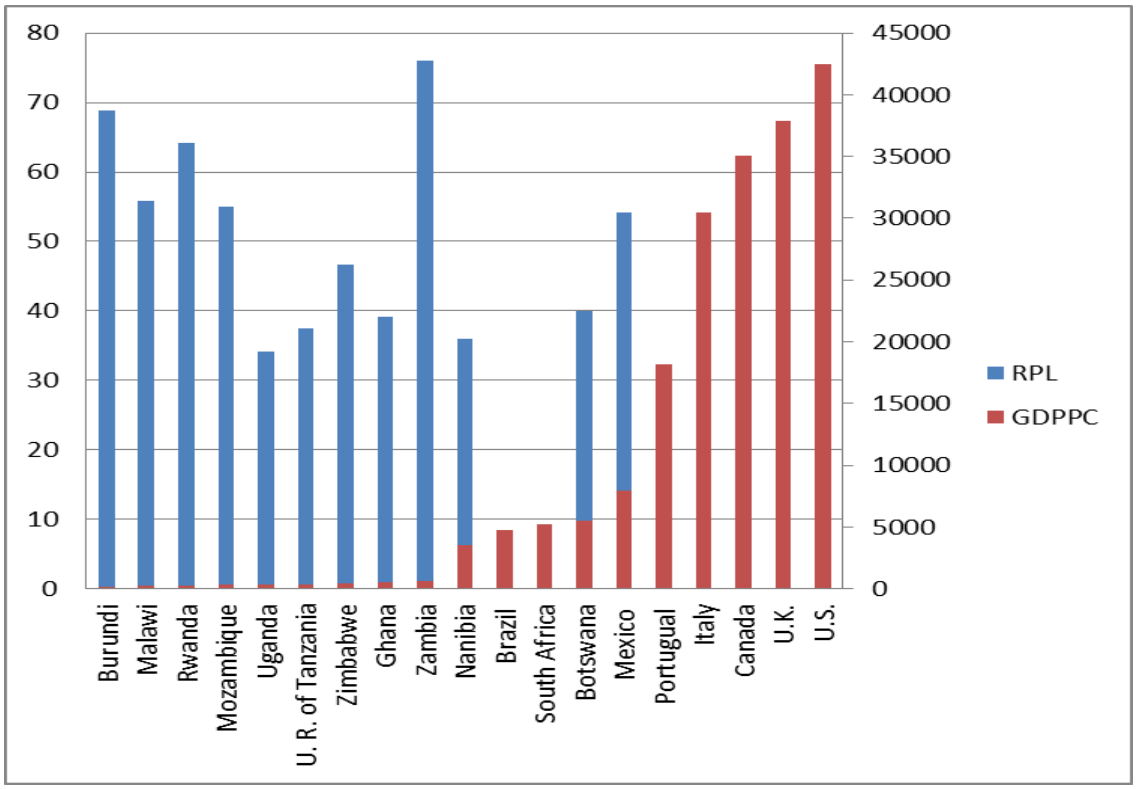
But GINI index showed not fit to describe the rural environment situation or identify the rural poverty levels, also our research looking for tool to reduce the rural poverty line we not assess the inequality. Disparity between rich and poverty is very important but is not our subject, and GDP per capita income is more effective tool to selected our sample, as we showed the next chart, furthermore west institutions using frequently USD 1000,00 per capita as border between developing and low developing countries.

Chart 3.1: Link between GINI index and rural poverty line.



Source: World Bank data. *GINI Zimbabwe 1995 and ** GINI Botswana 1996

Chart 3.2: Link between GDP per capita income and rural poverty line



Source: World Bank data

Also, we removed Nigeria and Kenya because, amongst their export goods, the mineral resources as oil and iron are the main products. But we kept another country that has a great dependence on copper exports: Zambia was maintained, because it has changed its economic profile and the percentage of arable land in this country has been growing faster than in other countries.

The market share of Nigeria's export was made up by 95 percent petroleum or petroleum products in 1990, while the arable land grew 6 percent between 1990 and 2005. Kenya's exports depended, for 48 percent of revenue on oil and iron and the arable land rose less the 1 percent in the same period. On the other hand, Zambia's exports relied on 60 percent of revenue on copper, but the arable land increased more than 9 percent between 1990 and 2005(IMF and FAOstat).

Lesotho has an economy based on re-exporting manufactures goods (drawback) mainly with South Africa and mining and quarrying, thus also Lesotho could not fit for this model.

Therefore, up to this step we had; Cote D'Ivoire, Ghana, Malawi, Mozambique, Zambia and Zimbabwe, to create a model that assessed the role of agricultural productivity and the socio-economic environment in low-income countries. As we know the linkages paradigm hinders the socio-economic environment in SSA (Delgado et al 1998), however, as we know too, the small agricultural countries can develop better when they increase international trade.

Thus, with the aim of leveling the group and reaching the largest possible number of countries, we used the gravity model, to fit the poll.

The Gravity Equation or so-called gravity model is now fashionable; it was originally used by Tinbergen (1962) and has become common; it explains the volume of trade between two countries. In a nutshell, the trade will be directly proportional of their GDPs and inversely to any trade barriers, distances, uncertainty exchange rate or cultural differences (Chen, 2002 and Cho et. al, 2002).

With the aim of increasing the number of surveyed countries, we researched and highlighted commercial treaties, the GDP and population sizes, geographic position and regional culture (Gravity model), besides the agro-food index, non-abundant mineral resources and similar GDP per capita. We arrived to 8 countries in southern Africa: Burundi, Malawi, Mozambique, Rwanda, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe. These SSA – 8 represents 63% of all agricultural low-income countries in SSA, 75% of all agricultural low-income countries with 7 or more agricultural westerns companies and, finally, they represents 84.7% of the all rural population of the so called "agricultural low-income countries"

Among these 8 countries there are 4 commercial treaties - Despite the appearance that the treaties are a kind of "private" trading arrangements, customized to fit specific economic circumstances like energy sectors. These treaties are: African Economic Community with 53 members (AEC) that involve the 8 countries; the Southern African Development Community with 15 members (SADC) which include Malawi, Mozambique, U.R. Tanzania, Zambia and Zimbabwe; The East African Community, with 5 members (EAC) which include Burundi, Rwanda, Uganda and U.R. Tanzania and The Common Market for Eastern and Southern Africa, with 20 members (COMESA) that involve Burundi, Malawi, Rwanda, Uganda, Zambia and Zimbabwe.

Some authors do not believe in African regional trades; Foote (2009) explained that all African integration treaties have statistically had negative effects, because endogenous concerns as civil wars, political and monetary stability, added up which African economies which still rely disproportionately on exporting commodities outside Africa, these inhibit, according to Foote, all possibilities to improvement regional trades.

Three reasons contradict his argument: first of all, in Foote's case he picked up all African countries and all goods, while our assumption was that mineral resources usually have as main goal the developed countries and the emerging market, rarely regional trade. This decision certainly affected the model, thus this result are not useful, in our opinion, to analyses the agricultural environment.

Secondly, the agricultural goods in African countries have large volumes of informal imports, mainly between neighboring countries since ethnic links are more important than bureaucratic permissions (UN 2005). However, the official numbers, between 2005 and 2010, showed that regional trade using EAC, COMESA and SADC treaties had great importance in agricultural business.

Among the imports, the three main agriculture commodities had a significant percentile within the intra-trade blocks; maize was 71,45 percent in 2005 and 72,3 in 2010. Rice was 38,14 percent in 2005 and 42,44 percent in 2010. Wheat reached 28,13 percent in 2005 and 23,88 percent in 2010 (Makochekanwa 2012).

Finally, IMF (2005) and World Bank (2004) agree that regional trade arrangements are the most promising way to development of African countries; with relatively small investments in regional ports and roads, the use of joint tenders to help secure key imports at more favorable prices and cooperation on various monetary and financial matters, all African economics will develop very fast. Hence, the similar GDP sizes, geographic position, population sizes, similar regional culture and mainly the commercial treaties are good items to fit our sample.

Out choice of limiting the analysis to these selections of countries has been based upon economic and technical issues. First of all African countries are not similar enough interns of economic structure: for example, few of them have an economy strongly based on oil or mineral resources (like Libia and Nigeria, for example).

On the other hand, the availability of a reasonable data set and a "reasonably" stable economic and political context, was also needed in order to attempt to evaluate the effects of other variables (i.e. the one of our interest).

Furthermore, this sample also belongs to or has a great link with the same agro-climatic zones as AW and CAW[6] types (figure 3.2), which supposed that agriculture could work at the same speed, if all external factors were the same as socio-economics environment. It was impossible to introduce the Republic Democratic of Congo and Angola because they have huge mineral resources.

Thus, our criteria for the choices were:

- Good economic environment conditions of agriculture: we used the attracting power of western enterprise of agro-foods in SSA countries (OECD 2008). So our sample reduced from 47 to 37 countries in SSA (table 3.1).
- Secondly, similar GDP per capita – less than USD 1000,00 in 2005 – and non abundance of mineral resources (table 3.2);, we divided them in three groups. Labeled as agricultural, mining and manufacturing countries, and we consider the list of export goods to do it.
- The same or similar agro-climatic zones (figure 3.2)
- Strong similaritiesamong countries in terms of GDP, population sizes, geographic position, alike regional culture and linkages by commercial treaties.

Hence, using these assumptions we have 8 countries – Burundi, Malawi, Mozambique, Rwanda, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe. However, The Agrisystem Ph.D. program contemplated the experience abroad, and during our experience at The ICCO in London, we had the opportunity to investigate deeply the international cocoa market and among main cocoa producers there are some African countries, whereof Ghana showed more details about the rural economy.

Then, with a more detailed database, it was possible to write an especial chapter about regional economy and type of crop, their paybacks, and we can observe whether the "poverty trap" theory is confirmed (Lipton 1977, Ravallion and Chen 2005 and Fan, Hazell and Thorat 1998).

[6] See Peel et al 2007 methodology

Also, we added Ghana in the model, because Ghana has the same, agro-climatic zone, the similar GDP per capita, non abundance of mineral resources and a good agro-economic environment, despite it has not indications that among Ghana and others eight countries did belong on the same gravital model, between 1990 and 2005.

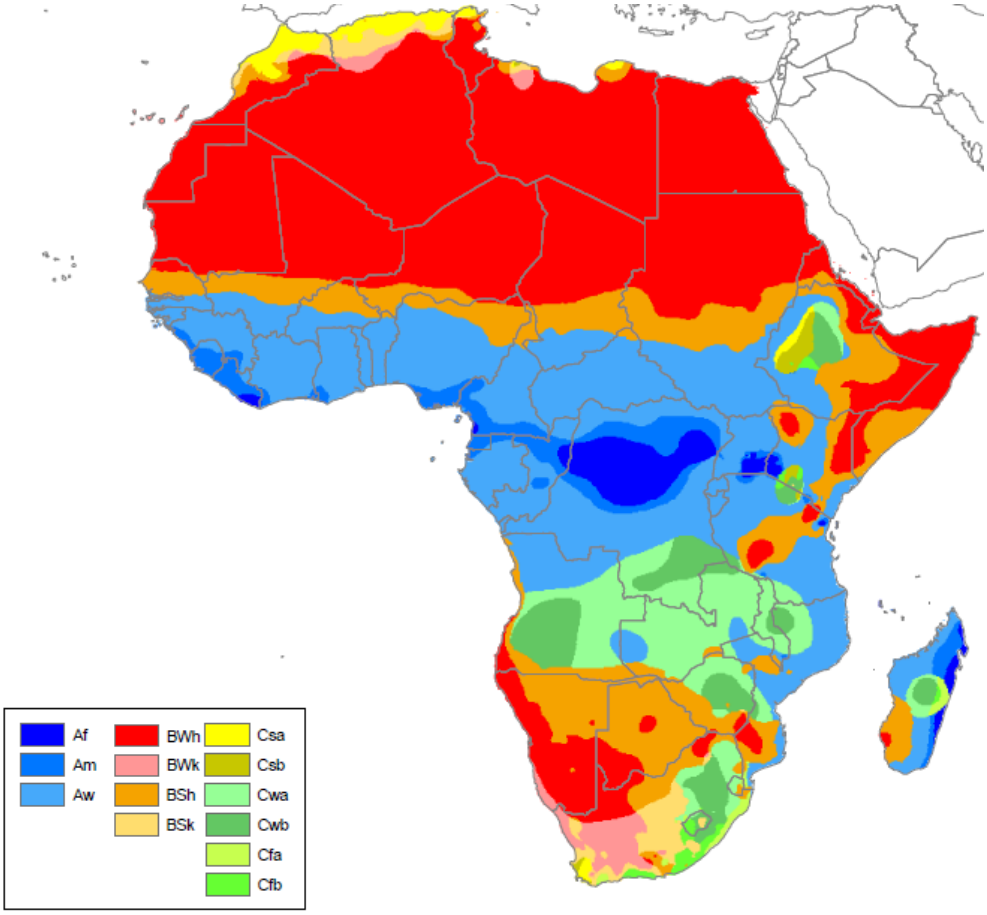
Table 3.2: The profile of SSA countries

Income per capita in 2005	Exporting mainly Agricultural goods	Exporting mainly Mining and quarrying goods	Exporting mainly Manufacturing goods
More than USD 10.001		Equatorial Guinea	
Between USD 1.001 and USD 10.000		Angola, Botswana, Congo Republic, Gabon, Namibia and South Africa****.	Swaziland***.
USD 1.000 or less	Benin, Burundi, Cote d'Ivoire*, Ghana*, Malawi, Mozambique*, Rwanda, Uganda, United Republic of Tanzania*, Senegal* and Zimbabwe.	Burkina Faso**, Cameroon, Central African Republic**, Congo Democratic Republic, Guinea, Kenya, Liberia, Madagascar** Nigeria, Sierra Leone and Zambia**	Togo*** and Lesotho.

Source: calculated by author with the World Bank database and CIA data base.

*agricultural country with mineral resources,** mining country with agricultural resources,*** manufacturing country with mineral resources and **** mining country with manufacturing resources

Figure 3.2: The SSA, agro-climatic zones



Source: Koppen-Geiger climate type map of Africa

4. THE NINE LOW-INCOME COUNTRIES OF SUB-SAHARAN AFRICA UNDER SCRUTINY

In this chapter we provide a synthetic view for each country, highlighting few aspects: colonial era, political and social situation until 1990, current geographic condition, macroeconomic data, education and health systems, infrastructure data, rural scenario, main crops, major international partners and finally GDP share mobility.

4.1 Burundi

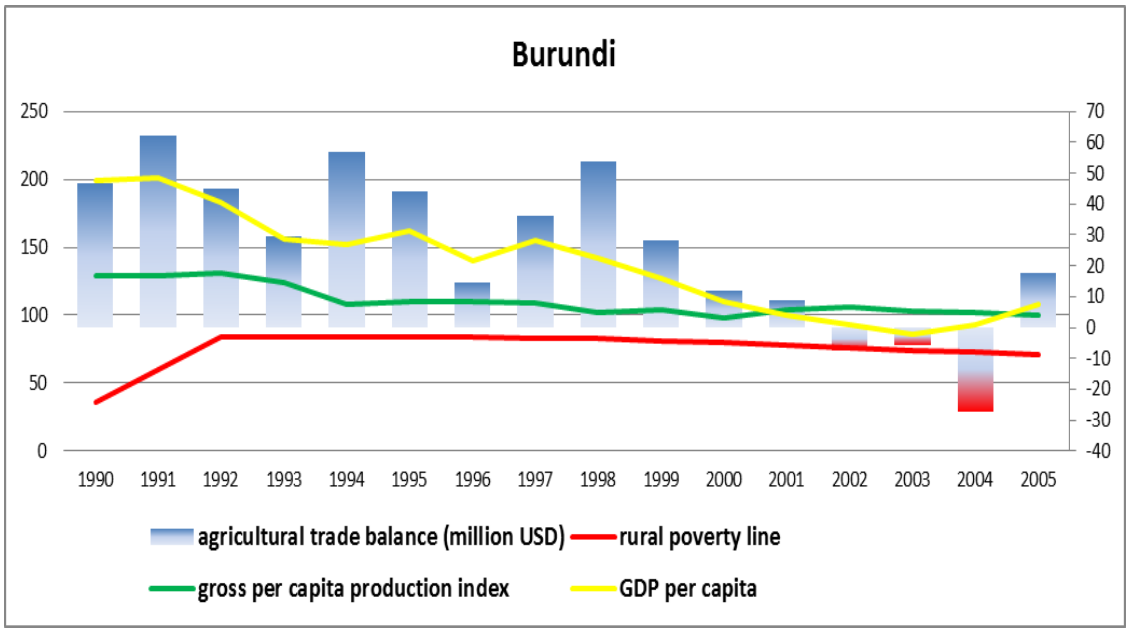
Under the Belgian colonial administration until 1962, Burundi was officially administrated by the United Nations (U.N.) between 1962 – 1966, but the civil conflict began in1965. After Burundi's independence, the country lived in a civil war regime until June 1993, when it had the first free and fair elections in post-independence (Bundervoet et. al. 2008)

With peace and the cease-fire agreement undersigned for all ethnicities in 2002, Burundi's history started again. In spite of this, the political stability has been improving since 1996, with the creation or recreated of national institutions as the Judiciary and Legislative ones.

With an area of 27.834 square kilometers Burundi has sixteen provinces and a terrible performance when we talk about rural poverty reduction. In 1990 the number of people living below the poverty line in rural areas was 36,2 per cent but in 2005 was around 70,68 per cent (World Bank data).

The income per capita in current USD plummeted from USD 199.26 in 1990 to USD 85,64 in 2003 when it began to rise and arrived at USD 107.87 in 2005. During this time the agricultural gross per capita production index fell from 128,68 in 1990 to 99,07 in 2005. Among these sixteen years the agricultural trade balance was weaker and during 2002 and 2004 it was negative (chart 4.1). Burundi faced the hard reality of the food security throughout 1997 until 2001.

Chart 4.1: Burundi macroeconomic environment



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

In the rural environment poverty is widespread, with the average farms sizes smaller than 1 hectare, household without land tenure or access credit. The land tenure system in Burundi started to move after 2007, although talking about land right in Burundi means bring up of the civil war feelings. It is a delicate topic and the changes will be slow.

Burundi has many macroeconomic problems that reduced access to credit; the percentile of domestic credit to private sector by GDP in 1990 was 8,61 percent and 2005 was 22,26 percent. IFAD (2008) estimated that rural economy had reached around 4 percent in 2002, nevertheless in this year the World Bank said that the domestic credit to the private sector represented 31,10 percent of GDP.

This scenario showed that, if Burundi's government resolved the macroeconomic problems, it would not improve the rural access to credit. In effect, if it had the money, banks would need the guarantees to lend money and without land tenure the farmers hardly offer guarantees.

However, the micro-farms phenomenon is increasing, for two basic reasons; firstly, the increasing density of population pushes to the reduction of farm's dimension. The rural density soared from 572.4 people per square kilometer of arable land in 1990 to 705,8 people per square kilometer of arable land in 2005 (World Bank data).

Secondly, the arable land areas shrunk very fast in the 1990s because, while the civil war was happening, the rebel and government forces were burning crops and fields. The rebels had burned coffee trees because they were trying to reduce government income, and the government forces had burned or stole food crops (Human Rights Watch reports 1998). After the civil war, the fields, degraded or abandoned were not recovered and the erosion by rainfall and wind is continuing to reduce the arable land in Burundi.

The good news comes at education level: we noticed that, in 1990, less than 40 percent of adult population was literate, but the gross school enrollment ratio at the primary level rose from 70,59 percent in 1990 to 88,24 percent in 2005. It indicated important progress to improve literate level of the country.

On the other hand, health situation has not improved, life expectancy at birth was, in 1990, 46,22 years and 47,75 years in 2005. The infant mortality rate was estimated at 110 per thousand live births in 1990 and 98,5 in 2005.

The situation was made worse by the HIV/AIDS pandemic: the official data indicate that about 4 percent of the population was infected between 1990 – 2005. But IFDA estimated that around 13 percent of population was HIV/AIDS positive in 2005.

Government data report all the people that used health public system and did an HIV test that resulted positive. On the other hand IFAD picked up data their own through field work and ONGs information. Anyway, the Burundi health system did not improved between 1990 – 2005 for simple and severe reasons, like a narrow budget and the very inflexible heritage the civil war produced: in 2002 around 25 percent of the adult population had some kind of mutilation caused by the war[7] and the poor infrastructure in Burundi.

The infrastructure in Burundi is similar to others low income country in SSA. Many problems reduced the competitiveness of Burundi environment business, as electricity supply and its prices, water systems that has insufficiencies water supply in dry months and the transport system.

[7] See Republic of Burundi "Poverty Reductions Strategy Paper – PRSP 2006.

All these factors are relevant, but among these the transport system is more important to enhance of agricultural production. Because low costs of transport to help the tiller to leap from subsistence agriculture or "food crop" to agriculture trade or "cash crops", the farmer should reduce costs of input and output.

On the other hand, electricity and water supply are not relevant to enhances Burundi's agriculture. Farmers in Burundi use a very low standard of agricultural techniques, they do not use electricity: during 1990 – 2005, around 85 percent of rural household was not supplied by electricity. Despite the importance of water in agriculture in Burundi, this resources does not come by irrigation, basically the water comes by rainfall, with a mean of mm 103,66/month between 1990 – 2005. The number of rural household that had water supply systems was smaller than 15 per cent.

Although even transport is fundament to improve the agriculture trade, the Burundi transport did not improve during 1990 – 2005. Burundi does not have rail lines and its road density shrank from 52,03 kilometers of road per 100 square kilometers of land area in 1990 to 44,27 kilometers in 2005.

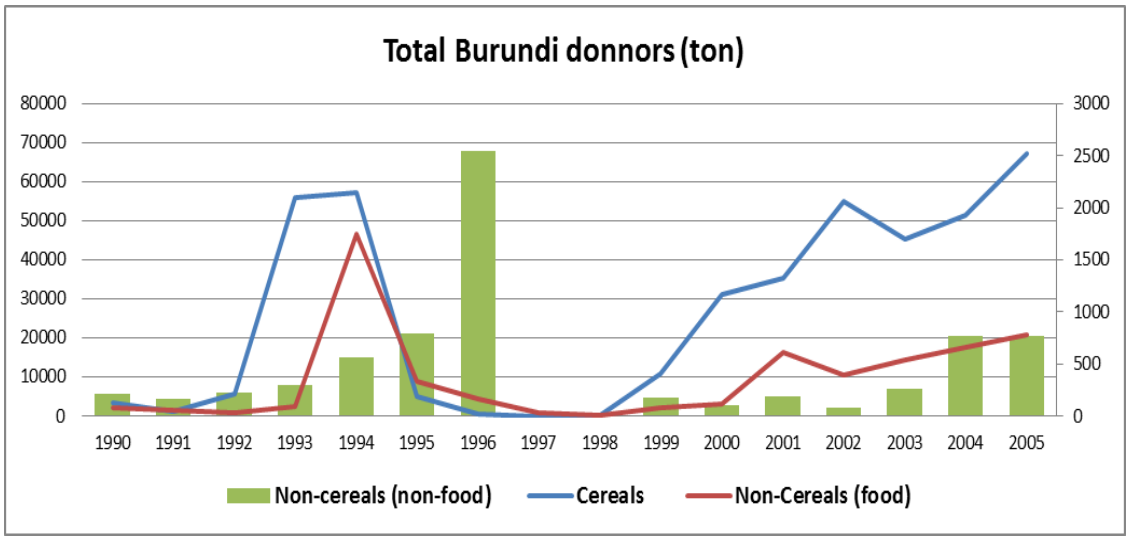
The geographic position limited Burundi's agricultural development: a landlocked country usually has problems with international trade, high costs of transportation, negotiation with neighbour; in this case, Burundi also had high costs of neighbour transportation and some conflicts.

With a small domestic market Burundi face more vulnerable indeed. The country macroeconomic index worsened very quickly after 1996, with an international embargo that isolated Burundi between 1996 – 1998 (chart 4.2).

Current, the main partners to goods exportation are, Germany (15.7%), China (10.5%) Sweden (9.5%) and Belgium (9%) all are traditional agriculture goods importers, Instead Burundi import energy and manufactory goods from Saudi Arabia (16.8%), Belgium (8.2%), China (7.5%) and Uganda (7.4%) according CIA data.

The UE 27 is the major trade partner for Burundi; it represented, in 2005, 25.2 percent the Burundi international trades. But the UE 27 import basically coffee and tea and export mainly machineries and products for the chemical industries. In other words the UE 27 imported in 2010 USD 26.3 million and exported USD 81.7 million.

Chart 4.2: Burundi total donnors (ton)



Source: Bundervoet et al 2008.

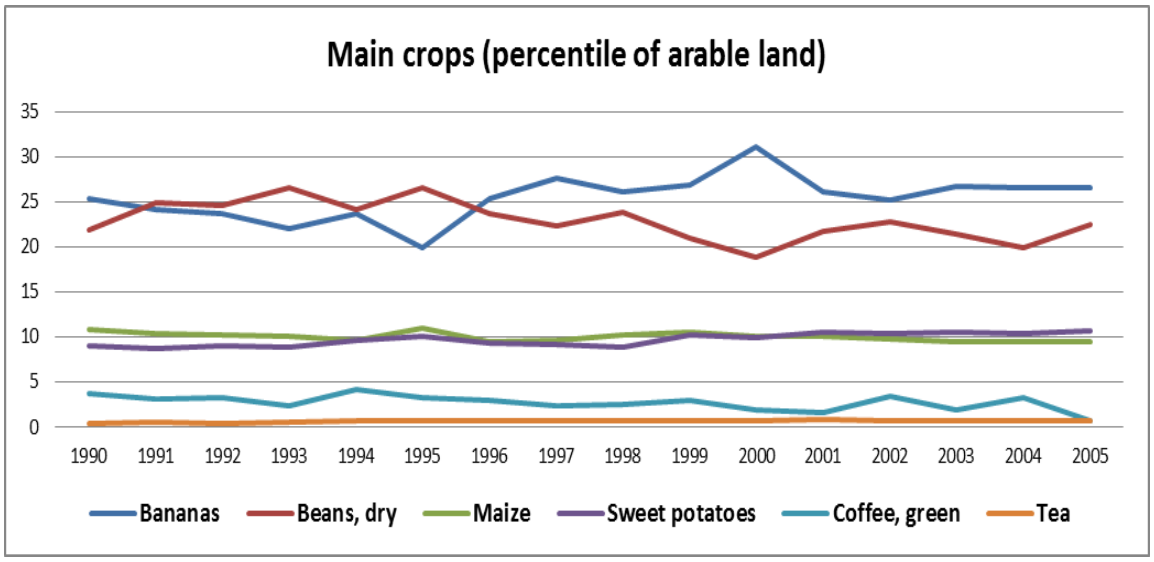
However, the regional commercial has been increasing very well in the last years. Between 2005 and 2011, the African Economic Community (AEC), The East African Community (EAC) trade grew on average by 3,8 percent and 4.6 percent per year respectively (IMF data). Despite the limited data we assume that Africa's regional trade could be more profitable for African countries than traditional north – south commercial.

The environment business in Burundi has so many hurdle that it is almost impossible to fight with northern industries and survive. Burundi's businessmen are trying competent with SSA countries that are members of the commercial treaties.

World Bank (Doing Business 2012), showed that, to export a container FOB from Burundi costs USD 2.965 and it takes 35 days to travel from Bujumbura and reach a port, but which agricultural product is fit to wait 35 days and supported this high cost? Similarly, importing is even more difficult and costs USD 4.855 and need 54 days from a port to Bujumbura.

The main crops in Burundi between 1990 – 2005 were: bananas with average 25.44 percent of area planted dry beans 22.91 percent and maize with 10 percent, all used as crops food or subsistence. The two main exporting agriculture goods, coffee and tea, had on average 2.71 percent and 0.65 percent of area planted respectively (chart 4.3).

Chart 4.3: Burundi main crops

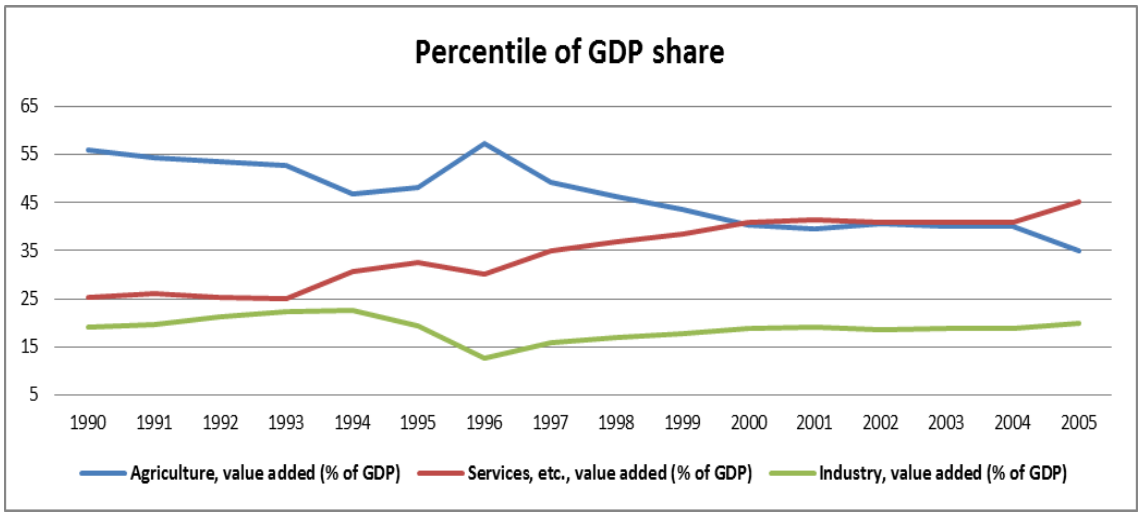


Source: FAOstat

On the other hand, in the United Republic of Tanzania, a member country in booth commercial treaties AEC and EAC, the export container cost is USD 1.255 it takes half the time of the Burundi, just 18 days, from port to Dodoma, and importing a container costs USD 1.430 and takes 24 days to do reverse path.

Although Burundi economics has been changing since 2000, the services value overtook the agricultural value of the GDP percentage; as a rule, agricultural GDP share lose weight when a country develops, off course Burundi has started over its history recently but the trend of the GDP share brought up good signals (chart 4.4).

Chart 4.4: Burundi percentile of GDP share



Source; The World Bank data

4.2 Ghana

Ghana is located at the West African coast and gained independence in 1957, but until 1960 the status of Ghana was that of a "commonwealth realm", in other words it was a sovereign state within the Commonwealth of Nations that currently has Elizabeth II as its reigning constitutional monarch. With a national referendum in 1960 Ghana was declared a republic.

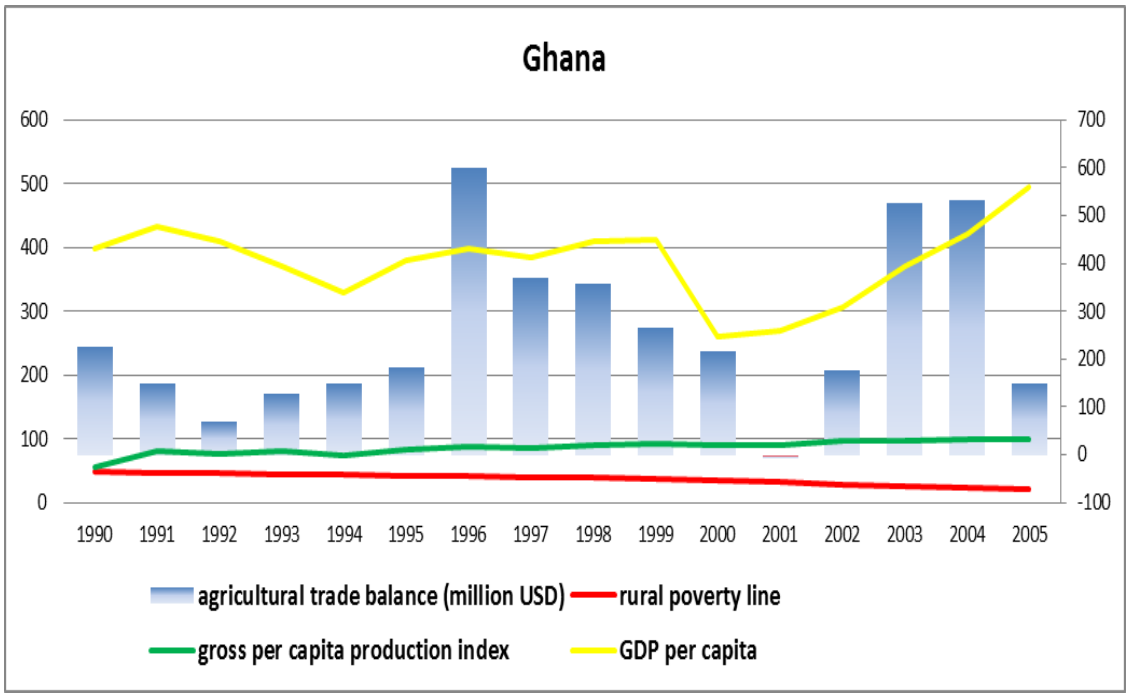
In February 1966 the first president was deposed by a military coup, and then in 1969 the so called "second republic" started. Ghana suffered very much with "cold war", because Ghana has a strategic geographic position and was leaning toward the US, USSR and national interests.

After 35 years of independence in November 1992, "the fourth republic" started and this was followed by a continuous economic growth which produced more social and political stability; however, this economic growth did not prevent the last civil conflict between Konkombas and Nunumbas ethnicities, which happened in 1994 and had around 2000 casualties. Despite this terrible incident, Ghana social environment has been improving year by year.

Ghana has 238.537 square kilometers in total land area and 10 provinces and the best performance in SSA when the subject is rural poverty reduction. The rural poverty fell from 48 percent in 1990 to 20 percent of the rural population in 2005 (World Bank data).

Even so, the rural poverty level fell very sharply, the GDP per capita income made a peculiar rally in current USD: in 1990 it was USD 397.88, in 2000 it was USD 259.71 and in 2005 stood at USD 495.39. Similarly, the gross per capita production index followed the rural poverty line lead, with inversed function and grew constantly from 55.15 in 1990 to 99.97 in 2005. Although the gross per capita production index in Ghana has been growing constantly, the agricultural trade balance has been fluctuating irregularly for these sixteen years (chart 4.5).

Chart 4.5: Ghana macroeconomic environment



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

The rural environment in Ghana have had good progress, despite the fact that the rural population grew by nearly 20 percent from 9.5 millions of people in 1990 to 11.4 millions of people in 2005, rural poverty declined from 4.5 millions of people to 2.3 millions of people in the same period, thus Ghana's agricultural have showed its strength.

Anyway, Ghana has a land tenure system to build and currently land tenure scenario is very complicated. Different interpretations about land tenure between central and local governments and indigenous traditional have created a land tenure systems with "6 different regimes of land tenure" which is not easy to sort out.

Awanyo (2009) gave a thorough explanation of the complex subject: the relations between farmer land investments and land tenure (figure 4.1),"*...That social identities created a scenario unease to understand that point of view the west countries...*", he claims that the whole system cannot change with new laws, it will lead to new civil conflicts. However, he says that the current land tenure system and bank needs are incompatible and they have blocked rural credit access.

On the other hand Ndulu (2008) has a very firm position, the lack of transparency of the land tenure process in SSA has as main goal to reduce the autonomy of citizenship, because access to land is strongly related to the ability to escape from dependence on the state, hence the citizen could have freedom of choice in multidimensional characters as political, cultural and social. "*...Without institutions stronger, SSA countries have preferred the maintenance the land tenure insecurity*"... (Ndulu, 2008).

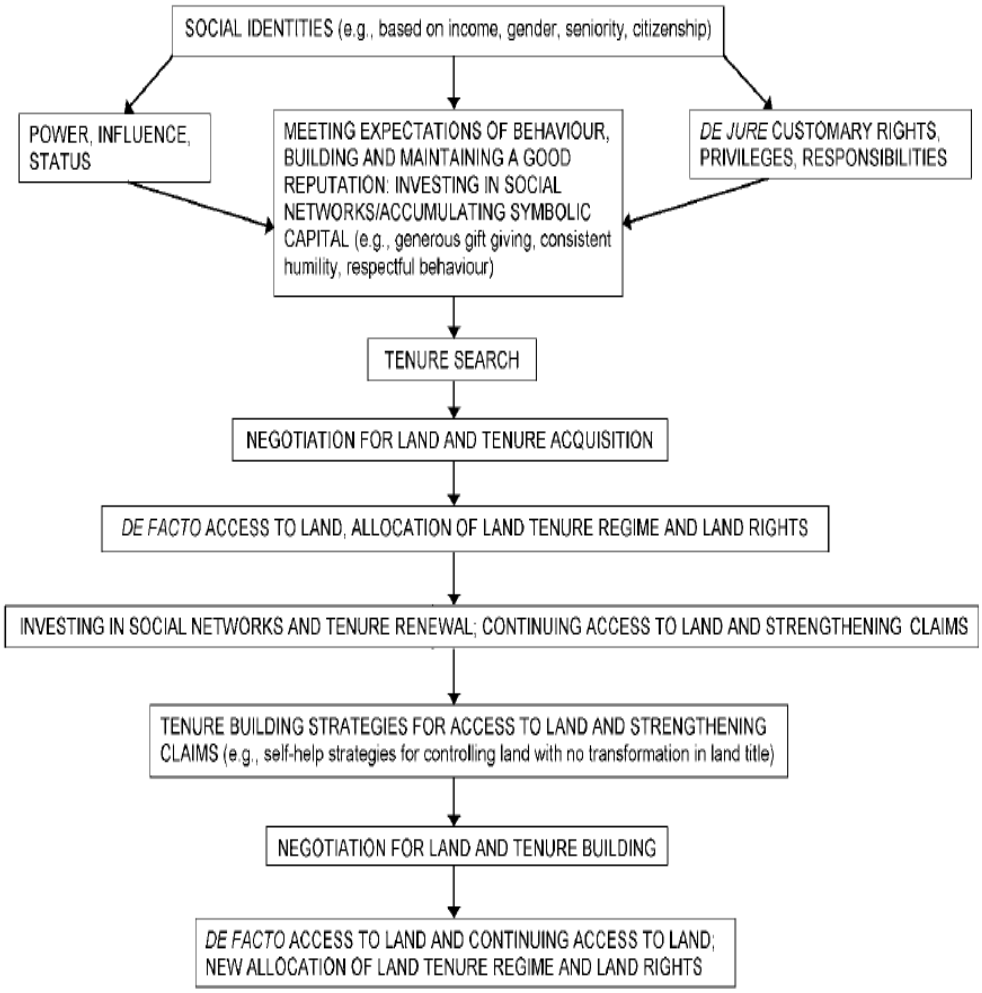
The modern literature shows a disparity of opinions about the solution to this problem. Platteau (2002) said that land titling does not necessarily impact on the investment behaviour of farmers, if a country or region has good opportunities, created by macroeconomic environment, the farmers' behavior may change form passive to proactive behaviour and they will do investments.

On the other hand, Besley's analysis (1993) holds that the farmers' investments will increase, whether the government investments spread in rural areas or they promote land security. Thus the governments of SSA have two ways to develop rural areas; either do great investments in rural area like China or they create a good socio-economic environment that gives guarantees to the private sector.

The apparent dichotomy among the authors and issues above disappeared in the particular situation of Ghana. In the same comfortable macroeconomic environment, with hardly no land tenure system, some farmers have been investment and others have not. In overall numbers the farmers invested and agricultural land areas increase from 126050 square kilometers in 1990 to 149500 square kilometers in 2005, the agricultural land areas was rising around 1 percent by years.

We assume that, if the land tenure process was resolved, the rural areas would undergo very good modifications, however it is also true that the six different regimes of land tenure are mutually respected by central and regional governments and also by indigenous traditions, this has contributed to creating a scenario with more security and peace in rural areas.

Figure 4.1: Ghana land tenure system



Source Awanyo 2009 page 148

On the other hand, with clear rules of land tenure, possibly Ghana's rural environment will follow the U. R. of Tanzania and Zambia's[8] path, which improve indeed their rural credit access. Ghana expanded the domestic credit to private sector in 1990, reaching 4.92 percent of the GDP, while in 2005 it stood at 15.54 percent of the GDP, but rural credit access was stagnant.

Land rights may open the possibility of the rural credit, although Ghana is an agricultural country, with 55% of the work force and 60% of the population in rural areas.

[8] IFAD Zambia 2004 and IFAD United Republic of Tanzania 2007.

The rural Ghanaian people usually do not have guarantees to get loans, 87.1% of males and 91.9% of females in Ghana indicated with guarantees for loans only their name, in others words, nothing. As a result the average 95 percent of application was refused in 2005. Only 1.8% of males and 0.8% of females, in rural areas, had indicates with guarantees their land (GLSS5).

While in land rights Ghana has few problems, in education level Ghana is better than the SSA average, the adult population literacy corresponded in 1990 to around a half of the inhabitants and the gross school enrollment ratio to the primary school level was 70.49 percent. In 2005 this index leapt to 90.3 percent. In others words, 90 percent of the pupils of school age were attending school in Ghana. In spite of good national numbers, the public investments in education are concentrated in regions where there is political (Accra) or economic power.

Between 1990 and 2005 public investments per capita in education in northern Ghana were smaller than in others regions. We know that the problem does not only education investments, but also Ghana's division; the regional problems between Accra, the Eastern region, the Western region, Central and Northern regions are historic, structural and cultural[9].

Besides, Ghana's slavery history created deeper scars between the north ethnicities, enslaved, and the south ethnicities, that were involved in the slave business. Furthermore, in the past, different natural ecosystems lead to different economic environments that were accentuated with more investment in southern than northern regions. Finally, the higher education investments in southern regions created a kind of barrier to stop the emigration from north to south.

Only 30.2 percent of Ghana's population speaks official language: English. In the rural savannah only 8.5 percent is literature in English and 10.1 percent of Ghanaian speaks English, in Accra 61 percent is literature in English and 80 percent speaks English (GLSS5).

[9] See Destombes J. 1999 (Nutrition and Economic Destitution in Northern Ghana 1930-1957)

Ghana's government is trying to change this situation[10], but at present Ghana is divided as follows: Most of people from the northern only speak *Frafra's*, in the center of the country *Brong* and *Adan's*, in the east of the country, *Ewe* finally in the capital, Accra, people speak *Ga's*. In the others words, communication is still is an invisible barrier to immigration flows and can be explained by the separation of the country.

Some things are changing because - in despite of difficulties- the people from the north are attracted by the idea of moving to the south, and choose predominantly to settle in the Brong Ahafo and Ashanti regions, overloading the local health system (Geest, Vrieling and Dietz, 2010).

The whole health system is not working well in Ghana but the national and regional numbers have the same shape, when we talk about life expectancy at birth the index worsened, it was 57.32 years in 1990 and 56.53 years in 2005.

The infant mortality rate, instead, and the life expectancy at birth improved their numbers and fell from 75 per thousand live births in 1990 to 55,4 in 2005. But the infant mortality rate is not egalitarian by regions. The Upper West province had the worse result with 110 per thousand live births and Accra has the best one with 43 in 1990. The scenario worsened in 2005, Accra infant mortality rate fell to 31 per thousand live births and Upper West level grew to 115.

Finally, the percent of adult population infected by HIV/AIDS in 1990 was around 0.6 percent and doubled in 2005 with 1.2 percent of adult population infected. By showing the data, we assume that positive HIV results have stronger links with human behavior than the socio environment as; good health system, education level and public information campaigns or support.

Upper West and Upper East have the worst numbers of the national ranking in education level, health system, government investments, poverty incidence, but the percentage of adults infected in 2005 had 1.1 and 1.2 respectively and the virtual regions like Accra and Eastern that have good performance in social environment had the adult population infected level was 2.3 and 3.7 percent, one-to-one (GLSS5).

[10] See Blunch 2008

The infrastructure of Ghana is another factor that clarifies the level of life quality there, Ghana has the huge infrastructure gaps between regions. Among the ten regions the access to water, electricity and roads is very disproportion.

Around 39.5 percent of households in Ghana had access to the water supply in 2005, but Accra's households served represented 84.3 percent, the others regions as Eastern, Central, Western and Ashanti around 12 percent of families had access – this regions the so called "forest region". On the other hand, the region so called "savannah ecosystem" that is represented by three regions, Upper East, Upper West and Northern only 5.9 percent of households had access to the water supply.

The Electricity supply had the same profile, 49,2 percent of household had access in 2005. Accra had 88.1 percent of household assisted, the forest region around 32.4 percent and in the savannah region only 16.6 percent of household had access to electricity (GLSS5).

Ghana's roads density has the same profile as the water or electricity supply, national level was 24,15 kilometers of road per 100 square kilometers of land area (World Bank).

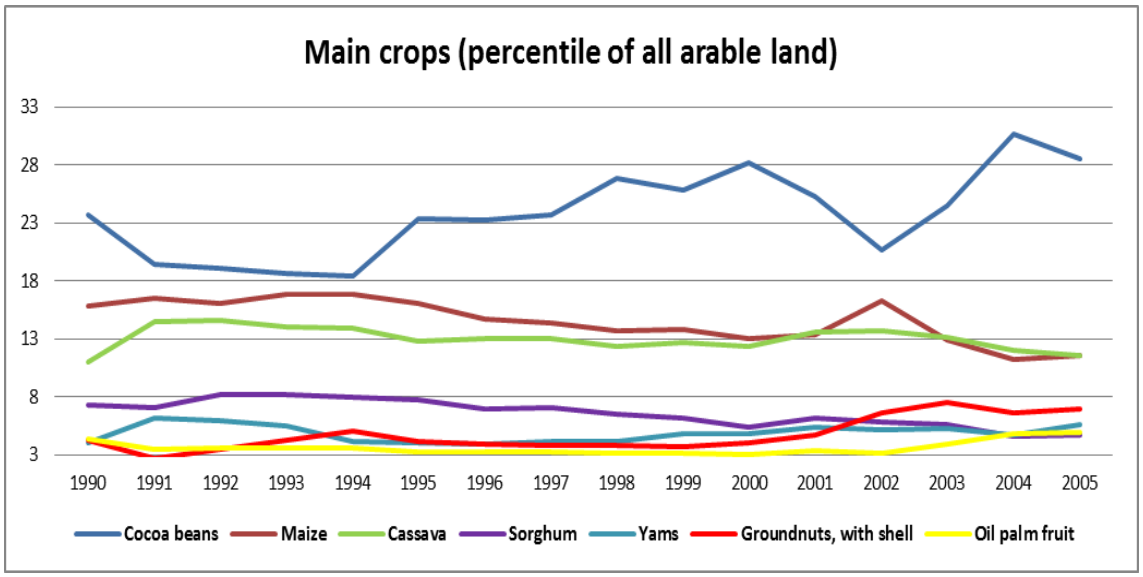
Ghana has a relativity modern economic if compare with the SSA average, the merchandise trade as a share of GDP leap from 42.72 percent in 1990 to 98.17 percent in 2005. As explained Ghana export basically primary products, its principal partners are; the Netherlands (11,7%), the U.K. (7%), France (5,7%) and the U.S. (5,6%).

On the other hand it imports main capital equipment and petroleum the principal partners are: China (16%), Nigeria (15%), India (5,6%) and the U.S. (5,6%) according to CIA data.

However the EU 27 is the largest trade partner of Ghana, representing 27.4 percent of all Ghana trades. Ghana imported USD 2.25 billion and exported 1.31billion (Euro STAT data).

The seven main crops in Ghana occupied more than 73 percent of the arable land in 2005. Cocoa beans represented 28.43 percent of the area, and its area grew 16 percent, between 1990 – 2005. Cocoa crops were following by maize and cassava with around 11.5 of the area each. Nevertheless the crop which grew the most was groundnut; with an increase the 38 percent in its area, and oil palm had great performance growing by 11 percent in its area (chart 4.6).

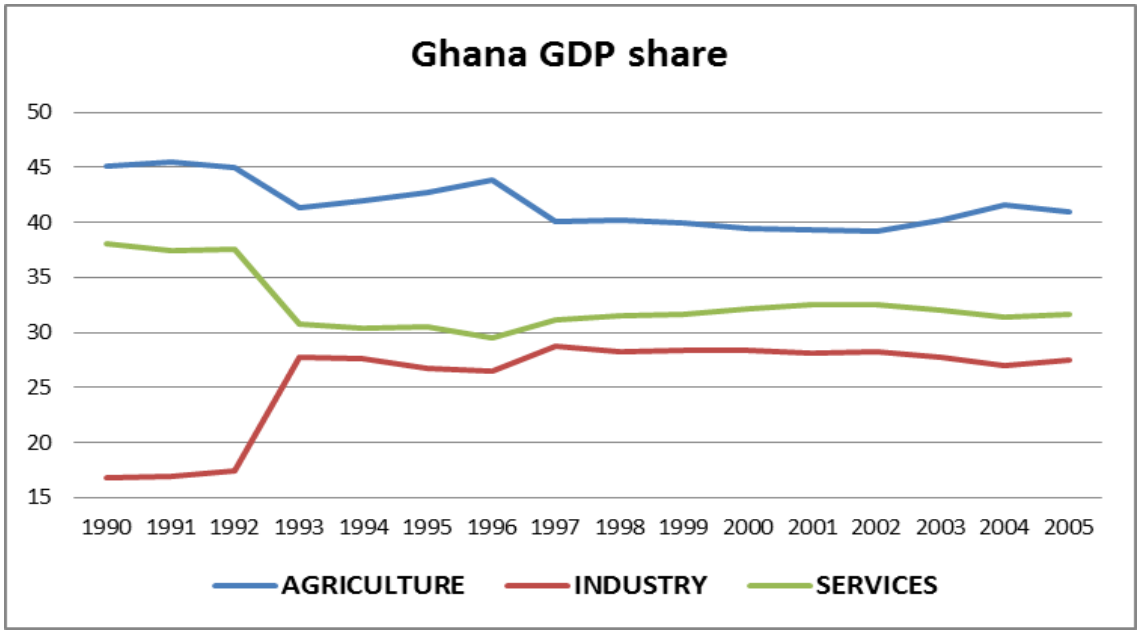
Chart 4.6: Ghana main crops



Source: FAOstat

The widely accepted hypothesis is that vis-à-vis the economic developed, the social environment improved, the share of agriculture GDP should decline during this economic phenomenon (Lipton and Ravallion 1993, Roemer and Gugerty 1997, Delgado, et al 1998), but it is not working in Ghana. Ghana produced welfare, the poverty in rural areas was reduced but agriculture's GDP remained firm, the GDP share changed sharply in 1993, just because, Ghana's calculation methodologies had changed (chart 4.7).

Chart 4.7: Ghana GDP share



Source; The World Bank data

4.3 Malawi

Nyasaland won independence on July 6, 1964. But between 1962 and 1963 it joined a kind of federation, the Commonwealth of Nations with Northern Rhodesia (Zambia) and Southern Rhodesia (Zimbabwe), that was dissolved in 1963 and the country changed the name for Malawi.

The first Prime Minister Dr. Banda declared in his first month as ruler, "*one party, one leader, one government and no nonsense about it*". In 1971 he affirmed himself president for life and consolidated the authoritarian rules. After violent protests that started in 1992, Malawi had the first free election in May 1994, so Banda's era ended after 30 years.

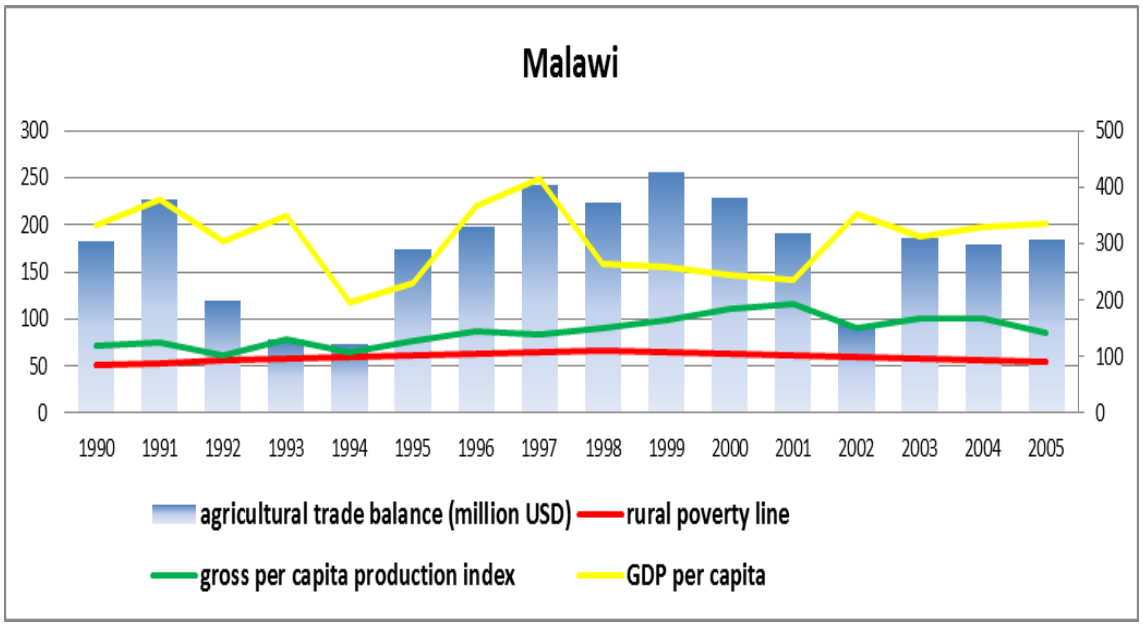
Currently Malawi has three regions, Northern, Central and Southern, the country has 118.480 square kilometers with a particularity, more than 20 percent of the country or 24.400 square kilometers of the country area is water surface, mainly composed by Lake Malawi that is the biggest, Lake Malombe, Lake Chilwa and Lake Chiuta.

The data about poverty line during Banda's dictatorship are always estimated, the NGO ActionAid said that, in 1990, 51 percent of the population lived in extreme poverty and the World Bank data show which in 1998 it reached a peak with 66,5 percent of the population living below the poverty line, after 1998 the poverty started to decline.

At the same time GDP per capita made a rally between 1990 – 2005 in 1997 it reached its highest point with USD 248,67, in 1990 was USD 198,99 and in 2005 USD 201,79 (World Bank data). The agricultural gross per capita production index (API) started to grow significantly after 1994; with the end of Banda dictatorship, this trend kept following gradually until 2001 when it started to decrease (chart 4.8).

The rural environment in Malawi changed completely with the end of the program so called "The Agricultural Development and Marketing Corporation" (ADMARC), which was created in 1971 and provides farmers with inputs and output of market with a major focus on improve the food security level. ADMARC finished in 1988 with the end of monopsonistic government position.

Chart 4.8: Malawi macroeconomic environment



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

When ADMARC collapsed, the food security problem increased because the opportunities for small farmers that had no access to the credit market shrunk, mainly in remote areas.

At the beginning of the 1990s, to respond to social problems, the government created Agricultural Sector Adjustment Program (ASAC), which basically introduced hybrid maize through subsidies to improve the yield and at the same time the government gave the permission to plant tobacco for small farmers, which was a prerogative of farms of states.

However, this government attempt was blocked for two reasons; the droughts years between 1990 – 1993, and the suspension of western trades and financial aid. Unlike the Burundi embargo, which isolated that country between 1996 – 1998, in Malawi's case, the western countries denied the international Malawi trades, but, with the help of Mozambique government, the humanitarian aid continued.

The effects of the international embargo were the end of Banda's era and the downfall of the entire agricultural sector; without government subsidies or access to credit, with no access to international market and due to the continuous arrival the foods by international donation, the agricultural business was practically disintegrated.

After the democratic government, the Malawian assumed the government and the subsidy program began; this gave vouchers to small farmers to buy seed and fertilizer in the free market (IFAD 2009). However, the domestic credit to the private sector in Malawi, compared with the share of GDP declined from 1990, with 10,94 percent of GDP share to 7,91 percent in 2005 (World Bank data).

The traditional problem, with the land tenure system, is present also in Malawi; this has simple rules from colonial era and maintained by the Banda government. Malawi has three categories of controlling land as: Public land, Private land and Customary land (Matchaya 2008). The main problem is that around 66 percent of land tenure remains under customary tenure, government land were 21 percent and only 13 percent of farms had the formal deal of the land (Malawi government 1997). Customary land that was the exception to the rule nowadays is the common rule.

Nevertheless, the Malawi macroeconomic problems have forbidden the growth of the credit market and government accounts have a historic huge deficit which has dragged down all the opportunities to development the credit market; this problem caused, for example, the max-devaluation – 50 percent – of Malawi currency in 2012 second IMF.

In spite of many macroeconomics difficulties, the education level in the country improved, until 1995 as in slow-motion at an average 2,6 percent per year, between 1990 – 1995 it skyrocketed, in the firsts years of democracy the growth was on average 5,6 percent per years. Between 1995 – 2005 the gross school enrollment ratio at the primary level rose from 71,53 percent in 1990, to 128.17 percent in 2005.

On the other hand, the health system in Malawi showed awful numbers, the main threat being the HIV/AIDS epidemic. Western institutions have different statistics about it, the most optimistic said that the national rate of infection among adults remains near 11 percent (IFAD 2009) and the most pessimist believed that adults infected were 20 percent in 2005 (UN 2005).

This disparate of numbers is justified because Malawi's health system has problems about management database and sometime the sources of the government have more than two data about the same subject. Malawi government report (1997) showed that AIDS produced 650.000 orphaned, on the other hand the site of Malawi government displayed very different numbers, it talks about 120.000 orphaned in 1998.

Anyway, with a faulty health system and indigenous behavior, the HIV/AIDS pandemic increased and reduced the work force in agricultural, created serious problems about land heritages[11]; furthermore this phenomenon reduced indeed the capacity of Malawian people to have food for subsistence. FAO estimated that, between 2002 and 2003, around 3 million people suffered the food shortages and in 2005 Malawi's situation worsened and it faced more than 4 million people or 34 percent of the population was without adequate food supplies.

Infrastructure is another point that weakens agricultural production and the poverty reduction. With high costs, it landlocked country, which may improve the rural environment in two ways; building rural roads in remote areas to facilitate the domestic trade and the biggest modal project that will link Shire-Zambezi waterway with Sena Corridor: this project will connect the entire country with Nacala port in Mozambique.

The strategy led Malawi to increase roads density from 8,61 kilometers of road per 100 square kilometers of land area in 1990 to around 13,88 kilometers of road in 2005. On the other hand, rail lines density decreased at the same time from 0,66 kilometers of rail line density in 1990 to approximately 0,59 kilometers of rail line density per 100 square kilometers of land area in 2005 (World Bank data)

Malawi government estimated that transportation costs account around 55 percent of the total transaction costs in Malawi trades. Doing Business 2010 confirm that Malawi has the same problem of almost all landlocked countries in Africa: the high costs and complicated bureaucratic system which prevents carrying out international trade.

A container cost is USD 1713,00 and takes 41 days for export process and 51 days for the import process. The costs to import is higher than for the export process; it takes around USD 2570,00 to arrive in Nacala port from Mozambique (Doing Business 2010).

Although the importation costs are 50 percent higher than exportation costs, this does not prevents the negative historic balance on international trade. Malawi's exports are essentially primary goods, and the country imported mainly fuel and secondary products.

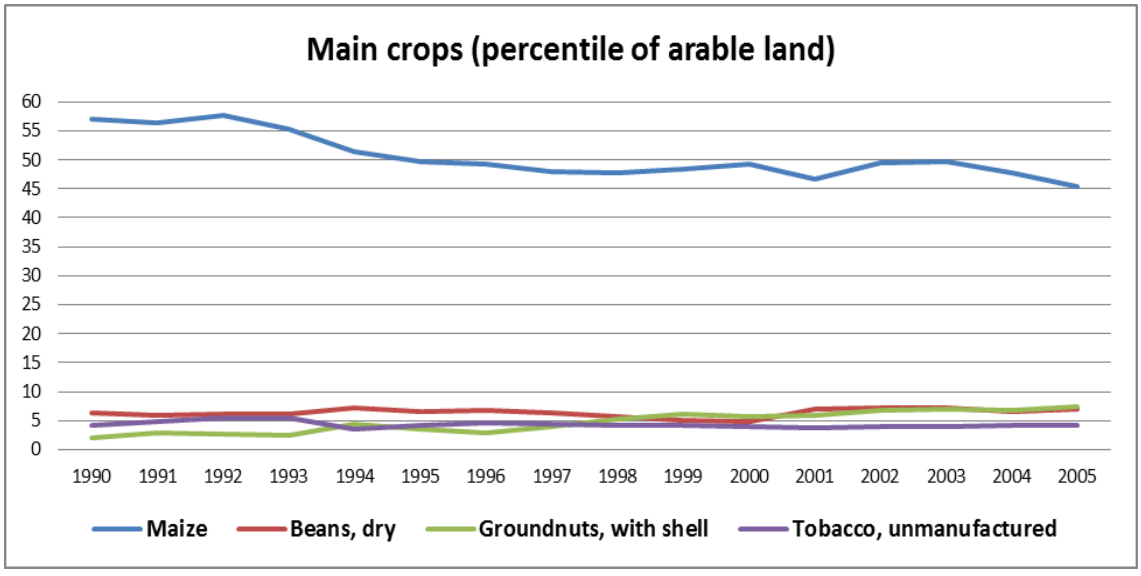
[11] See Matchaya 2008

Nowadays the major export partners are: South Africa (43%), EU 27 (12,9%), Zambia (8%) and India (7%). The main import partners are EU 27 (28,2%), South Africa (8,5%), Zimbabwe (8,4%) and Russia (7,3%) (EUROSTAT data).

Despite the fact that Malawi has historically a negative international balance trade, with EU 27, Malawi has a positive balance; it exported USD 230 million and imported USD 129 million. Naturally, 83 percent of export goods share was tobacco, and 47 percent of importations corresponded to chemical products and 24 percent was machinery (EUROSTAT data). Malawi's main problem is in "fuel account" with South Africa.

Even though tobacco is the main exported goods and play a crucial role in the balance of account of Malawi, the maize crops is without doubts an indispensable source for food and the percentile of area planted decreased from 56 percent in 1990 to 45 percent in 2005 (chart 4.9), but maize continue support around 67 percent of all calories in the Malawian diet between 1990 – 2005 (FAOstat).

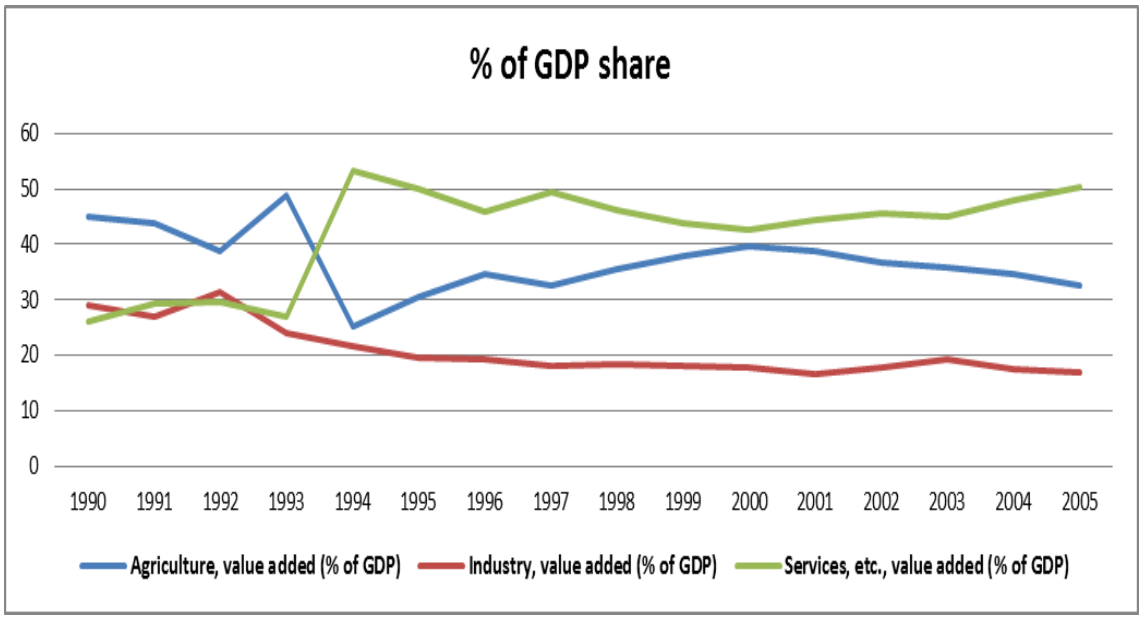
Chart 4.9: Malawi main crops



Source: FAOstat

After 1994, Malawi GDP share had a drastic change, the democratic government cut its economic participation and, as a main consequence, the services portion of GDP grew up very fast. However, many SOEs or State Companies closed the doors and Malawi did not have a very strong deindustrialization process (chart 4.10).

Chart 4.10: Malawi percentile of GDP share



Source; The World Bank data

4.4 Mozambique

Almost African countries won the independence, because after the Second World War Europeans nations were weakened and this created possibilities for African colonies to fight for freedom, Except for Portuguese colonies, Portugal had been neutral during World War II and the "Estado Novo" or Portuguese dictatorship drove the country and all the colonies with "the sweet iron hand" until April 1974.

Mozambique became independent from Portugal on June 25, 1975. The Front for the Liberation of Mozambique (FRELIMO) made the first government with a strong influence from the Soviet Union, FRELIMO established a one-party and the Socialist State. After a few years the civil war exploded, and it lasted 16 years starting in 1977 and finishing 1992.

Formed in 1975 the Mozambican National Resistance (RENAMO), was the main objector to Mozambique's government. RENAMO intensified the fights in 1990, supported by U.S. forces, South Africa and the newly independence country, Zimbabwe, thus in November 1990 FRELIMO government adopted a new constitution that guaranteed multiparty state and periodic elections.

In October 1992, the cease-fire agreement was signed in Rome between opponents and in 1994 Mozambique had the first free elections: the FRELIMO party won the election and after one year Mozambique joined the Commonwealth of Nations, hence the ex-Portuguese colonial is the only member of Commonwealth of Nations, that never been part of the British Empire.

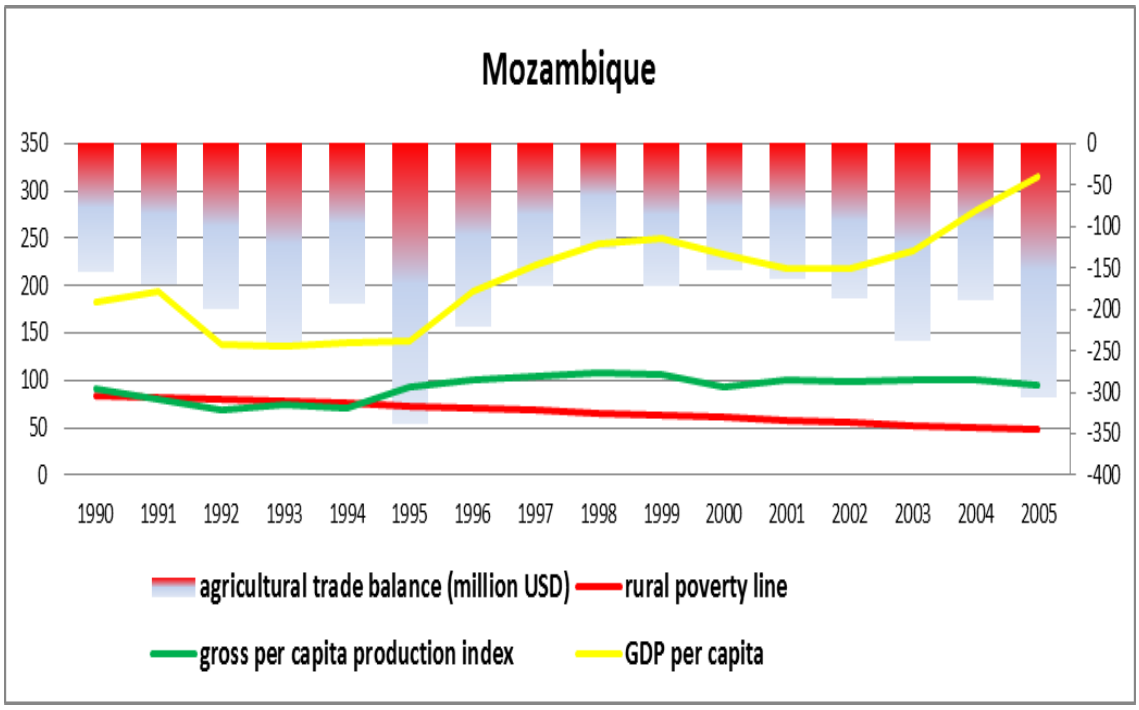
By mid-1995, around 5.7 million refugees returned to their homes, over 1.7 million refugees who had sought asylum in neighboring countries had returned to Mozambique and the internally displaced completed this number (Mozambique Government report 2010).

Mozambique has 799.380 square kilometers and 10 provinces, the country have fought very successfully against the extreme rural poverty, this was reduced from 83,9 percent in 1990 to 47,9 percent in 2005 (World Bank data). Then again, extreme rural poverty trend changed after 1995 and poverty reduction was accelerated between 1995 and 2002, unfortunately after 2002, rural poverty reductions come back of the first year's rhythm of 1990s.

The income GDP per capita following poverty reduction lasted until 2002, after that we saw a dichotomy of the data. Until 1995 both indexes remained relatively stable, after this year the rural poverty reduction and income GDP per capita statistics improved considerably, the income GDP per capita fluctuated between 2000 – 2002, but rural poverty reduction kept its good performance. After that income GDP per capita restarted growing well, on the other hand, rural poverty reduction slowed the accomplishment.

1995 was a significant also for the agricultural gross per capita production index (API), it grew 22 points in a year, but that was the unique sprint, while between 1996 and 2005 API remained stable. This climb of the API level helped the agricultural trade balance of Mozambique that reduced the deficit during the three successive years (chart 4.11).

Chart 4.11: Mozambique macroeconomic environment



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

To explain the low performance of the agricultural sector, we should be aware of Mozambique particularity, the northern and central provinces have a fine agro-ecological conditions and good potential to develop agro-business, on the other hand southern provinces have a very poorer soil and scarce rainfall, in addition are subject to recurrent droughts and floods.

Furthermore, the majority of the farms in Mozambique have produced goods for subsistence or the regional market. Typically a farm has on average 1,3 hectares, has no deed of property and never had access to credit market. (IFAD 2004).

On the other hand, 83 percent of the employees who earn a salary and 70 percent of urban population are in the south region, and in addition Mozambique has ones of the worst transports systems in SSA. According IFAD (2004), to carry agricultural goods for more than 50 kilometers, it takes more than a week and the average cost of transporting is bigger than the product value.

As a consequence only one quarter of the arable land was cultivated in 2004 (IFAD 2004), the south of the country imported food from South Africa and Europe. And the central and north regions have a slow development and have carried out the “informal” trades with Malawi and Zambia (Abdula and Tschirley 2007).

Not only the agriculture sector suffered with Mozambique's mismatch, all the domestic credit to private sector shrunk between 1990 and 2005 in percentile of GDP from 17,58 to 11,84. But again the IFAD estimated that rural sector suffered more and in 2004 got around 3,5 percent of the credit from the private sector. Although Mozambique in this period did not has big problems with macroeconomics numbers, because the foreign direct investment net was on average 3,51 percent of the GDP between 1990 and 2005, it overtook by an average of 40 percent the budget government deficit (World Bank data).

In spite of the access to finance, in Mozambique there were bigger problems for entrepreneurs there, according to the EnterpriseSurveys (2007) to have access to finance in Mozambique is 40 percent more difficult than SSA averagely. On the other hand, corruption of public officials is around 20 percent lower than SSA average, hence the contraction of credit private sector has other starting point, probable owing to regulation, taxes or the bureaucratic system.

Apparently the bureaucratic system affected also the gross school enrollment ratio at the primary level, which increased only by 0,10 percent between 1990 and 1998, from 62.89 percent in 1990 to 63.80 percent in 1998, but the index changed the trend and soared significantly, between 1998 and 2005 from 63.80 percent to 101.10 percent rose on average 5,44 percent per year.

The life expectancy at birth followed the inverse movement of education level and improved regularly, between 1990 – 1998 it rose from 43.34 years to 47.17 years. After 1998 the life expectancy level remained stable and in 2005 it was 47,61 years (World Bank data). Although the mortality rate per thousand births improved sharply from 155.2 children 1990 to 109.1 in 2005, this happened because HIV/AIDS pandemic dramatically affected all the health system (UN data).

Official numbers of people who died because of AIDS in Mozambique, sky-rocketed, in 1990 the number was 2.200 people per year but in 2005 it was 71.000 people, and the UN estimated that around 1.400.000 of people were living with HIV, that means 11.5 percent of population, so this phenomenon produced around 670.000 orphans in that period.

Also we can say that the infrastructure situation in Mozambique seems a nightmare, notwithstanding a good geographic position, with 4.571 kilometers of coastline on Indian Ocean and three countries that must use it infrastructure to access international market – Malawi, Zambia and Zimbabwe – the road and rail lines densities persist in the same density.

Road density in 1990 was 3,36, and arrived to 3,78 in 2005 while rail lines density had the same numbers during these sixteen years; 0,38 kilometers per 100 square kilometers of land area. For the farmers in Mozambique worse than density numbers is the government strategy that has invested in the so called "corridors".

The corridors always have latitudinal position toward the east – west linkages, they leave the north arable land and south consumers without linkage, furthermore, the conditions of the main road, which has longitudinal direction and connects north – south areas, are in fair or poor conditions, depending on part of road (Dominguez-Torres and Briceño-Garmendia 2011).

Currently, the Mozambique exports have with main partners the Netherlands (47%), South Africa (20,8%) Portugal (5%) and China (3%). The main goods exported are unwrought aluminum, electrical energy and unmanufactured tobacco. On the other hand Mozambique imported mainly; motor vehicles, petroleum and commodities foods to South Africa (43%) Portugal (3,7%) India (2,8%) U.S. (2,6%) in 2005 (CIA data).

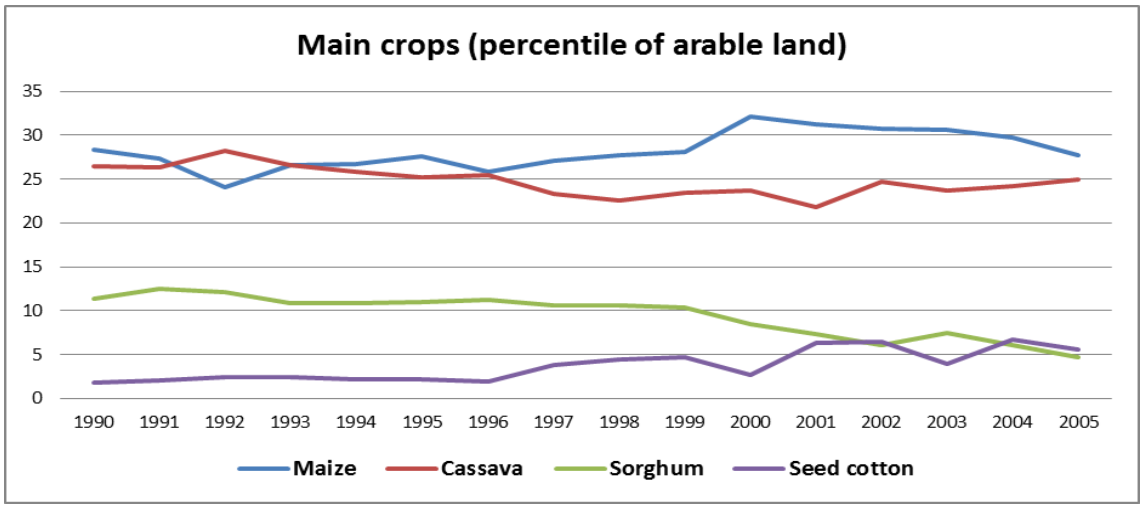
EU 27 is the major partner and represented 43,6 percent of the Mozambique international trades, exporting USD 858,6 million and importing USD 1.136,5 million. The EU 27 had a negative balance exporting mainly machinery and importing basically aluminum. However, Mozambique's international trade was historically negative in 2005 (Eurostat).

We observed which this phenomenon, the problem of trade balance, can does resolve with a higher integration within Mozambique regions, using the agricultural potentials, and improvement of the environment business.

The Mozambique environment business has positives and negatives points: unlike most SSA countries, Mozambique does not have problems with the electricity supply, apparently corruptions levels and tax rates are lower than SSA average. In contrast, entrepreneurs in Mozambique have to deal with problems like access to finance, a huge informal sector and highs transport costs; all these items have higher levels than SSA average.

Despite all negative events, the agricultural business continued to grow constantly, harvest areas leapt from 3.564 thousands hectares in 1990, to 4.429 thousands hectares in 2005. Unfortunately the majority's area is mostly using subsistence or "food crops" as maize and cassava, while traditional crops like sorghum have been replaced by cash crops like cotton (chart 4.12).

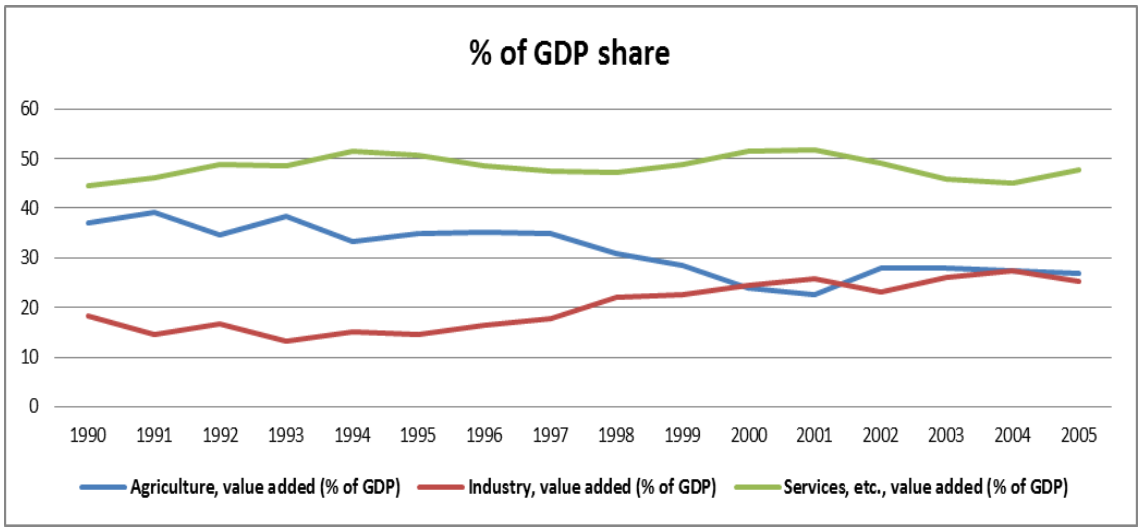
Chart 4.12: Mozambique main crops



Source: FAOstat

The percentile of GDP share in Mozambique had changed after the democratic period and industry value had been increasing. Here we can see other example that did not follow the classic hypothesis (Lipton and Ravallion 1993, Roemer and Gugerty 1997, Delgado, et al 1998), despite Mozambique has unused arable land, the agriculture in Mozambique is underdevelopment and the country has problems with supply foods, although the urban areas and local industry have been stocked by food imported (chart 4.13).

Chart 4.13: Mozambique percentile of GDP share



Source; The World Bank data

4.5 Rwanda

Rwanda's colonial age had a confused history, after I World War, the European convention of Brussels transferred the "Ruanda-Urundi territory" to Belgium. The Belgian government used the Tutsi (14% of population) power to control the region, the Hutu (85% of population) and Pygmies (1% of population) – other ethnicities – are subject to the forced labour.

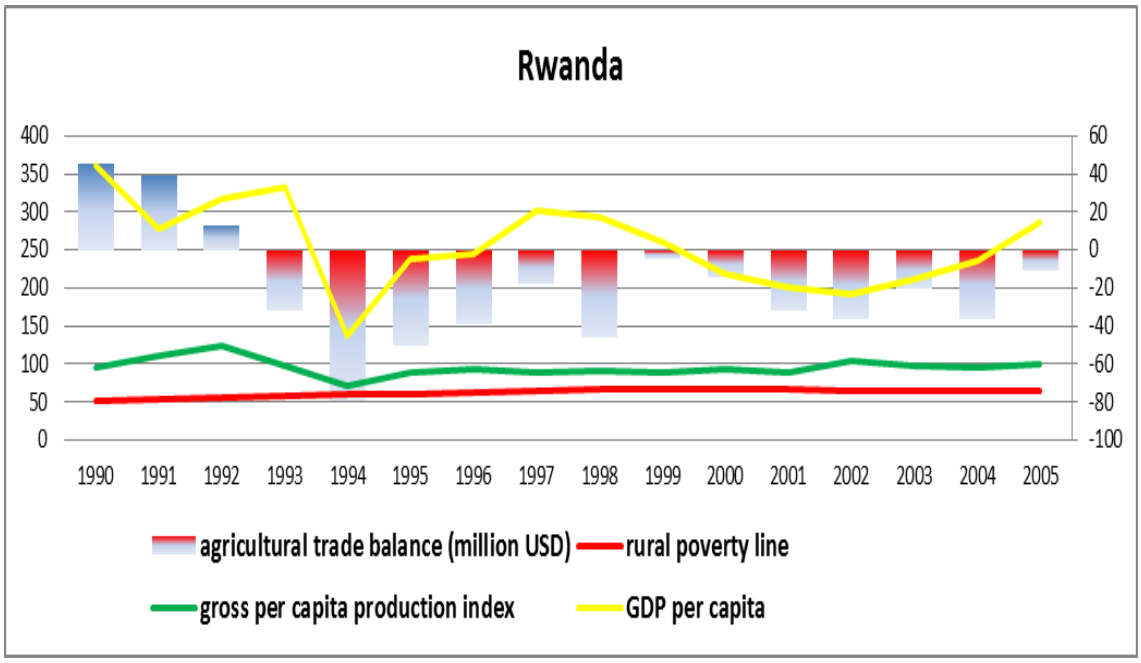
In July 1962, Ruanda-Urundi become independent and each region opted to go their separate ways. Thus was born Rwanda, the first president Gregoire Kayibanda (Hutu) ratified a new constitution and the Tutsi, who were dissatisfied, invaded Rwanda from Eastern Congo – ex Belgian Colonia –; in retaliation the Hutu government massacred 12 thousands Tutsis and in 1969 The military dictatorship of Juvénal Habyarimana started.

Habyarimana remained in power for twenty-one years, on 1 October 1990 Rwanda Patriotic Front (RPF) invaded Rwanda from Congo and installed the Tutsi government between 1990 – 1993. During this period, unfortunately, around 300 thousand Hutus were killed. In April 1994 a civil war started, and killed 800 thousand people, the majority of which were Tutsis, this was the saddest and shameful chapter of 1990s because both sides of fighters were sponsored by "developed countries" (Article 19, 1996).

Nowadays Rwanda has 26.338 square kilometers and five provinces with the capital Kigali, the rural poverty line in 1990 was estimated 51,7 percent (World Bank 1994) and the official numbers reached 64,2 percent of rural population in 2005 (World Bank data).

The income GDP per capita in 1990 was USD 361.43 and plummeted to USD 135.89 in 1994 for obvious reasons and attained USD 287,04 in 2005. The agricultural gross per capita production index (API) followed the same tendency slumped in 1994, after that it started to recover, influencing the agricultural trade balance, which had the worst result in 1994 and leveled off in 2005 (chart 4.14).

Chart 4.14: Rwanda macroeconomic environment



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

The rural environment in Rwanda suffered the strongest distortion between 1990 and 1994, during RPF governments, many Hutus left their properties and, in 1994 Hutus revolutions provoked a new wave of displacement, hence with the end of civil war Rwanda had two homeless groups. This situation created tensions, so, in 1997 the government, concerned with a possible second ethnic war, implemented a great land redistribution and housing relocation program.

This program called the "*villagization* policy" or "*imidugudu* policy", depending on ethnicity, contributed to the re-settlement of refugee and reduced the land related tensions among two ethnicities; moreover, through the public services, it helped households to create clusters that could enhance agricultural productivity.

After eight years, the tensions between Hutus and Tutsis decreased and is was possible to see many positive signs coming to rural areas; the arable land grew from 869 thousand hectares in 1994, to 1.714 thousand hectares in 2005, on the other hand the average size of farms decreased from one hectare in 1994 to 0.8 hectare. In 2005, 43 percent of farms had 0.5 or less hectare.

Rwanda's government fought the micro's farms phenomenon, in 2000 it did another land reform, that increased arable land indeed in Rwanda, and finally in 2004 it adopted one of the most modern land policies in SSA, that banned the prerogative of men land ownership according to which the land rights were inherited from father to son excluding the female heirs, thus Rwanda government "*ensure that equal rights and security of tenure are guaranteed for all land users without discrimination whatsoever*" (Uwayezu and Mugiraneza 2011).

Despite the rural population density, that is main causer of micro's farm phenomenon in Rwanda, the density persisted and was very high – 645.05 people per one square kilometer of arable land – in 2005. The principal problem of this is that, even though the land tenure policy in Rwanda is very simple and avant-garde for the SSA parameters, it has a technical problem.

The guidelines of land reform in Rwanda guaranteed certificate of ownership for all Rwandese the so called "security of tenure", but put limits of size for farm and residential plots in rural areas. "*The minimum limit of land tenure will be 1 ha when the maximum limit will be 50 ha in rural area for agricultural production. Residential plots should no exceed 6 ares.*"

Thereby, with this setup, around 60 percent of rural properties were in a kind of limbo and could not get the title of farms, because they were smaller than 1 hectare and could not be residential because are bigger than 0,06 hectare. Consequently, these farmers had the same problem which almost all SSA farmers, they cannot access credit market.

Even though the macroeconomics environment in Rwanda was not the most friendly between 1990 – 2005 the government expenditures averaged 2 percent over than revenues and current account deficit was averagely 6 percent of the GDP. After 1994 Rwanda was being maintained by a large inflow of international finance aid, around 9 percent of GDP (World Bank data).

Naturally this scenario affected all domestic credit market, that improved in those sixteen years, the domestic credit to private sector in percentile of GDP was, in 1990, 6,92 percent and rose to 11,20 in 2005 (World Bank data). Although the agricultural credit market practically did not exist in Rwanda, farmers there were helped by international aid, IFAD estimated that, in 2005 USD 180 million were invested on agricultural projects or around 7 percent of the GDP.

Assessing the efficacy of international aid is always very difficult, in general African countries create the needs for aid, that does not mean that the African people do not need help, but most of African governments should be more transparent (Ndulu 2008). Hence we assumed that the best way to develop agricultural sector was creating tools to access a credit market.

While the agricultural credit market is not going well, the education system shows a good performance, of course the civil war time produced a lack of information, but considering the data that we have, the figures are good; in Rwanda the gross enrolment ration of primary schooling rose from 75,62 percent in 1990 to 133,81 percent in 2005.

Indicators of the health system are very complicated to account for; only one example demonstrates all horror that happened in this country: between 1990 and 1994 despite a very high fertility rate, an average of 6 births per woman, the Rwanda population shrunk more than 7 percent. Nobody can assess or blame the health system for this picture.

Anyway, the mortality rate of infants per thousand live births improved from 102,9 children in 1990 to 85,4 in 2005. At the same time life expectancy at birth had a terrible level of 32,68 years in 1990 and improved to 48,32 in 2005 (World Bank data). The only data didn’t progress was HIV/AIDS, around 3 percent of adult population was infected in 2005 and in 1990 the same percentile of population had been infected (UN data).

A peculiarity is that the rural areas and the urban areas had the same level of HIV/AIDS in 1990, but in 2005 the adults infected in rural areas were 2,2 percent of adult population, on the other hand 7,6% of adult urban population was infected (UNAIDS data). However this data has no information about social mobility, thus it is impossible to know whether the rural population has had different behaviors from urban population or rural population migrated looking for better health infrastructures in the cities.

Rwanda, as almost all countries in SSA, has a great gap between urban and rural infrastructure, the level of water and energy supplies are very different. The national level for water supply in 1990 was 69 percent of residences and fell to 65 percent in 2005, the rural areas maintained the same level (62 percent) and urban areas worsened the numbers from 93 percent in 1990 to 76 percent in 2005 (IMIS).

On the other hand energy supply has a very different trend: 80 percent of residences have energy supply in urban areas e only 5 percent of rural residences have energy supply in 2005. (IMIS). What we know is that the most important tool for farmers to overtake the poverty line is the road and in Rwanda there was a slight improvement from 49,84 kilometers of road per 100 square kilometers of land area in 1990 to 53,00 kilometers in 2005 (World Bank).

Nowadays Rwanda's major trading partners for its goods are: Kenya (30,1%), China (13,5%) the Democratic Republic of Congo (12%) and Malaysia (8,8%), among the goods exported coffee represented 56 percent of revenues, tea 27 percent and ores like gold, tin and wolframite together represented 17 percent (CIA data).

On the other hand Rwanda imported mainly petroleum (11%), machinery and equipment (10,3%) and foodstuffs (8,3); the goods came from Kenya (18,1%), Uganda (16,4%), UAE (8,8%) and the United Republic of Tanzania (5,8%). The EU 27 represented 16,8 percent of Rwandan trades and was the second major partner (Euro stat).

Rwanda trade balance had a historical deficit, only in 2005 it was USD 177 million, added to the Government fiscal balance that was 5,6 percent of GDP it created a current account balance of -18,1 percent with respect to GDP. It was helped with FDI and international financial aid.

The FDI and international financial aid probably will remain and increase just because the Rwanda government has worked very hard to transform the country and turn over the page – recent history – and has apparently been successful.

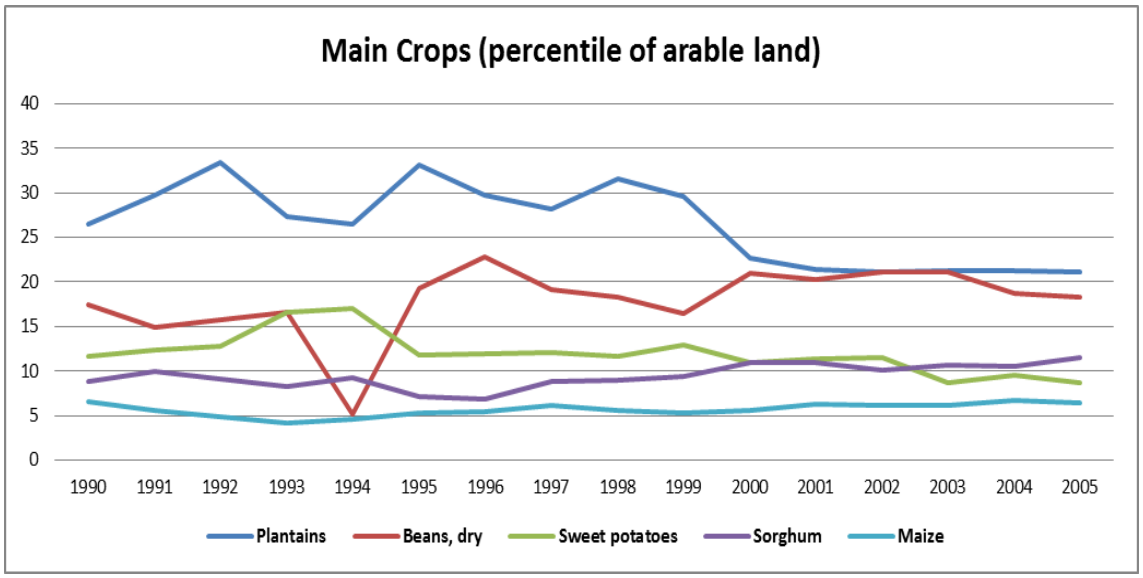
Doing Business ranked Rwanda's 2008/09 reforms in the first place of the top 10 reformers in 2008/09. "*For the first time since Doing Business started tracking reforms, a Sub-Saharan African economy, Rwanda, led the world in reforms. Rwanda has steadily reformed its commercial laws and institutions since 2001. In the past year it introduced a new company law that simplified business start-up and strengthened minority shareholder protections. Entrepreneurs can now start a business in two procedures and three days. Rwanda has also enacted new laws in order to improve regulations to ease access to credit*"

Regardless of all reforms, the agricultural environment has not responded yet, the majority of farmers have produced for subsistence only and failed to overtake the poverty line, perhaps the bad infrastructures, ethnic division and geographic position are the reasons that have forbidden the development, seeing that many other indexes are positive, like education level and environmental business.

The main crops in Rwanda are plantains, beans and sorghum (chart 4.15).

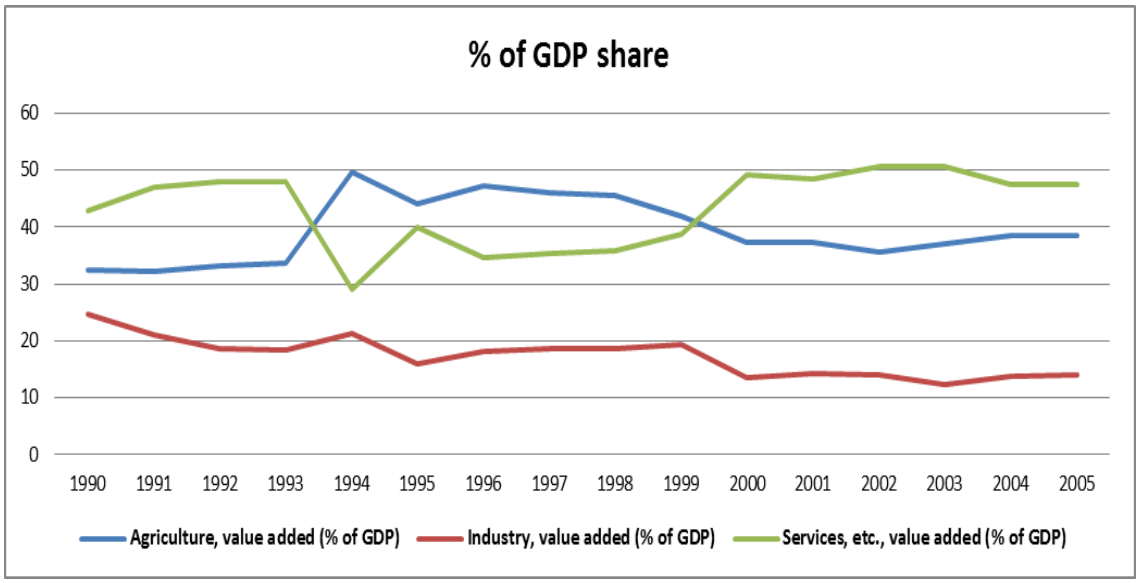
The mobility of GDP share suffered two disruptions between 1993/1994 and after the reforms in 1998. Although all the "Western Institutions" say that Rwanda's reforms are positive, industry is decreasing, the agricultural sector has remained stable and run toward a dangerous path, with micro-farms and low productivity; finally, the services sector growth happened by importation and the financial sector has been driven by government deficit (chart 4.16).

Chart 4.15: Rwanda main crops



Source: FAOstat

Chart 4.16: Rwanda percentile of GDP share



Source; The World Bank data

4.6 Uganda

Uganda's independence happened in 1962, the ex-British colony became independent led by Milton Obote, the first prime minister, and the so called “Uganda’s tribal kingdoms”. After five years Obote changed the constitution and abolished all traditional kingdoms and made himself president with great powers; as a consequence another state coup occurred in 1971.

The new dictator, Idi Amin, remained for nine years and this time was marked by economic decline, for three main reasons: Amin's ordered all Asians people who were not Ugandan citizens must to leave the country – around 60 thousand people –. There were many human rights violations, the UN estimated that 100 thousand Ugandans had been murdered. Currently Uganda's government says that 300 thousand people were killed. Finally, in 1978, Ugandan Army invaded the U. R. of Tanzania's territory looking for exile.

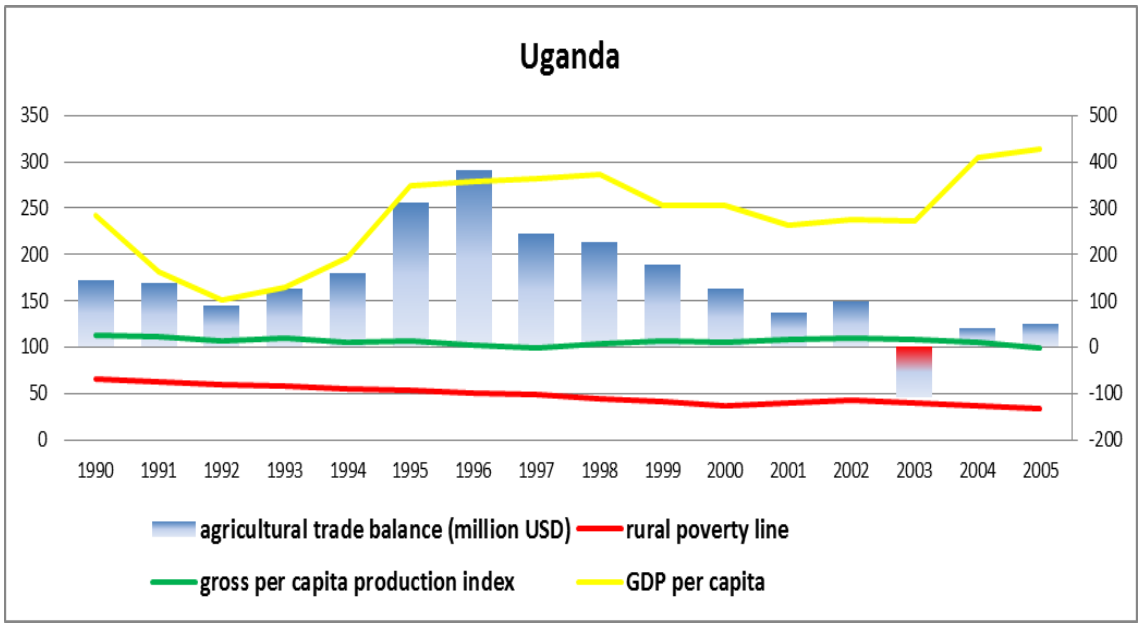
As a response, the U. R. of Tanzania invaded Uganda in 1979, the army was helped by anti-Amin forces within Uganda, but after Amin fell between 1980 and 1986, Uganda had five presidents and a very hostile civil environment. However, the last president Yoweri Museveni brought stability and improved human rights protection, in 1993 civil war was over and the country made the new constitution which restored the traditional kings

Now Uganda's territory has 236,04 thousand square kilometers with a complicated political map, the country is divided in four regions; Central – capital –, Eastern, Western and Northern. But there are more than one hundred autonomous districts, and, besides, Uganda has six traditional kingdoms that enjoy degrees of cultural autonomy.

It happened because in 1995 the constitution reestablished autonomy for each traditional ethnic group. Even though apparently there was political confusion, Uganda’s fight against extreme poverty worked well, the rural poverty decreased from 65 percent in 1990 to 34,2 percent in 2005. And the income GDP per capita rose from USD 242,76 in 1990 to USD 313,59 in 2005, of course we cannot forget that the civil war provoked the fall of GDP per capita among 1991 and 1994.

At the same time the agricultural gross per capita production index (API) had an inverse trend with respect to income per capita, it decreased from 112,28 points in 1990 to 99,89 points in 2005. It is important to explain the low performance of the agricultural trade balance (chart 4.17).

Chart 4.17: Uganda macroeconomic environment



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

Despite API's low performances, the rural environment in Uganda has positives features; first of all Uganda had good land and water resources, secondly the farmers use good agricultural methods to enhance the productivity like "coffee-banana techniques", and the Ugandan land tenure system has practically been resolved since 1995 and there has not been the title land problem.

The 1995 Constitution recognized the four tenure systems existing before, hence in accordance with local governance, the Ugandan government wrote:

• *All Ugandan citizens owning land under customary tenure may acquire certificates of ownership in a manner prescribed by Government;*

• *Land under customary tenure may be converted into freehold ownership by registration;*

• *any lease which was granted to a Ugandan citizen out of public land may be converted into freehold in accordance with law made by Parliament; and,*

• *Lawful or bona fide occupants of Mailo land, freehold or leasehold land shall enjoy security of occupancy of the land.*

After it, one part of agriculture was modernized and some agricultural commodities as coffee, tea, tobacco and cotton gained importance. Even though the rural population density rose from 315,25 people per one square kilometer of arable land in 1990 to 465,03 people in 2005 (World Bank data), the national average of farm size remained 2,2 hectares (FAO data); the non-agricultural sector also improved and jobs and welfare were created.

This improvement was not only in the agricultural sector, Uganda's new path meant progress for all the macroeconomic system. In 1990 the domestic credit to the private sector did not exist, the FDI had negative inflows, the domestic market was very close and the merchandise trade represented only 10 percent of GDP; the Government budget account was surreal.

With very hard work, Uganda "made a miracle", since in 2005 the domestic credit to the private sector was 8,63 percent of GDP, while the FDI represented 4,11 percent of GDP, Uganda's economic modernizing and merchandise trades accounted for more than 31 percent of the GDP and the Government account was negative 1 percent compared to the GDP.

This "miracle" was possible with the convergence of two factors, first the political desire to change the social-economic environment, second because Uganda had most of the population in rural areas (89%) and with clear and fair rules and good natural resources as land and water the agricultural sector spread the welfare.

It affected the education index: the gross school enrollment ratio at the primary level leapt from 69,51 percent in 1990 to 123,22 percent in 2005. Also the situation of the health system improved, and two important indexes, life expectancy and mortality rate, also regained. Life expectancy at birth improved from 47,35 years in 1990 to 50,12 in 2005 and the mortality rate per one thousand live births fell from 105,8 to 74,7 in the same period (World Bank).

Also for HIV/AIDS, that is an endemic SSA problem, Uganda had good numbers: the adults infected represented 10,2 percent of the population in 1990 and declined to 6,4 percent of the adult population in 2005 (UN).

Almost all the infrastructure system improved its numbers, the national level of water supply rose from 43 percent of household in 1990 to 64,5 percent in 2005.

There naturally exists a gap between rural and urban areas, in 1990 it was 50 percent, in other words for each house with water access in rural areas Uganda had 2 in urban areas. However in 2005 this gap was reduced to 30 percent (AMCOW 2010).

The roads density per one hundred square kilometers of land area had grown from 7,77 kilometers in 1990 to 29,35 kilometers in 2005. On the other hand, the rail lines density decreased from 0,51 kilometers per one hundred square kilometers of land area to 0,10 kilometers in 2005, therefore it influenced the government decision to intensify the road transportation and give up the rail lines "of colonial model".

However Uganda has a bigger problem, the electricity supply: even though it rose by 350 percent between 1990 – 2005, it covered only 9 percent of Ugandan households in 2005, furthermore its supply was concentrated in the central area – the capital – cities in the others regions depended on generators and rural areas simply did not have electricity because 90 percent of the country's population was not connected to the national network.

Fortunately, as we know, the electricity supply did not influence the start-up and the development of the basic agriculture as the road's influence. Electricity supply will be important if Ugandan farmers become exporters of fresh fruits and vegetables, but if they wish this to come true they should overtake food safety barriers first.

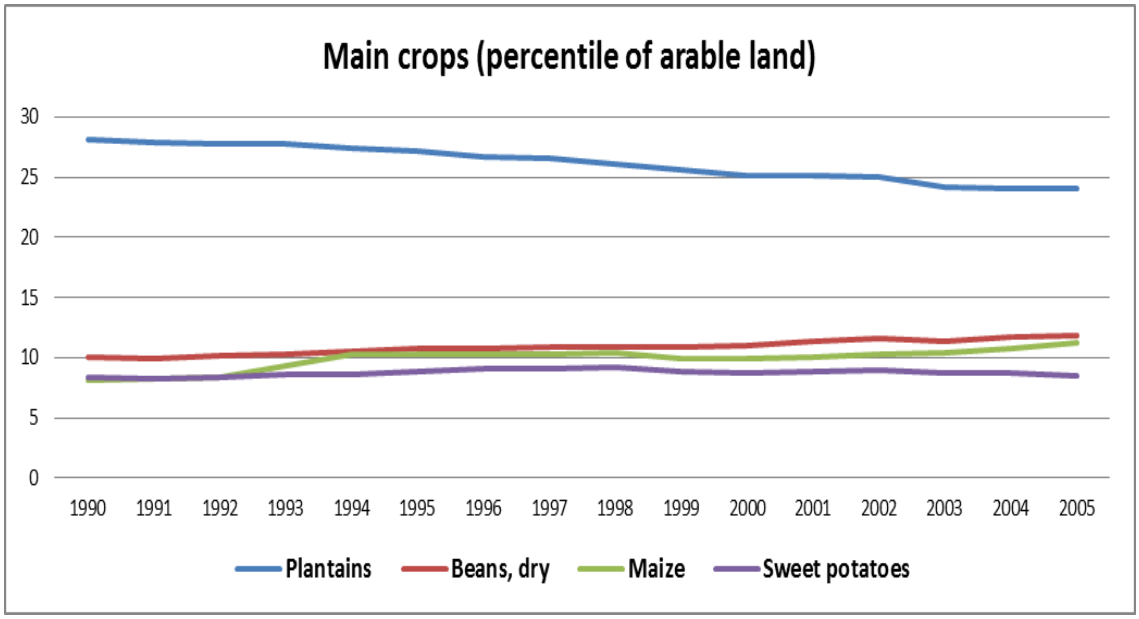
Nowadays the main goods exported by Uganda are; coffee, tea, fish and fish products and cotton These goods go to Sudan (14,3%), Kenya (9,5%), Switzerland (9%) and Rwanda (7,9%). Uganda's imports are petroleum, capital equipment, vehicles and medicines. The goods come mainly from UAE (11,4%), Kenya (11,3%), India (10,4%) and China (8,1%) (CIA data).

With a trade balance deficit of USD 1.178 million in 2005, Uganda has with his major trade partners, the EU 27, the biggest gap between export and import. It represented 21,3 percent of the whole Ugandan trade and this trade contributed for 40 percent of the deficit. They have basically imported food and fish (78,3%) and have exported mineral fuels (28,8%) and machinery (26%) (Euro stat).

Environmental business in Uganda is very a friendly, the rules are simple, the labour market is dynamic and public offices have one of the highest corruption levels in SSA (Doing Business data), but the energy supply problem practically prevented industrial development. Meanwhile, the agricultural sector made a sprint after 1995 but couldn't continue to run at the same speed to transform into an advanced agriculture, because the flow of urbanization couldn't happen in a country where the cities do not have electricity supply.

Ugandan agriculture is being modernized by the private sector, which means that marginal areas are not used with the same goals. Agricultural commodities need the good corridors to access the global market, thus in remotes areas there were no investments, and there the farmers continued to live on subsistence agriculture, and the majority of arable land was used for plantains (FAO data) (chart 4.18)

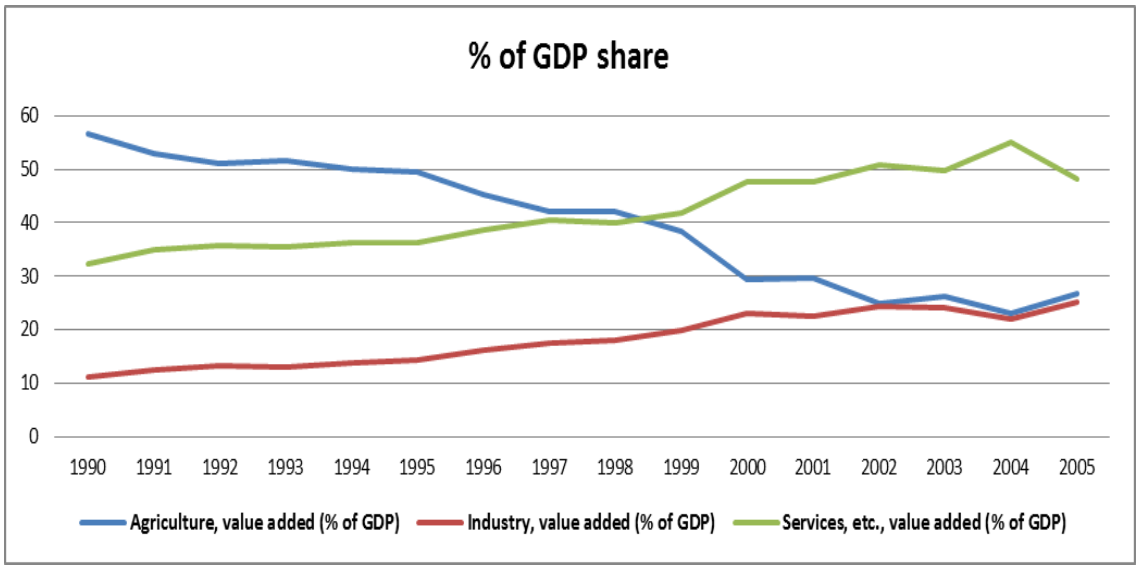
Chart 4.18: Uganda main crops



Source: FAOstat

Despite the modern profile since 1995, the Ugandan government had new challenges: the GDP share trend altered, it flexed to stabilization, thus this landlocked country should do the next step to continue fighting against poverty. Either spreading welfare with subsidies programs, or make investments that help the industrial sector development (chart 4.19).

Chart 4.19: Uganda percentile of GDP share



Source; The World Bank data

4.7 The United Republic of Tanzania

The U. R. of Tanzania was born in 1964 with the fusion of two ex-British colonies. Tanganyika that had becomes independent in 1961 with Julius Nyerere as prime minister, and Zanzibar, which had become independent in 1963 with the Sultan Abdullah Bin Khalifah. After one year the Zanzibar sovereign suffered a coup, the so called "Zanzibar revolution", it overthrew the Abdullah dynasty and the new leader, Abeid Karume, in a couple of days, murdered 5 thousands Arab people and 15 thousands Asian people.

In April 1964 Tanganyika joined Zanzibar to form the United Republic of Tanzania, the name Tanzania is a portmanteau of Tanganyika and Zanzibar. Nyerere, the main leader after unity, also called "baba wa taifa" – father of the nation – stopped the slayings; he remained on power until 1985 when he retired.

Nyerere introduced the socialist state in 1967 with Arusha Declaration, but he respected the regional differences, thus the country had "only one political ideal but had two parties" the TANU in Tanganyika region and the ASP in Zanzibar region. They merged in 1977 as CCM, the so called Revolutionary Party.

The U. R. of Tanzania achieved good results in education and social-stability between 1967 – 1985, practically all the children were at school and there were civil conflicts like in most SSA countries, but the economic policies failed, probably because "the non-alignment countries" as China and USSR had stopped to send financial aid.

Nyerere left voluntarily the power, but remained in the party, and possibly helped the changes there. The new president, Ali Hassan Mwinyi, made a new democratic constitution in 1992 with a multiparty, but it had one condition: the party would only be registered if they were active in both regions – Tanganyika and Zanzibar – and if they were not identified with religious, regional, tribal or racial groups.

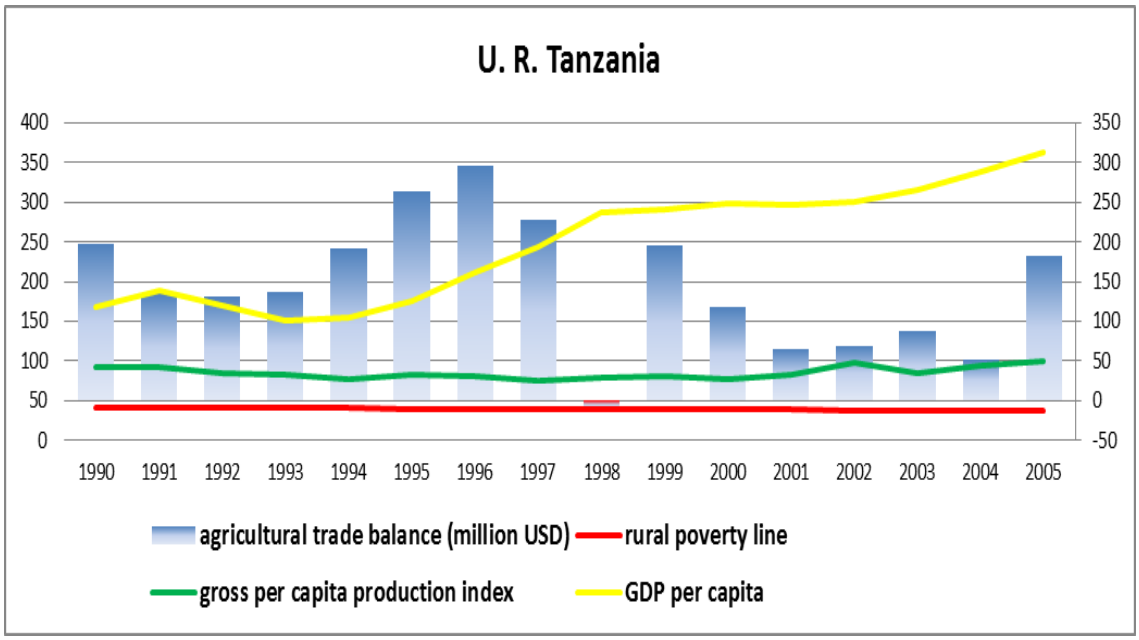
All rational concerns to prevent civil conflicts didn't save the U. R. of Tanzania. During the 1990s the ethnic conflicts outside Tanzanian frontiers – Rwanda and Burundi – created a very great strain. In 1994, during only 24 hours, 250 thousand Rwandan refugees arrived in Tanzania; furthermore in the course of 1990s a heavy burden was placed on an already impoverished U. R. of Tanzania: 650 thousand refugees arrived there, 550 thousand from Rwanda and 100 thousand from Burundi (UN data).

Nowadays, the U. R. of Tanzania has 945,1 thousand square kilometers and 26 provinces and a very low performance against extreme poverty. The extreme poverty in rural areas decreased from 41,35 percent in 1990 to 37,74 percent in 2005. Of course the "refugees period" hindered Tanzanian development, but the income GDP per capita did not suffer the same fate: it was USD 167,30 in 1990, it started to rose considerably after 1994 and rocketed to USD 362,54 in 2005.

The agricultural gross per capita production index (API), instead, followed the poverty line lead, and had a low performance improving from 92,22 points in 1990 to 100,34 point in 2005. The disparity between API and income GDP per capita probably contributed to shrink the agricultural trade balance in Tanzania (chart 4.20)

Unlike Uganda, where the new constitution (1995) changed the entire rural environment, cutting the entire bureaucratic barrier to get a land title very easily. The U. R. of Tanzania's new constitution (1992), did affect many changes.

Chart 4.20: The United Republic of Tanzania macroeconomic environment.



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

The national land policy was enacted in 1995; amended in 1997, the law became operational in 2001, but three main laws were enacted only in 2007 – the land use plan, the town and country planning and the registration board act –. In 2008 one more followed, the unit titles law and finally in 2009 the mortgage financing act law. Thereby, after 17 years, Tanzania had a land tenure system much closer than in western countries. However the agricultural sector changed at the same speed of the laws.

That does not mean a bad performance, just a performance below the real potential. Macroeconomic numbers changed greatly after 1992, the government of Tanzania started the programs of privatization and fiscal consolidation. It reduced the supply of credit to the public sector and the percentile of domestic credit to the private sector decreased from 13,90 percent of GDP in 1990 to 10,18 percent in 2005.

Whether macro economy should first stabilize and after grow, the gross school enrollment ratio at the primary level (PRI) should be like in the past. PRI that was on average, in 1980s, higher than 90 percent, reached 69,40 percent in 1990 and continued stable until 2000 with 68,25 percent; after 2000 they started to improve and stood at 105,35 percent in 2005 (World Bank data).

On the other hand almost all the health system numbers were positive: life expectancy at birth increased from 50,39 years 1990 to 53,34 years in 2005. The mortality rate per one thousand live births had a very good performance, improving from 95,2 children in 1990 to 65 children in 2005 (World Bank data). Only HIV/AIDS number's worsened and won the status of pandemic: in 1990 around 4,8 percent of adult population was infected and in 2005 around 6,2 percent had the disease (UN data).

Infrastructure data showed a dichotomy between, the modern Tanzania's path, and the country's logistics, that followed the deterioration route. If Tanzania had relatively good numbers in infrastructure in the 1980s, after the privatization program the access to water and electricity power decreased and the mesh logistics – roads and rail lines – had no new investments to build new projects or maintenance of existing roads and rail lines.

As a consequence all the numbers fell: 55 percent of households had water supply in 1990 (46% in rural areas and 94% in urban areas), while 54 percent had it in 2005 (45% rural areas, 83% in urban areas). The electric power supply decreased from 15 percent in 1990 (rural areas 4,3%, urban areas 29%) to 13,9 percent of household in 2005 (2% urban areas, 19% urban areas).

The mesh logistics that is the most important tool to integrate a country and reduce the poverty also performed badly. The road density shrunk from 9,32 kilometers of road per one hundred square kilometers of land area in 1990 to 3,34 kilometers in 2005. The rail lines density had the same trend, declining from 0,47 kilometers in 1990 to 0,27 kilometers of line per one hundred square kilometers of land area.

Currently the main international trade partners for Tanzania’s export goods are: India (8,1%), Japan (6,5%), China (6,3%) and UAE (4,9%). Tanzania export share is composted basically of Fish and fish products (10,2), tobacco and tobacco products (8,1%), gold (8%) and coffee (7,3%). At the same time Tanzania imports mainly machinery (12,6%), Mineral fuels (12%), electrical and electronic equipment (10%) and vehicles (9,4%); theses goods come from China (14,4%), India (9%), South Africa (7,7%) and Kenya (6,9%).

EU 27 have had a modest participation in Tanzanian trades, ranking third, while all trades goods contributed 13,2 percent and had a surplus of USD 403 million in 2005. At the same time the Tanzania international trades historically had a negative result: in 2005 it was USD 1.6 billion, but with "friendly environment business" the FDI had sustained trade deficits and the government current accounts, that in 2005 was negative, was 3,8 percent of the GDP (World Bank data).

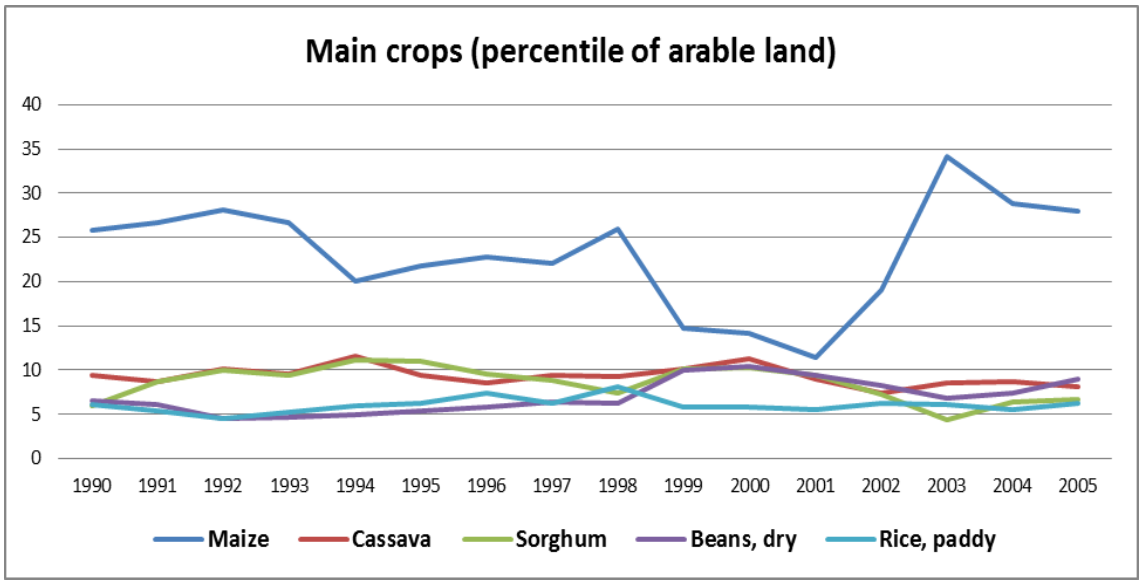
The "friendly environment business" means good laws that protect investment and enforce contracts existing in Tanzania, but the U. R of Tanzania had a very difficult labour market (Doing Business data). Maybe Tanzania was not ready yet to do business with intensive labour-force. To start up, an Agro business in non-developed countries usually needs cheap and intensive labour force to develop well. On the other hand the mining business only needs to protect the investment.

Among the main crops maize is the best representative of the Tanzanian agricultural modernization process. In 1990 Tanzania kept the maize market close and was utilizing 25,8 percent of arable land and was exporting 57 thousand tones; when the market opened in 1998, this area started to decrease very fast until 2001, then it began to grow and in 2005 27,91 percent of arable land was used and 98,9 tonnes were exported, and in the same year Tanzania imported 44,5 tonnes of maize (FAOstat).

In other words, the market became more flexible and dynamic, this transformation didn't happen only in the maize market, but also in the tobacco market, where exportations in tonnes rose more than 500 percent from 7,06 thousand tonnes in 1990 to 42,3 thousand tonnes in 2005, just to give an example (FAOstat) (chart 4.21)

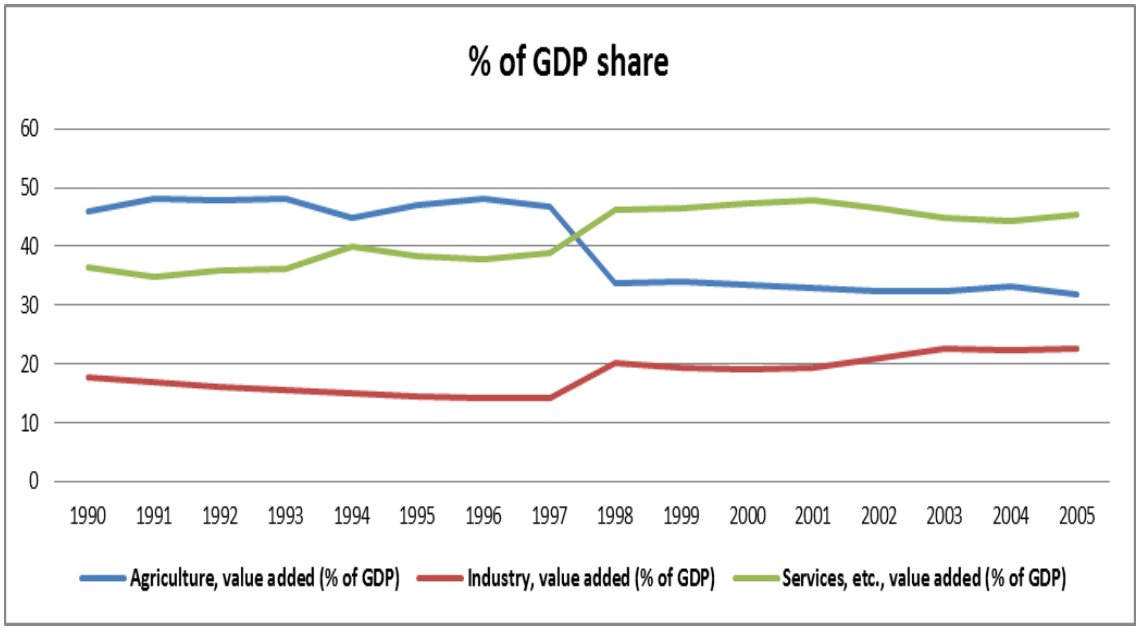
The politicians of the United Republic of Tanzania have made slow changes, but a constant changing of the rules reflected on percentile of GDP share too. Between 1990 and 2005 we can see that, at the beginning of the 1990s, the opening of the goods market provoked a kind of deindustrialization; in 1998 the agricultural market was opened, and then the services and industry sectors became stronger (chart 4.22).

Chart 4.21: The United Republic of Tanzania main crops



Source: FAOstat

Chart 4.22: The United Republic of Tanzania percentile of GDP share



Source; The World Bank data

4.8 Zambia

In 1961 Northern Rhodesia integrated a federation, the Commonwealth of Nations with Southern Rhodesia (Zimbabwe) and Nyasaland (Malawi), the federation was dissolved in 1963, thus the independence process of the ex-British colony was concluded and in 1964 the country changed its name to Zambia.

The first Prime Minister Kenneth Kaunda changed Zambia's economic policy, nationalized great mineral companies, started a plan to be self-sufficient through the import of substitute goods, and also changed civil rights, he abolished racist laws for black or white people. The economic shift displeased the western countries, mainly the U.K. government and the last change, the abolition of racist laws, irritated indeed Southern Rhodesia, after 1967 so called Rhodesia (Zimbabwe), and South-West Africa (Namibia), both neighboring racist governments supported by South Africa.

Zambia is a landlocked country, without oil and the economy was heavily dependent on the copper industry. In 1965 Zambia stopped importing goods from Zimbabwe while Zimbabwe retaliated by stopping the supplies of petroleum that was transported through its territory. Isolated Zambia was using guerrillas fought in Zimbabwe to receive petrol. Finally it received the Chinese loan and in 1968 an oil pipeline was built in Tanzania – Zambia, while a railway was built in 1974.

Kaunda declared another new constitution in 1973, it had socialist ideals and imposed a one-party state. Kaunda's authoritarian rules suffered a strong blow in 1975, the price of copper plummeted and the oil price soared, thus between 1975 and 1990 Zambia's economy dropped by around 30 percent.

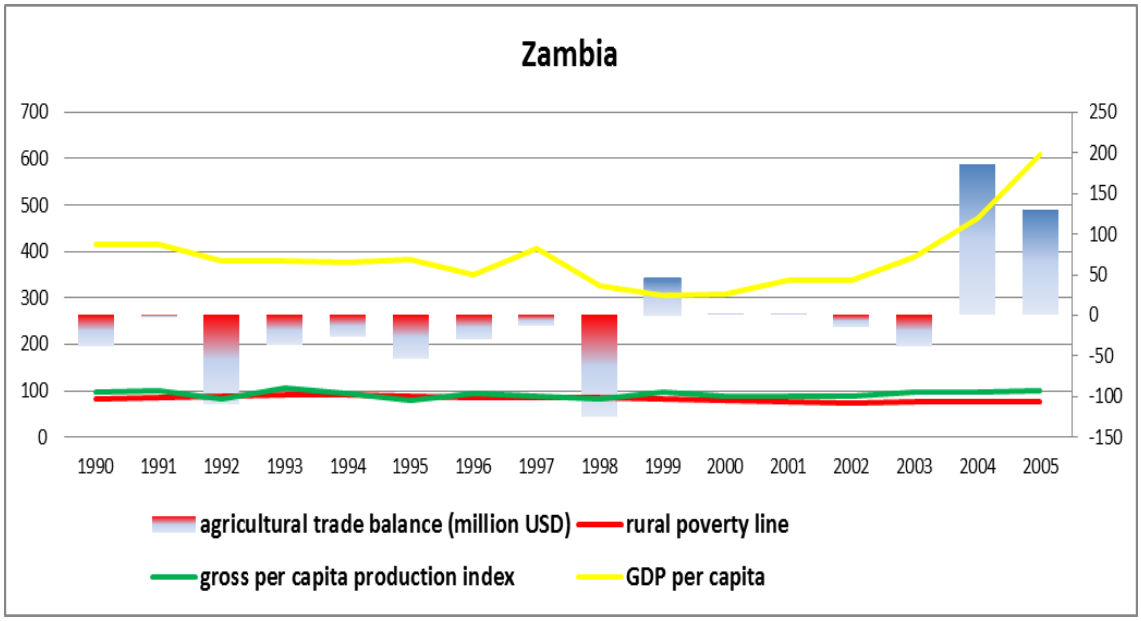
To complicate the situation more, in the late 1970s Mozambique and Angola had attained independence from Portugal with a terrible civil war and Zimbabwe began the fight in 1979. As a consequence, the main port used by Zambia was not working anymore – Beira in Mozambique – and the Benguela rail line which extended for western – Angola – was closed, damaging Zambia's international trade. Furthermore Zambia supported the Zimbabwe guerrillas, that had an external headquarters in Lusaka – Zambia capital –, with food and weapons and this increased the financial deficit of Zambia even more.

In 1991 Kaunda's government ended, luckily it finished with multiparty elections and a new democratic constitution. Zambia lived a rare situation in African countries, a pacific transition from autocratic government to democratic government.

Presently Zambia has 752.614 square kilometers and nine provinces. Extreme poverty in rural areas between 1990 and 2005 was high, endemic and constant. In 1990 poverty represented 83 percent of all rural population, with the end of the communist government it reached 92,2 percent of the population and in 2005 it represented 76,8 percent of the rural population.

The income GDP per capita followed the poverty index, which fell between 1990 and 1999 from USD 415,70 to USD 306,98 per capita; in 2000 it started to rise and in 2005 it was USD 609,69 per capita (World Bank data). The agricultural gross per capita production index (API) grew merely 1.26 points in sixteen years, from 98,88 points in 1990 to 100,14 points in 2005.In the same period the agricultural trade balance showed a dependence on the outside, the balance was positive on three occasions only (FAO stat) (chart 4.23).

Chart 4.23: Zambia macroeconomic environment



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

Even though Zambia is an agricultural country with more than 65 percent of the popupation living in rural areas in 2005 (FAO stat), the situation in the countryside was worsening for two important issues after 1990.

Firstly, the hipper-inflation in the last years of Kaunda's government and after it, the inflation affected mainly the people that did not have access to the bank system; the number of Zambia's account in 2005 represented only 3,8 percent of the population but this data included accounts of firms and some people were allowed to have more than one account. Furthermore, only 0,02 percent of rural population had a Bank account (Martinez 2006).

Secondly, Zambia's macroeconomic policies focused on copper mining in the colony era, after indepedence on "white elites" and nowadays history is repeatng itself again with the "black elites". The privatization of the rail line program is an example: the rail line company stopped with agricultural subsidies of transport and the main goal of the new company was to improve the efficiencies for the mining companies, but 60% of the population that was concentrated along the rail was without services. As a result many rural areas were isolated and the agricultural goods production declined.

While Zambia's privatization program intensified poverty in some areas, this helped the macroeconomics numbers. Zambia GDP averagely rose by 0.16 percent between 1990 and 1998 and after 7 years of privatization program GDP started to rise with good numbers, about 4,26 percent between 1999 and 2005. The inflation in 2004 was below 20 percent per year, for the first time since 1984 (World Bank data).

Anyway, this improvement of macroeconomic data did not follow the whole private sector, the domestic credit to private sector fell from 8,87 percent of GDP in 1990 to 7,22 percent in 2005 (World Bank).

The communist government left a bad heritage as hyperinflation, but alos positive elements, like the education system. In 1990 Zambia had 96,59 percent of the gross school enrollment ratio at primary level (PRI), which was one of the best performances among SSA countries; this level fell continuously until 2001, when it represented 83,78 percent, then it began to rise and in 2005 it reached 118,73 percent PRI.

The health system in Zambia had a contrast: it had a relatively good infrastructure, a good interconnection for medicinal supplies, a good training system to staff,. On the other hand, the budget per capita had been shrinking. Consequently, the life expectancy at birth fell from 47,48 years in 1990 to 44,38 years in 2005. However, the mortality rate per one thousand live births improved from 109,20 babies in 1990 to 83,5 children in 2005 (UN).

Two factors had a close relationship with life expectancy: between 1992 and 2002 the government did not have the money to buy basic medicines and in this period the supply depended on international aid; secondly the HIV/AIDS diseases had always had high infection levels. 12,7 percent of the adult population was infected in 1990 and this number rose to 14 percent in 2005 (UN).

If the health system in 1990 was well, the infrastructure was not bad too. Even though the electricity grid supply had been built to support cooper mining, around 19 percent of population had access to the electricity supply in 1990, the water access had the same level, 20 percent of the population had it. Unfortunately this level remained the same in 2005.

Another datum that persisted was the rail line density: in 1990 Zambia had 0,16 kilometers of rail line per one hundred square kilometers of land area and in 2005 the same numbers. On the other hand, road density improved sharply and rose from 4,69 kilometers of road per one hundred square kilometers of land area in 1990 to 8,87 in 2005 (World Bank).

The aim of Zambia's government was Zambia's integration and trades along the roads. Currently, Zambia's major partners to goods exporting are; Switzerland (51,7%), China (20,3%), South Africa (9,2%) and the Democratic Republic of Congo (4,6%). Zambia exports mainly: copper/cobalt (64%), electricity (8,9%),tobacco (7,6%) and cotton(4,3%) (CIA data).

On the other hand Zambia imports principally: Machinery(26,3%), Petroleum(16,1%), chemical products(8,4%) and Fertilizer(3,9%) from South Africa (35%), Democratic Republic of the Congo (23,5%), Kuwait (8,9%) and China (5,6%) (CIA data).

Thanks to copper, Zambia historically had a surplus in international trade, but not with EU 27; in 2005 Zambia had a deficit of USD 143.3 million. The main Zambian exports were copper (50%) and tobacco and cotton (24,2%) and the country imported basically machinery (54%) and chemical products (18%). The EU 27 represented 6,3 percent of Zambia's trade and occupied the 5 position in importance (Eurostat).

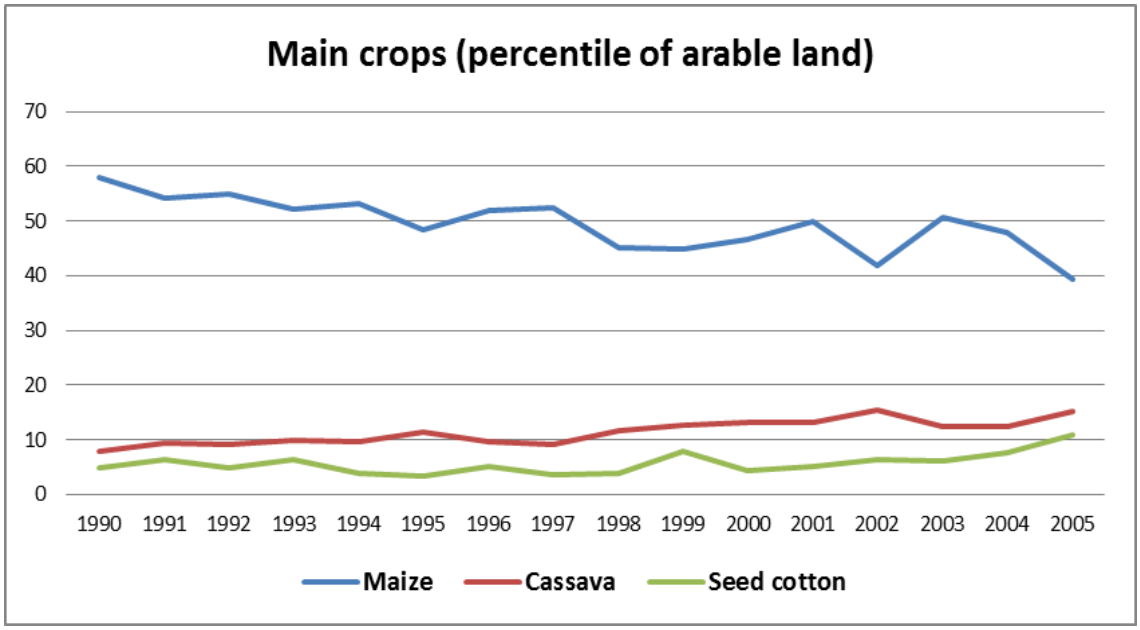
The Zambia environment business is built around around copper mining or agricultural business. Despite respectable rules and a pacific social environment, Zambia should affront a paradigm. The land reform started in 1991 and implemented in 1995 is simple and modern, and it allows title of land for all Zambians, including women, but this title could be withdrawn in the interest of the country.

In other words, if this this place has mineral resources. Thus farmers feel safer to invest when they are away from mining activities, but as they are more distant from the mines, farmers are more distant from the domestic consumer market and the good infrastructures. The more fragile the infrastructure the more difficult the access to the international market.

The main crops in percentile of arable land are maize, cassava and cotton seeds. However, between 1990 and 2005. the profile of crops has changed, maize crops shrunk 32 percent in the use of arable land but at the same time the yield increased by 25 percent. The improvement of productivity happened also in other cash-crops as sugarcane (21%), cotton seeds(59%) and tobacco (80%) (FAOstat)(chart 4.24)

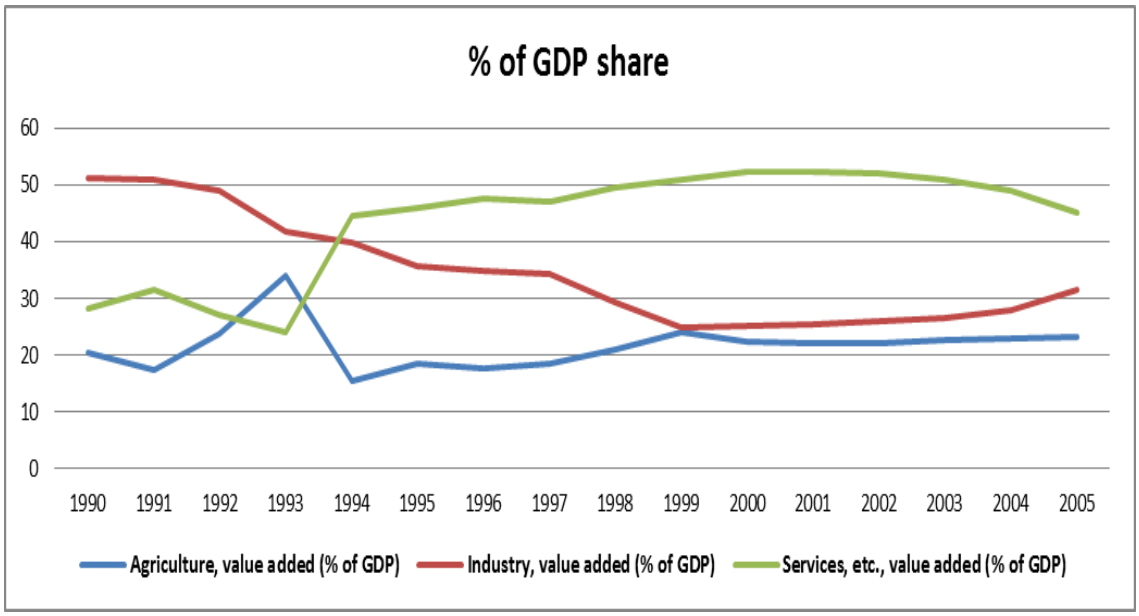
With the end of communism in Zambia, the services market grew more than the average GDP and won market share. The agricultural sector grew well after land reforms and even though the percentile of market share started to decrease in 1999, it was not a bad news, but a collateral effect of modernizing the sector (chart 4.25)

Chart 4.24: Zambia main crops



Source: FAOstat

Chart 4.25: Zambia percentile of GDP share



Source; The World Bank data

4.9 Zimbabwe

Ex-British colony, the so called Southern Rhodesia followed a different way to independence. With the end of the Federation of Rhodesia and Nyasaland in 1963 that included Northern Rhodesia – Zambia – and Nyasaland – Malawi –, Southern Rhodesia declared independence in 1965 with "the white- minority" very different from most of the former African colonies, that won the independence with fighting with the "black-majority".

Perhaps influenced by South African history, the first Prime Minister Ian Smith started in 1965 a "white government", the United Kingdom declared the independence illegal and banned all trades with Rhodesia. After one year the United Nations imposed sanctions on Rhodesia. In 1969 Smith declared a new racist constitution and on 2 March 1970 created the Republic of Rhodesia.

In 1970s the world was divided between US and USSR blocks or capitalists and communists, the Zimbabwe northern neighboring countries had turned communist – Zambia, Tanzania and Mozambique (1975) – and the southern neighboring countries were capitalist and with a close relationship with the U.K., hence Smith's government was pressed by guerrillas in the north and by armies and a heavy diplomacy in the south.

After ten years, in 1979 the elections took place and were described by the Rhodesian government as non-racial and democratic, but the main parties/guerillas – Zimbabwe African Nation Union (ZANU) and Zimbabwe African People's Union (ZAPU) – did not participate because the new rules were perceived as retaining "strong white minority privilege". However Great Britain recognized the country's independence in 1980 and Rhodesia's name was changed to Zimbabwe.

Robert Mugabe won the elections, and rose to power, he was associated with ZANU's party and merged ZANU with ZAPU party in 1987; finally in 1988 he created a one-party-state. In this period Mugabe started the systemic attacks against everyone that had a different point of view, thus in 1988 Zimbabwe's commenced a dictatorship. And again, Zimbabwe was contra-flowed; at the close of 1990 almost all of the neighboring countries were looking for political stability and to open their economies.

After 7 years of dictatorship and with strong international pressure, in 1995 the country had new elections and Mugabe won once more. The economy of Zimbabwe collapsed in 1998, and Mugabe's government worsened the economic situation when, in 1999, he engaged in DR. Congo's civil war. To calm down Zimbabwe's population, in 2002 Mugabe ordered all white commercial farmers to leave their land without compensation because that land had been taken under British colonization.

The chaos exploded in rural areas, squatters seized hundreds of white-owned farms in an ongoing and violent campaign to reclaim what they said was stolen by settlers. During 2002 the State of disaster was declared due to the worst food shortage of history; at the same time about 3 thousand farmers left their land. The protests widespread around the country lacked everything. The government responded violently with arrests, beatings and murders.

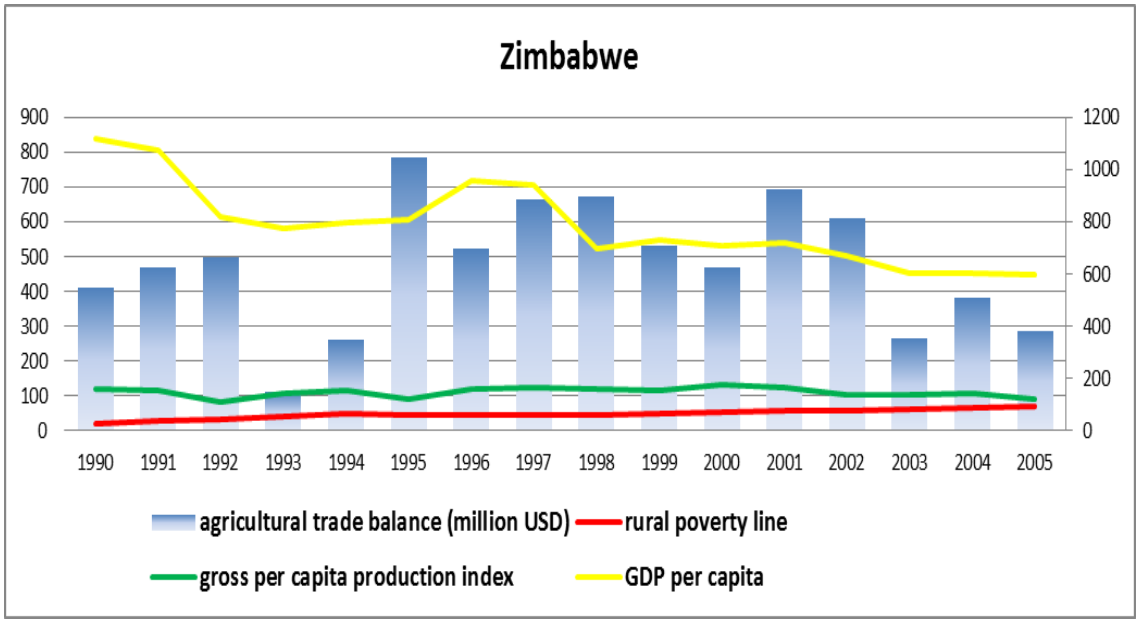
The confiscation policy of "white-farms" was affected by several years of droughts as well as a serious lack in inputs as fertilizer, consequently the economic system fell together with the decline of agricultural exports. As a result a severe hard-currency shortage led the country to hyperinflation and chronic shortages of fuel and basic consumer goods.

In 2005 Zimbabwe government created the "Urban clean-up programme"; this program consisted in wiping out all shanty dwelling in the cities. The UN estimated that around 700 thousand people were missing because of this program.

Zimbabwe has 8 provinces and 390.757 square kilometers, Zimbabweans saw the level of extreme poverty in rural areas soar from the estimated 20 percent in 1990 to 71 percent in 2005, the income GDP per capita slumped dramatically from USD 839,66 in 1990 to USD 447,56 in 2005.

The agricultural gross per capita production index (API) fell too from 120.59 points in 1990, to 93.11 points in 2005. Here we should say that while the growth of population trend in 1980s had been maintained, the API had fallen more. The Zimbabwe population decreased despite rate birth was very high . And the agricultural trade balance made a rally based on the number of consumers and their purchasing power (chart 4.26)

Chart 4.26: Zimbabwe macroeconomic environment



Source: Agricultural trade balance and gross per capita produciton index by FAOstat and rural poverty line and GDP per capita by The World Bank data.

The rural environment was not perfect, before 1990 one-third of Zimbabwe's arable land was owned by 4 thousand farmers, versus a rural population of 7.5 million of people. Although the rural business was running better than the majority of SSA countries, there were formal jobs and the linkages between agricultural business and non-agricultural business in rural areas happened as well.

Zimbabwe had a similar profile as Latin America, a great concentration of income and large land holdings and with good yield. After the reforms the majority of Zimbabweans did not win their land and the largest farms, nationalized, lost the productivity.

The decline of agricultural production affected the macroeconomic numbers in Zimbabwe, because in 1990, among the main revenue of export goods, it had cotton (12%), tobacco (22%) textiles and clothing products (39%). All these sectors had had great losses, mainly textiles and clothing: in 1990 around USD 900 million were exported and less than USD 300 million in 2005.

Textiles sector lost international market for two important factors: first, the lack of raw material to work, second the inflation. Inflation history in Zimbabwe showed bizarre numbers: it rocketed from 17 percent per year in 1990 to 585,84 percent per year in 2005 (World Bank data), of course this work used only this time series – from 1990 to 2005 – but only for curiosity in 2008 Zimbabwe's inflation was estimated by UN in 79.6 billion percent per year or the equivalent of daily inflation rate, 98 percent.

With this scenario the domestic credit to the private sector fell too, from 23,03 percent of GDP in 1990 to 16,27 percent in 2005. Obviously, monetary policies are not a point of strength in Zimbabwe between 1990 – 2005. They had many monetary expansion policies, for example in 2002 the credit to the private sector was 104,46 percent of GDP.

The country had bad performances, but also good numbers: the educational level is one of the gross school enrollment ratios at primary level; historically they had one of the best performances of SSA countries: in 1990 it was 100,59 percent and the last data that exist was 1997, and it represented 103,15 percent of children in aged school enrollment (UN). Even though after 1997 specific numbers in Zimbabwe are lacking, the UN considered that the country had continued with the same trend, and in 2005, according to UNESCO, Zimbabwe had 92 percent of adult literacy.

While the economic crises did not affect the educational system, the health system suffered indeed. The life expectancy at birth dropped from 60,52 years in 1990 to 43,86 years in 2005. At the same time mortality rate rose from 52,1 per one thousand live births to 60,2 babies per one thousand live births (World Bank).

Doubtless HIV/AIDS is the worst health problem in Zimbabwe, the rate of adult infected in 1990 was 10.1 percent, this percentile grew continuously and in 1997 it reached 26,5 percent of adult population, then after a peak it started decrease and in 2005 it stood at 18,4 percent (UN).

Two infrastructure data have the same dichotomy of movements like education and health, the water and electricity supply. Between 1990 and 2005 the access to electricity improved from 20 percent of population in 1990 – 70% in urban areas and 10% rural areas – to 41,5 percent in 2005 – 86% in urban areas and 31 percent in rural areas – (UN).

At the same time access to water deteriorated from 74 percent in 1990 – 95% in urban areas and 65% in rural areas – to 46 percent in 2005 – 60% in urban areas and 40% in rural areas –. Another index that decreased was rail lines density from 0,70 kilometers of the line per one hundred square kilometers of land area in 1990 to 0,66 kilometers in 2005.

However the most interesting data was the dynamic of the road density, Zimbabwe had in 1990, 23,08 kilometers of road per one hundred square kilometers of land area, this number got worse and in the election year, in 1995, Zimbabwe had only 4,72 kilometers of road per one hundred square kilometers of land area; in other words, just roads which have been policed were drivable, after that the level improved and in 2005 it reached 24,89 kilometers of road per one hundred square kilometers of land area (World Bank).

All these changes also transformed Zimbabwe international trade: if in 1990 the textile's products was the main export goods (39%), in 2005 the export market share of goods was ores, slag, and ash (23,8%), nickel (20,5%), tobacco (14,3%), iron and steel (12,9%) and cotton (5,9%). The main partners to export merchandises were South Africa (32,1%), China (9,7%), Botswana (8,5%) and Zambia (3,7%).

Zimbabwe imported mainly, fuels (14,8%), cereals (14,5%), machinery (12,3%) and vehicles (10,9%), the goods in 2005 came from South Africa (56,6%), China (8,5%), Botswana (3,4%) and Zambia (3,2%), and (CIA data).

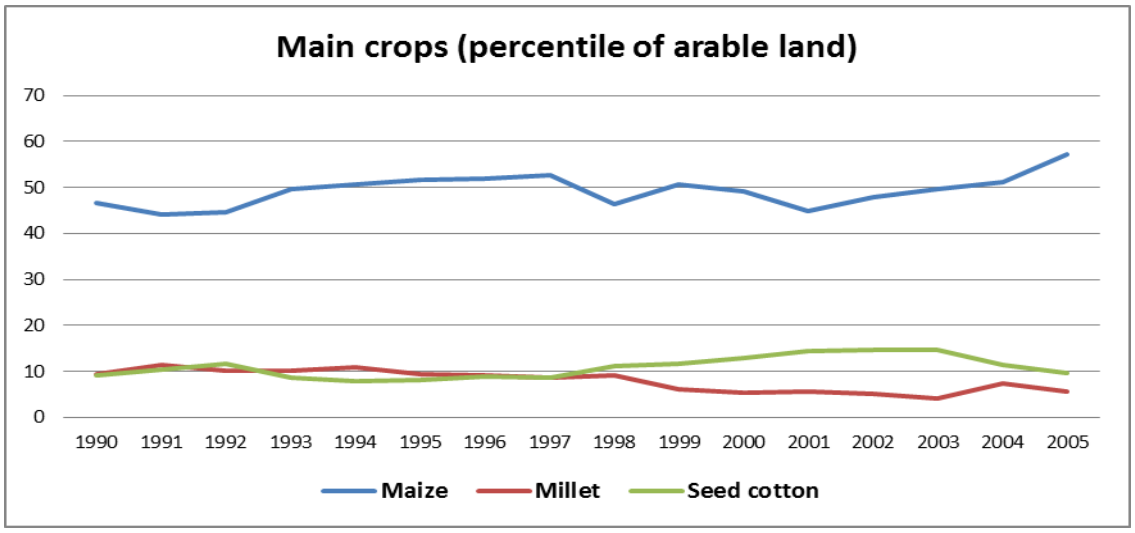
The EU 27 had a surplus with Zimbabwe's trade in 2005, which represented around 10,5 percent of all Zimbabwe trades, however 2005 was a terrible year for the economy of Zimbabwe, and all these numbers have problems of "interpretation", just two examples could help understand the scenario.

The borders of the country were controlled by ethnic groups, which helped its groups to trade with the same ethnicity that lived outside the country; thus this numbers did not exist in official data. On the other hand, the official data referred to the official USD

exchange, but in 2005 the percentage premium of Zimbabwe's "USD black market" was 500 percent (Makochekanwa 2007).

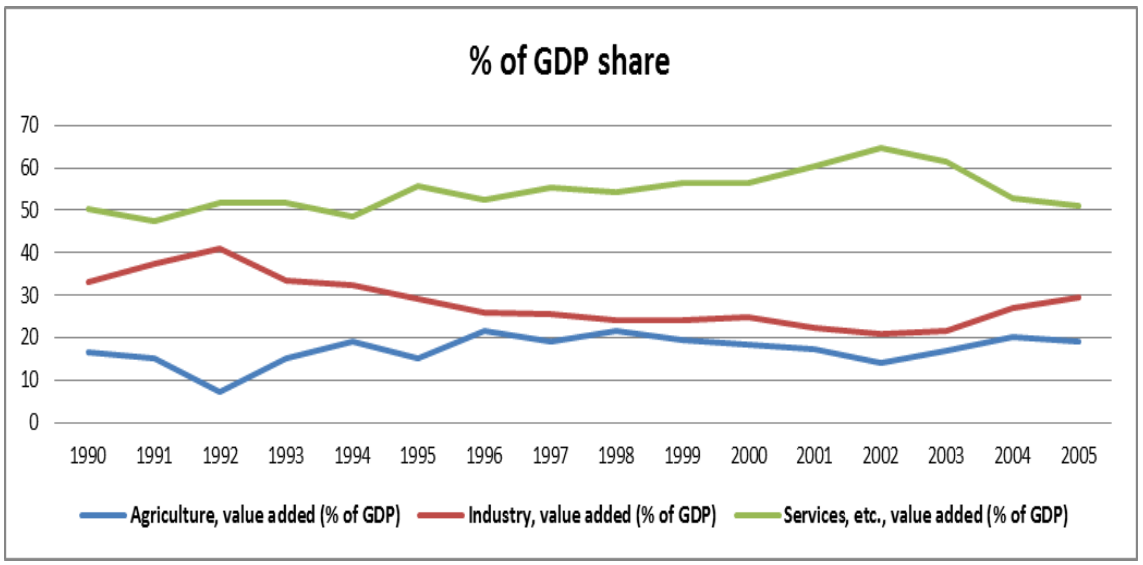
Although Zimbabwe had turned into another country from the point of view economy, between 1990 and 2005, the main crops remained relatively stable, maize and millet were used like food crops and cotton was the main crop for state's farms. And the same stability can be seen in the percentile of GDP share (charts 4.27 and 4.28).

Chart 4.27: Zimbabwe main crops



Source: FAOstat

Chart 4.28: Zimbabwe percentile of GDP share



Source; The World Bank data

5. A COMPLEMENTARY ANALYSIS: THE POVERTY TRAP IN GHANA

This chapter describes the regional economy of Ghana. The Agrisystem Ph.D. program contemplated the experience abroad, and during my experience at The International Cocoa Organization (ICCO) in London, I had the opportunity to investigate deeply the international cocoa market and, among main cocoa producers there are some African countries, whereof Ghana has more details about the its rural economy.

Then, with a more detailed database, it was possible to write a especial chapter about the regional economy as type of crop, their paybacks, and we can observe the confirmation of the "poverty trap" theory as Lipton (1977), Ravallion and Chen (2005) and Fan, Hazell and Thorat (1998).

The geographic position or few natural resources, which offer low potential for agriculture, are the main hindrances to develop agriculture and reduce the poverty these areas are suffering from the so called "poverty traps"(Lipton, 1977, Ravallion and Chen, 2007 and Fan, Hazell and Thorat, 1998).

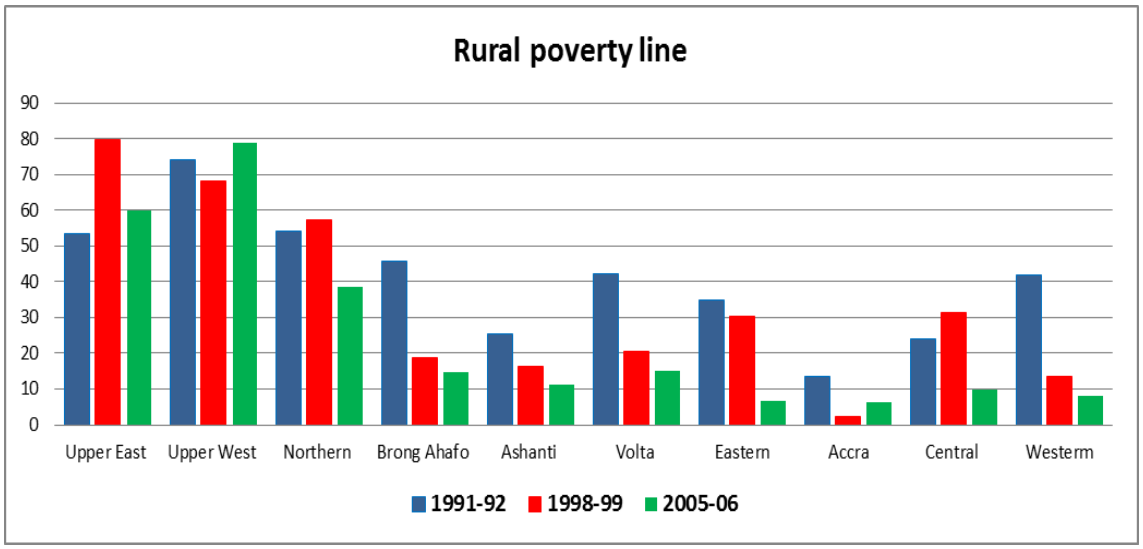
When a region has the poverty traps, it cannot develop at the same speed as the rest of the country: geographic position or shortage of natural resource reduce the development capacity, and also interfere negatively in the socio-economic environment and as a consequence, rural poverty reduction has not happened.

Despite the best performance of the rural poverty reduction among the nine countries, Ghana showed a regional discrepancy of data and confirmed that there exists the poverty trap.

Between 1990 – 2005 some regions as, Ashanti, Brong Ahafo, Central, Eastern, Volta and Western, showed very well data about rural poverty reduction. But in two others regions, Upper East and Upper West rural poverty increased in this period (chart 5.1).

Adding Northern region we have three regions that had the worst performance in poverty reduction in Ghana. They are those with larger distances from the sea – geographic position –, and with different ecological zones from the rest of the country, they belong to Guinea and Sudan Savannahs – few natural resources –. Albeit these situations are not means a poverty trap scenario, showed strong indicia.

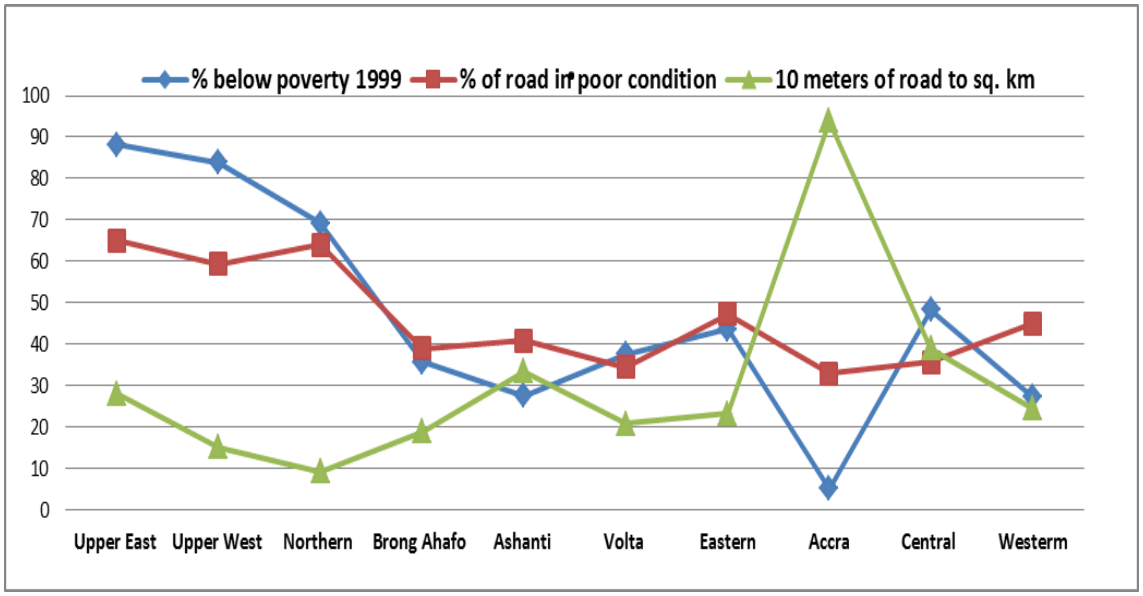
Chart 5.1: The Ghana regional rural poverty



Source GLSS 3, 4, and 5

Usually, to fight against the poverty trap cause by geographic position, a country should improved the infrastructure. But in Ghana the north regions have faced as the worse infrastructure level of the country. Amoatey (2007) showed the inequality of distribution and also showed the difference in the quality of road and the close relationship between poverty and bad road conditions. Following this reasoning we decided to add the road network density, which might improve the link between people and goods, reduce the costs and improve quality of life (chart 5.2).

Chart 5.2: Ghana poverty and roads conditions and density



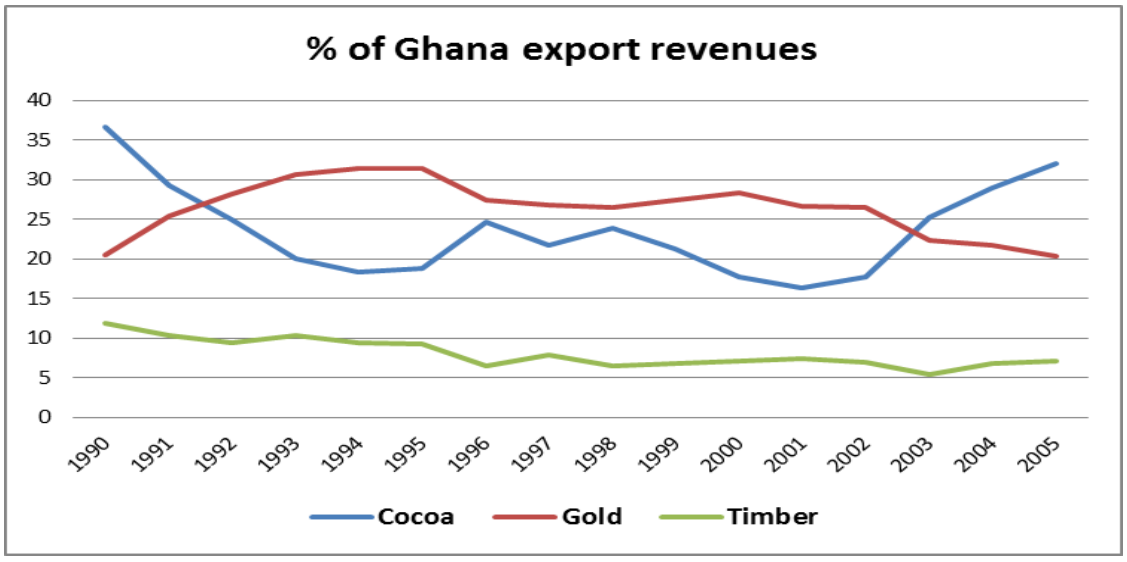
Source: Ministry of Road and transport (MRT, 2002) by Amoatey (2007) pg 7 and road density by World Bank data

Roads are the main link between regions and have the strong impact to reduce poverty. Better roads enable access to markets, created jobs and reduce the cost of goods. Ghana proved it with a regional situation that created a kind of map, where roads reflect the socio economic environment; the capital Accra, has political power and had great density of road, the main exporting regions, like Western, Eastern and Ashanti have the road in the best conditions to facilitate the production and poor regions have the worst conditions and the less density of road.

Furthermore, also the natural resources, demonstrated an imbalance among the provinces, as we said, and produced dissimilar wealth among they; the three main export goods of Ghana come from the regions with good performance in rural poverty reduction.

Ghana suffering of high commodities dependence (chart 5.3), in other words it has a low diversification of exports goods; cocoa beans, gold and timber have had a significant numbers, they represented around 60 percent of Ghana export revenues throughout these sixteen years (Ghana stat).

Chart 5.3: Ghana export revenues



Source IMF data

Between these goods, cocoa has more volatility in the market share, because the monopsonistic government position is very strong, but Ghana's frontiers system is not. It lead a great flux of smuggling sometimes positive sometimes negative, with the neighbours, Cote d'Ivories and Togo. ICCO estimated that between crop years 1999 and 2002 Ghana had a negative smuggling flux and positive one after that.

However, Ghana's scenario between 1990 and 2005 showed strong evidences that north regions did not can to develop at the same speed as the rest of the country, the literatures sustain that it is the first token of poverty trap phenomenon, but we kept the research looking for more evidences.

5.1 The differences in regional agriculture

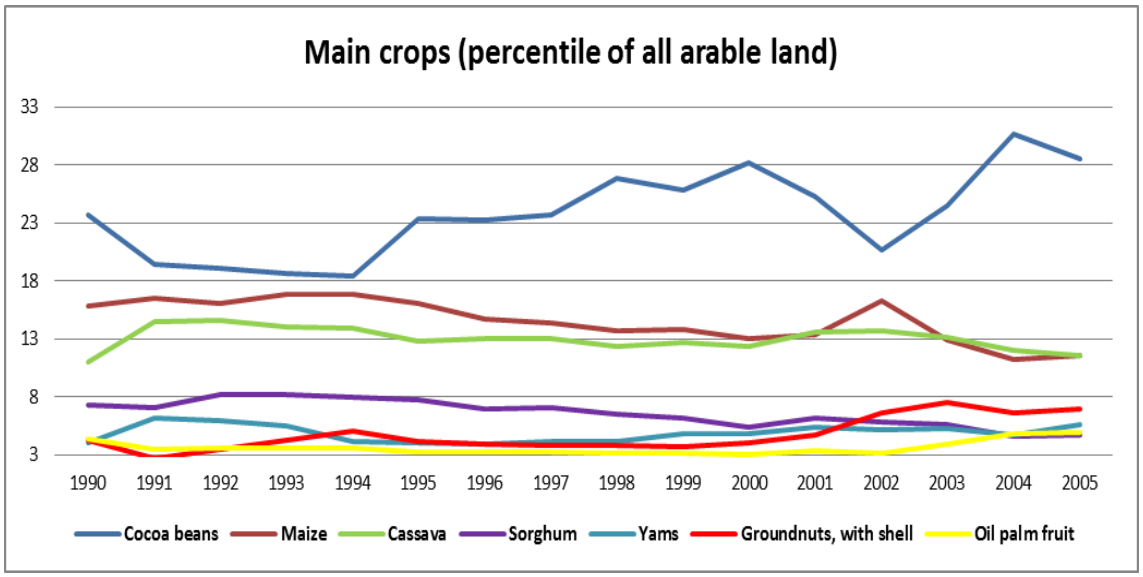
The seven main crops in Ghana occupied more than 73 percent of the arable land in 2005. Cocoa beans represented 28.43 percent of the area, and its area grew 16 percent, between 1990 – 2005. Cocoa crops were following by maize and cassava with around 11.5 of the area each. Nevertheless the crop which grew the most was groundnut; with an increase the 38 percent in its area, and oil palm had great performance growing by 11 percent in its area (chart 5.4).

Similarly, Ghana increased its agriculture area around 123 percent from 2.92 million hectares to 6.49 million ha. Which means that, to increase the market share of percentile arable land; cocoa beans, groundnuts and oil palm, increased their area even more (chart 5.5).

Ghana had and has a "stock land" that has been used differently for each type of crop; cocoa beans, oil palm fruit and groundnuts seemingly were on the road to extensive agriculture and the others ones intensive agriculture.

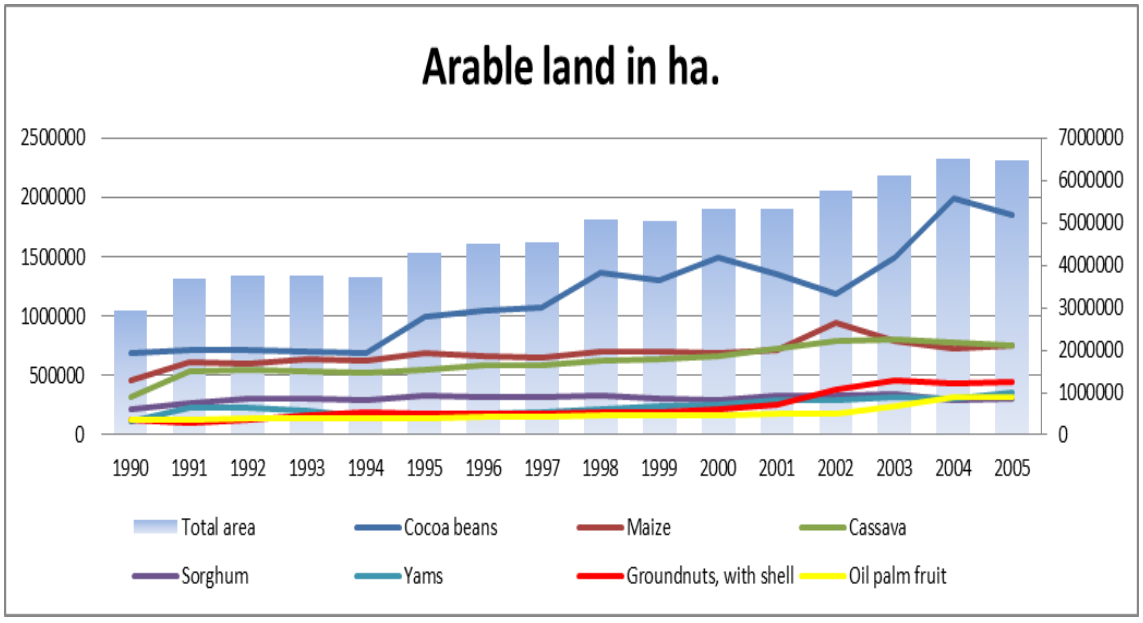
Among the seven main crops, three increased significantly the production by increasing their agricultural areas but with a productivity near to zero or negative – cocoa groundnuts and oil palm fruit –. On the other hand the yield of the sorghum increased more than 3.5 percent per year, followed very closely by cassava and yams crops, the maize crops had a productivity growth of 31 percent during the sixteen years.

Chart 5.4: Ghana main crops



Source: FAOstat

Chart 5.5: Ghana arable land



Source: FAOstat

Many developing countries have been increasing the agricultural output using more arable land instead of more efficient land. The farmers in developing countries usually have: difficulty to get credit, high interest cost, and local technologic has a low level.

At the same time costs of lands, local labour and social concerns about ecologic problems were also minimal. With this scenario, most of the farmers deal with food and feed demand demanding the use of more and more land.

Frequently the farmers, in low-developing countries, do not use intensive agricultural techniques, because the government, in these countries, has raised taxes on the agricultural output. Anderson (2009) showed that developing countries needed the agricultural taxes to manage the domestic budget, but his reduced the competitiveness of its own agriculture for the global market.

The Ghana agricultural scenarios show that among the seven main crops, three increased significantly the production by increasing their agricultural areas but with a productivity near to zero or negative. These are cash-crops. The first one is cocoa, which has had a huge importance in Ghana export revenues: the country was the second largest exporter of cocoa in the world between 1990 – 2005 Ghana governments had a monopsonistic position in cocoa market.

The others two cash-crops in Ghana, groundnuts and oil palm, have as its main market the energetic market as biodiesel and both crops have "government attendance", but these markets are much more free than the cocoa market. They have sellers and buyers at regional and national level everywhere, the government is present in the distribution sector and export taxes.

On the other hand the food-crops in Ghana are following the intensive agricultural path, the yield of the sorghum increased more than 3.5 percent per year, followed very closely by cassava and yams crops, the maize crops had a productivity growth of 31 percent during the sixteen years (chart 5.6).

The agricultural productivity growth means that the farm producers, in a region or country, can manage the available resources and increased the output, using the same amount of land. However agricultural productivity growth is not constant in time because exogenous factors as weather influence the results.

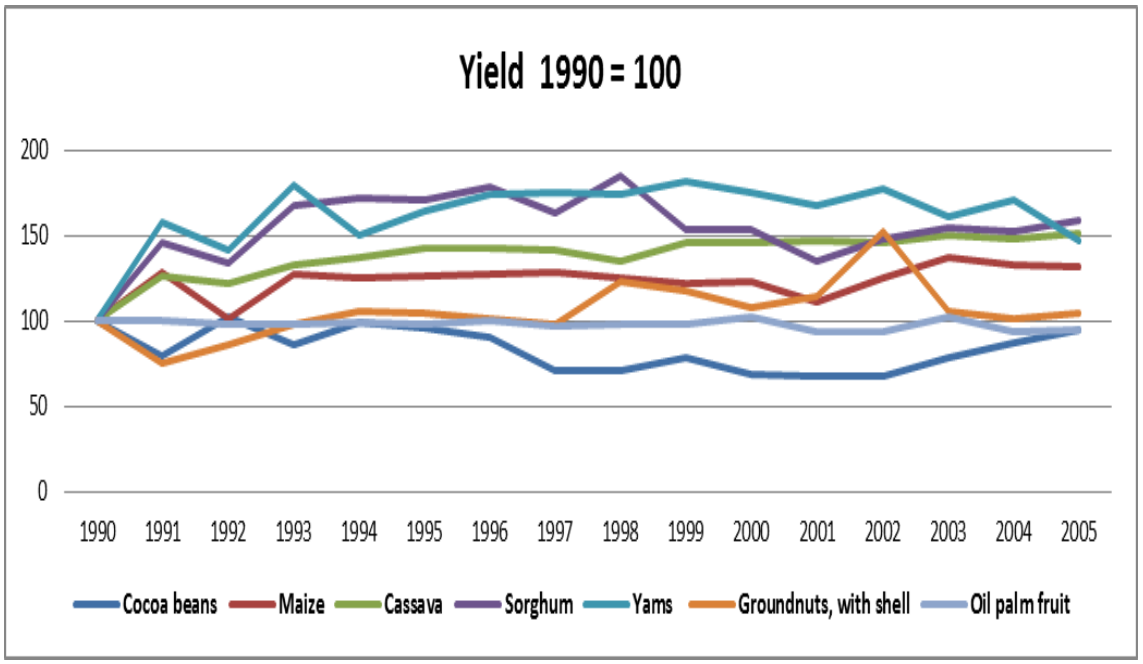
The apparently dichotomy between extensive agriculture and intensive agriculture decisions is explained by Ghana's agriculture policies.

The Ghanaian government authorized and promoted new cash-crops in forest areas, at the same time they started to give assistance to farmers' food crops with the training and commercialization of goods.

Howsoever, we did not judge the best path to the agricultural policies of Ghana as extensive or intensive. Likewise we did not assess if it is good or bad to use forest area to plant cocoa or oil palm tree, neither did we estimate the possible ecologic impact or CO2 balance.

Our analysis aims to help the farmers overtake the poverty line assessing all agricultural environments as: agro-ecologic zone, infrastructure and market size. We wanted to show "what and how" each crop, among the main ones, had the best financial results and which one is the optimal output.

Chart 5.6: Ghana yield crops



Source: FAOstat

Hence, we picked up the data to reinforce the poverty trap thesis, in other words, if the farmers of a region to use all available sources as natural resources, agricultural techniques, work forces and financial sources and yet not out of poverty. It is another signal of poverty trap.

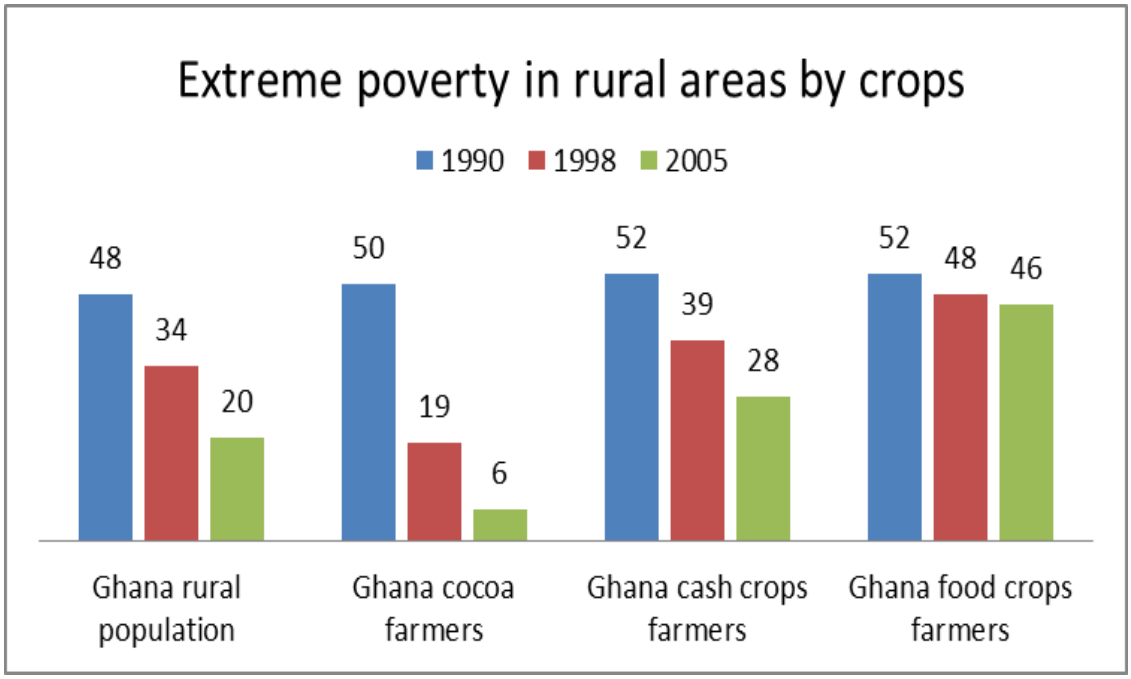
However we noted that the Ghanaian government program that authorized and promoted new cash-crops in forest areas produced the lost 25 percent of its forest cover, between 1990 – 2005. Ghana forests covered in 2005 around 23 percent of its areas or 5566 thousand hectares; of these, only 8 percent or 395 thousand hectares is classified as primary forest.

Deforestation in Ghana has happened for three reasons: the exploitation of timber for commercial purposes – timber is the third exportations goods in Ghana –, the expansion of agriculture in forest areas and "fire wood" the majority of Ghanaian people depends on the forest for cooking and creating energy.
Returning to the main focus, through the GLSSs data was possible check the profile of the farmers and their socio mobility, that we will showed in the next paragraph.

5.2 Implications on rural poverty reduction

The World Bank did a work that showed the cocoa farmers had the best performance in poverty reduction between GLSS 3 and 4. Following the same methodology, by Canagarajah and Pörtner (2003), we did GLSS 5 and we confirmed this trend.
Obvious, one farm has more than one type of crop, but this methodology consider the main crop of the property and its aims i.e. in Ghana 2005/06 among the maize farmers 86.19 percent of the production was consumed and 2,4 was sold, sorghum crops had 74,84 percent of the production was consumed and 15,33 percent traded, so both harvests were so called food-crops.
On the other hand, in the same period the 75.22 percent of groundnut production was sold, while 15,33 percent was consumed, more than 90 percent of the palm oil crops was traded, thus they were cash-crops, and so forth. (GLSS 5)
Thanks to the additional data of GLSS 5 and the results of Canagarajah and Pörtner (2003) we observed that the three groups maintained the same trend between 1998 and 2005 (chart 5.7).

Chart 5.7: Ghana extreme poverty by crops



Source: 1990 and 1998 Canagarajah and Pörtner (2003) and 2005 GLSS 5 calculated by author

The cocoa farmers had great performances between 1990 and 2005, the poverty line fell around 65 percent in each of seven years. Also the cash crops farmers had a good performance, they reduced it by around 26,5 percent in seven years. But the food crops farmers reduced the rural poverty line only by 11,5 percent in the same period.

The numbers are well-defined, but the most interesting results are not obvious at first sight, the amount of cocoa farmers grew from around 280 thousand farmers in 1990, to 720 thousand farmers in 2005. The cocoa farmers increased around 139 percent in sixteen years, at the same time, the cash crops farmers rose around 60 percent, the food crops enlarged around 20 percent and the entire rural population grew 16, 6 percent.

In other words, cocoa crops were the main driver to reduce the rural poverty in Ghana for many reasons. First of all, as we saw and will show in the next paragraphs, the efficiency of cocoa crops – main cash crop – is better than maize crops – main food crops –.

Secondly in Ghana the majority of farms have a small size that reduces the possibilities to introduce new tools as tractors to reduce the costs, without these instruments it is difficult for maize crops to improve the yield. Finally, the food trade between north and south regions is practically nonexistent this surely inhibits investment in the north areas, consequently in the food crops.

We goal was to calculate the efficiency of the tree groups and find out the reasons of this scenario, but we did not find literature or data to support this research, thus this job at regional level and by crops we used the small time series – 2001 to 2004 –, only two crops – cocoa and maize – and we needed to accept some assumptions about some factors to calculate the cost function.

To calculate the efficiency of cocoa and maize crops we obtained, from TFP of the theoretical framework, the cost function. To decompose the efficiency we followed the Farell (1957) and Bauer (1990) methodology and all databases are in appendix III.

$E(Q,w,x,t) = C(Q,w,t) /C = w'x^{E}(Q,w,t)/w'x$ where $0<E(q,w,x,t) \leq 1$, $C(Q,w,t)$

E is measure of efficiency economics

C is the observed total cost

Q is a vector of output quantities

w is a vector of input prices and

t is a time index

$\mathbf{x}^{E}$ and **x** are the cost minimizing and the observed input vectors.

The improvement of costs crops is necessary to enhance the competitiveness, raise profits and spread the welfare in the rural environment. In academics works, business plans of agro-business and also governments, the performance is usually measured through the Total Factor Productivity (TFP) growth.

TFP is the difference between the growth of out-put and the growth of a combination of all factor inputs, usually labour and capital. The TFP reflects the contribution to output as a result of the more efficient use of resources or the adoption of new technologic. Many empirical studies proved the positive effect in local economy when the TFP grow. (Block and Timmer 1994, Alston, Pardey and Smith 1999 and FAO 2006).

But as we said, to do this job at regional level and by crops we faced, once again, the usual problem of the shortage of information and we should use the small time series – 2001 to 2004 – and we needed to accept some assumptions about some factors, such as:

For the input costs, as fertilizer prices and labour forces, we used the data base of the Ministry of Food & Agriculture Republic of Ghana (MoFa), Although we had many suspicions that information could be asymmetric.

For example the fertilizer prices, – NPK bag of 50 kilograms – were falling in current USD and the consumption was also declining up to 2001, after which prices rocketed and the consumption also. The insecticides that used urea derivatives had the same trend (table 5.1).

The fertilizer NPK 15/15/15 represented 82 percent of all fertilizer used in this period according to IFPRI/IFDC (2009), and the insecticides with urea derivatives represented 61 percent of all the insecticides consumed in Ghana between 2001 and 2005 (FAOstat).

Another important point is the exchanges rate, to change Cedi (CHS) to Dollar (USD) data of the Bank of Ghana were used, thus the black market rate was ignored. To be coherent in this analysis, together with alleged black markets of fertilizers and currency, we did not considered land prices, because we considered impossible putting the "real price" of rural land in Ghana. Despite the respectable land tenure system, the Ghana land markets are very stable and cheap in official data, but it is very dynamic in the real economy (Awanyo 2009).

Table 5.1: Ghana fertilizer prices and consumption

Prices & consumption bags 50 kg	2001	2002	2003	2004	2005	2006
Fertilizer NPK 15/15/15 CHS	500,00	800,00	8000,00	9000,00	20000,00	35500,00
Fertilizer NPK 15/15/15 USD	0,07	0,10	0,92	1,00	2,22	3,86
Consumption kg/ha	2,66	2,71	4,68	8,11	5,06	12,73
Insecticides Urea derivative CHS	1000,00	1700,00	16850,00	18940,00	42000,00	74500,00
Insecticides Urea derivative USD	0,14	0,21	1,94	2,10	4,66	8,10
Consumption kg/ha	0,01	0,19	0,00	0,20	0,41	1,77

Source; Ministry of Food & Agriculture Republic of Ghana

We are sure that to explain the parallels markets of fertilizer, currency and land, we need more one chapter, hence we assumed that possible distortions caused by black markets in the rural environment have had the horizontal effects for all crops, so this reduces distortions effects toward the main goal, check the efficiency between the two crops.

Another main factor that has strong influence on the agriculture output is the rainfall. In this specific period, between 2001 and 2004, precipitation had regular shape at national and regional level, according to Ghana's Meteorological Agency (table 5.2). Hence the productivity was influenced more by agriculture techniques than the weather.

Table 5.2: Ghana rainfall by regions

Region /rainfall mm	2001	2002	2003	2004	Average in last 10 years	Average in last 30 years
WESTERN	1235	1720	1467	1248	1471	1558
CENTRAL	1156	1305	1178	949	1242	1252
Greater Accra	773	899	908	484	790	788
EASTERN	1150	1583	1054	1174	1284	1340
VOLTA	1027	1263	1245	1215	1183	1180
ASHANTI	1136	1637	1326	1098	1343	1345
BRONG AHAFO	1170	1311	1325	1362	1280	1244
NORTHERN	880	1100	1420	1178	1204	1155
UPPER WEST	936	898	1117	613	937	912
UPPER EAST	968	1059	1189	607	947	1022
TOTAL	10431	12775	12229	9928	11680	11796

Source; Ghana's Meteorological Agency

After skipping the dilemmas of fertilizer, labour, exchange currency, and weather, we picked up data of consumed fertilizer and labour force to maize crops by MoFa data, and the data of cocoa crops by the Ghana Cocoa Farmers Survey reports 2001/02 and 2003/04. For the cost of wages we used the IFPRI report (Ngeleza et al 2011), that basically affirmed that the national minimal wage is respected in the cocoa and maize belts and is not used in other areas (table 5.3).

Table 5.3: Ghana wages by regions

	Daily wage	Contract Cost per acre	
Belt	CHS	Minimum CHS	Maximum CHS
Moderate cocoa	5	40	40
High cocoa	5	40	40
High maize	5	25	30
Volta valley	3	25	30
Cereals	2	25	30
High onion	2	20	25

Source Ngeleza et al 2011

To calculate the output of maize crops we used the wholesale price by FAOstat data, and the farm gate price estimated by MoFa, they analyzed the maize crops and asserted that the farm gate price in Ghana is around 24,12 percent of wholesale prices. At the same time, for cocoa farm gate prices we used the Ghana Cocoa Board data (COCOBOD).

Finally, as to the sizes of regional farms and the yield of maize and the sizes of regional farms and yield of cocoa, we used the same sources, MoFa and COCOBOD respectively. All these data were calculated by hectare in nominal USD, thus with this methodology we found out the economics efficiency by hectare and region.

As we said, even though the farms in Ghana had small areas, usually the farmers planted more than one single crops in own land, the GLSS 5 showed that this depended on ecological zones; the farmers behaviors changed, but they always had more than 2 crops per farm, independently of the farm size (table 5.4). Hence, the results represented the partial financial scores of one farm.

Table 5.4: Ghana farm size and ecological zone

Farm size/ecological zones	Coastal	Forest	Savanna	Average
< 0,5 ha	2,7	2,8	2,5	2,7
0,5 - 1 ha	3,2	3,3	2,4	3,0
1 - 2 ha	3,9	3,7	2,7	3,4
2 - 3 ha	4,1	4,0	3,3	3,7
3 - 4 ha	4,3	4,5	3,9	4,3
4 - 5 ha	4,3	4,3	3,8	4,1
> 5 ha	4,1	5,0	5,3	5,0
Average	3,5	3,8	3,5	3,7

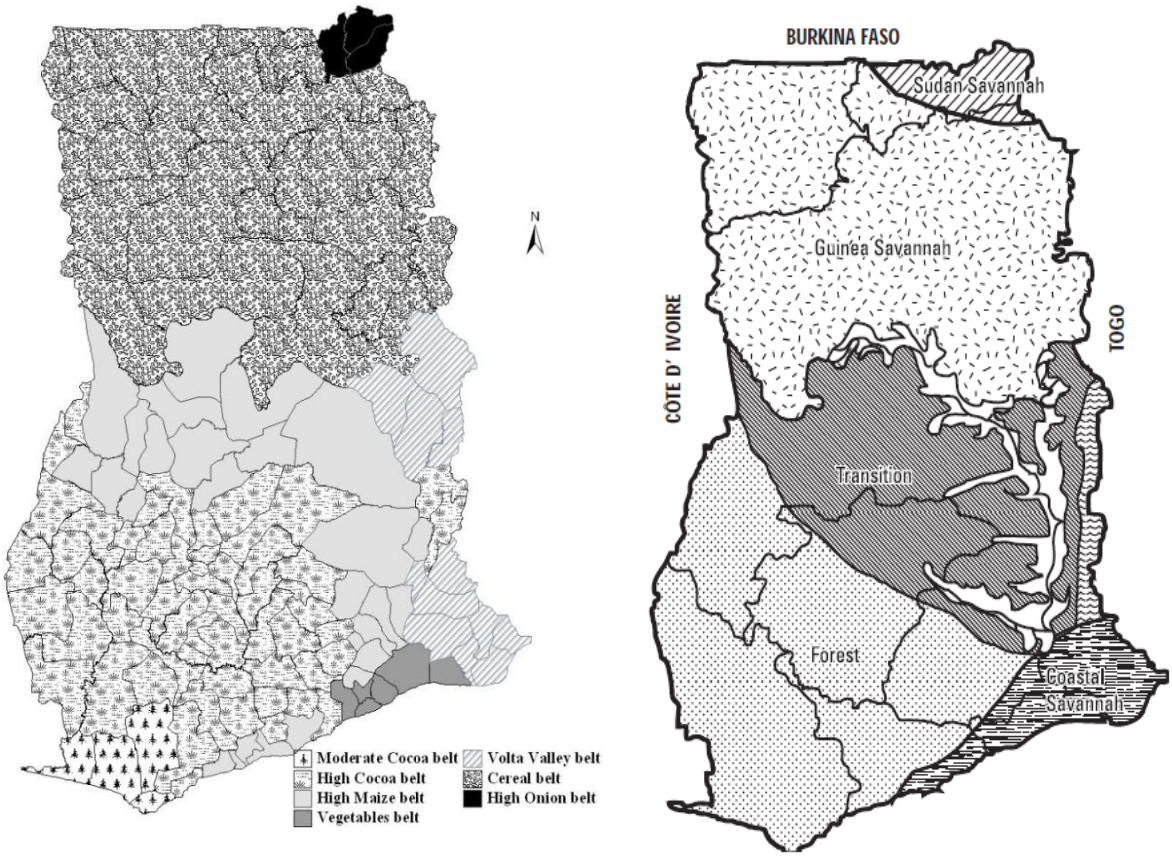
Source; GLSS 5

We analyzed the economics efficiency by region between two crops – Cocoa and Maize – but it is indispensable to highlight that some regions had their score affected or altered because they had a part of their territories in one ecological zone and another part in other. Consequently, there were at the same time two or more crops belt as Upper East – Onion and Cereal belts – Brong Ahafo – Cocoa and Maize belt – Volta – Cocoa and Rice belts – and Easter – Cocoa and Maize belts (Figure 5.1).

However the frontier between cocoa, maize and rice belts always are at the end of the forest; on the other hand, the frontier in Upper East between the Guinea and Sudan savannah is less visible, almost all literatures and the official government data divided the Forest and Savanna regions on the edge between Brong Ahafo and Northern, but the Upper East often appears like "savanna". Hence this region probable had their results more modified.

Despite the same limitation our research shows the following important results; between 2001 and 2004 the maize and cocoa crops had one improvement of the farm gate price around 11 percent for maize and 16 percent of cocoa. The productivity per hectare grew round 19 percent of cocoa crops and fell around -15 percent of maize crops (table 5.5).

Figure 5.1: Ghana ecological zone and main crops



Source; main crops by Ngeleza page 7 and ecological zone by MOFA

Table 5.5: National average yield of cocoa and maize crops

Yield and prices	2001	2002	2003	2004
Maize yield (ton/ha)	0,78564	0,73101	0,67111	0,67882
Maize prices (USD/ton)	134,15	108,41	110,41	151,19
Cocoa yield (ton/ha)	0,29539	0,28499	0,33123	0,36849
Cocoa prices (USD/ton)	533,26	848,75	796,56	639,78

Source; MoFa data and COCOBOD data calculated by author

The inputs of maize crops remained stable between 2001 and 2004, the use of fertilizer, (one bag of 50 kilograms per hectare), insecticides (0.32 bags of 50 kilograms per hectare) and labour force (4,7 worked per hectare).

On the other hand, cocoa crops increased the use of fertilizer from 0.45 bag per hectare in 2001 to 5.14 bags per hectare in 2004, also the use of insecticides grew from 0.14 bag per hectare to 0.94 bag per hectare at the same period. But the most significant movement was the work force that dropped from 5.02 people per hectare in 2001, to 1.69 employees per hectare in 2004.

According to the average of national numbers only it would be easy to say the North regions are poor because producing maize and the South regions are better because they have planted cocoa. However, when we bring out the regional level, the efficiency of maize crops in the North is moderately better than in the South, because north farmers pay less than 60 percent of national minimal wage for their worked. So we went into more detail (tables 5.6 and 5.7).

Table 5.6: Profitability from cost-effectiveness to maize crops

Region/year	2001	2002	2003	2004	Median
WESTERN	10,3%	-24,9%	-35,3%	-26,5%	-19,1%
CENTRAL	17,9%	-52,1%	-65,3%	-42,5%	-35,5%
EASTERN	12,4%	-36,3%	-44,1%	-38,1%	-26,6%
VOLTA	0,4%	-28,2%	-32,1%	-23,0%	-20,7%
ASHANTI	7,5%	-33,7%	-44,2%	-34,6%	-26,2%
BRONG AHAFO	25,8%	-12,6%	-24,9%	-12,7%	-6,1%
NORTHERN	493,8%	354,7%	272,2%	252,4%	343,3%
UPPER WEST	184,8%	60,8%	45,3%	80,0%	92,7%
UPPER EAST	54,7%	-1,0%	-19,9%	20,1%	13,5%
National	50,6%	-3,7%	-18,1%	-4,6%	6,1%

Source; MoFa data calculated by author

Table 5.7: Profitability from cost-effectiveness to cocoa crops

Region/ year	2001	2002	2003	2004	Median
WESTERN	58,45%	120,63%	425,48%	275,87%	220,11%
ASHANTI	60,24%	123,13%	411,12%	265,60%	215,02%
BRONG AHAFO	55,74%	116,87%	399,14%	257,03%	207,19%
CENTRAL	10,94%	47,85%	202,26%	234,38%	123,86%
EASTERN	10,94%	47,85%	202,26%	234,38%	123,86%
VOLTA	797,37%	1264,48%	759,46%	974,00%	948,83%
National	49,09%	100,29%	358,20%	264,61%	193,05%

Source; COCOBOD data calculated by author

The best efficiency in maize crops was achieved for Northern, Upper West and Upper East regions. For the same reason the high performance of the Volta region was in cocoa crops. As to the low price of the workforce, the north region paid in rural areas around 40 percent of the national minimal wage and in Volta the wage pay was around 60 percent of the minimal wage.

We followed the goal that understand the gears helping poverty reduction, we divided the suppose efficiency surplus for the numbers of worked per hectare by crops. Because almost all farmers in Ghana use intensive labour force and usually this workforce comes from their families. Hence we attained the income per capita per crops/hectare and compared it with the minimal national wage (tables 5.8 and 5.9).

Table 5.8: Revenue per employee based on the % of the minimum wage in maize crops

Region / year	2001	2002	2003	2004	Median
WESTERN	102,43%	94,10%	91,59%	93,68%	95,45%
CENTRAL	104,23%	87,68%	84,46%	89,89%	91,57%
EASTERN	102,92%	91,40%	89,50%	90,93%	93,69%
VOLTA	60,03%	57,67%	57,34%	58,09%	58,28%
ASHANTI	101,76%	92,04%	89,49%	91,76%	93,76%
BRONG AHAFO	108,47%	95,84%	91,73%	95,77%	97,95%
NORTHERN	88,78%	75,06%	67,37%	65,34%	74,14%
UPPER WEST	58,25%	46,00%	44,55%	48,02%	49,21%
UPPER EAST	43,14%	39,94%	38,84%	41,16%	40,77%

Source; MoFa data and Ngeleza et al 2011, calculated by author

Table 5.9: Revenue per employee based on the % of the minimum wage in cocoa crops

Region / year	2001	2002	2003	2004	Median
WESTERN	111,64%	107,68%	385,00%	238,19%	210,63%
ASHANTI	111,98%	124,50%	375,38%	276,37%	222,06%
BRONG AHAFO	111,09%	123,25%	367,35%	270,67%	218,09%
CENTRAL	102,18%	109,52%	235,48%	255,63%	175,70%
EASTERN	102,18%	109,52%	235,48%	255,63%	175,70%
VOLTA	70,13%	77,48%	219,11%	239,27%	151,50%

Source; COCOBOD data and Ngeleza et al 2011, calculated by author

The best performance in maize crops happened in Brong Ahafo the so called "Ghana maize belt" where the average pay is around 97 percent of minimal wage. Meanwhile, in cocoa crops, Volta region that had the best efficiency, but also offered the worse per capita payment and the Ashanti region had the best score (tables 5.10 and 5.11).

These results point out other reasons; if we look for the other point of view, it seems clear that cocoa belt must stop to plant maize crops and intensify cocoa crops, this path can be supported by the supply of cereal belt, which could intensify the maize crops or sadly by importation, in one classical argument proved by Ricardo in the 19th century.

Again, it is not worth harvesting maize in the forest. Every time that one hectare of maize is planted in Ashanti region the farmer loses around 88 percent of national minimal wage per capita. Comparing the maize crops with cocoa crops income, we wondered.

Table 5.10: The income of maize crops in USD per hectare

Region / year	2001	2002	2003	2004	Median
WESTERN	9,04	-25,74	-43,11	-38,11	-24,48
CENTRAL	15,74	-53,76	-79,64	-61,02	-44,67
EASTERN	10,88	-37,50	-53,83	-54,76	-33,80
VOLTA	0,35	-30,14	-40,46	-34,17	-26,11
ASHANTI	6,55	-34,73	-53,87	-49,71	-32,94
BRONG AHAFO	16,24	-9,36	-21,86	-13,17	-7,04
NORTHERN	166,18	140,43	128,76	140,42	143,95
UPPER WEST	62,19	24,06	21,43	44,48	38,04
UPPER EAST	31,60	-0,70	-16,02	19,05	8,48
National	35,42	-3,05	-17,62	-5,22	2,38

Source; MoFa data calculated by author

Table 5.11 The income of cocoa crops in USD per hectare

Region / year	2001	2002	2003	2004	median
WESTERN	61,75	145,68	236,70	178,38	155,63
ASHANTI	63,64	148,69	228,71	171,73	153,19
BRONG AHAFO	58,90	141,14	222,04	166,19	147,07
CENTRAL	11,56	57,79	112,52	151,54	83,35
EASTERN	11,56	57,79	112,52	151,54	83,35
VOLTA	11,56	57,79	112,52	151,54	83,35
National	51,86	121,12	199,27	171,09	135,84

Source; COCOBOD data calculated by author

Whether the agricultural policy changes and forest areas stopped to plant maize, will it help the rural poverty reduction in the north regions? And then break the cycle of poverty trap.

To answer this question, we should highlight that the efficiency of the maize crops is microeconomic, thus we can see how the maize agro-business in the north regions could response on the new policy. On the other hand, changing the minimal wage, improvement of the interregional trades and the policies of birth rate that can reduced the rural poverty, are the macroeconomic policies.

As we saw, the minimal wage is respected only in the south areas, the minimal wage in Ghana represented an income little more than USD 1.25 (PPP) a day, in others words when somebody has a job, and he can overtake the poverty line there. But in Volta valley, Northern, Upper West and Upper East, who has one job cannot do it, the rural salary in Volta is around 40 percent less than minimal wage and in the other regions the wage is around 60 percent lower.

However, the need to enlarge the supply of maize could press the farmers that will have more necessity of labour force, it could will help the wage level in the north, only, if the demographic profile change your trend, then start to reduce the amount of family members.

Again, historically, the farmers in Ghana used intensive labour force and usually this workforce come from their families, so we hypothesized that crops which use fewer workers led the family to have a smaller amount of children and vice-verse (table 5.12).

To check this assumption we used the Coase methodology (1937, 1960) we showed up the problem of social cost in Ghana.

Coase explained, with one simple example, the herd of input and output, that in this case the farmer make choices to achieve the best performance, Coase proposed to use an arithmetical example; the annual cost of fencing the farmer's property was USD 9, the price of the crop was USD 1 per ton (table 5.13).

Table 5.12: Ghana crops and family size

Regions	Main Crops	Family size
WESTERN	cocoa	4,7
CENTRAL	cocoa	4,4
EASTERN	cocoa	4,6
VOLTA	rice/cocoa	4,7
ASHANTI	cocoa	5,3
BRONG AHAFO	cocoa/maize	5,3
NORTHERN	maize/sorghum	7,4
UPPER WEST	maize/sorghum	6,4
UPPER EAST	maize/onion	7,2

Source; GLSS 5 data calculated by author

Table 5.13: Coase example

Number in herd	cost pay for fencing	Crop loss per additional steer ton	Annual crop loss ton	Total of cost	Cost for herd
1	9	1	1	11	11
2	18	2	3	23	11,5
3	27	3	6	36	12
4	36	4	10	50	12,5

Source; Coase 1960 pg 4

Thus the herd increasing depend on the price of output and the cost of input, in others words while the meat price grows enough to support the input prices, the farmers will continue to enlarge their farm. Otherwise they will decrease the supply until it reaches the optimization of input prices.

As we saw, the maize farms in the north regions had the highest efficiency for theses crops in Ghana, but it is obvious that their efficiency was supported by the low inputs, that produce one kind of "stagnation disease". Without new possibilities to trade their goods the farmers do not investing and the yield continue very low.

The farmers in Northern Ghana have great supply of labour, and we suspect that without policy intervention the wage will not increase up to Southern levels; the ecological zone prevents to plant cocoa or oil palm trees, the low infrastructure avoids improvement of trades goods like maize, and finally as we saw in Ghana's paragraph – 4.2 – public investments as education, water and electricity supplies, are smaller than in south areas, thus we concluded that the north regions of Ghana are in the so called "poverty trap" .

Therefore, the expectation is that the increase of the agriculture techniques and the improvement of yield can improve the income per capita per hectare in maize crops and help to change this setting .Then we bet in this new scenario and we simulated this hypothesis.

To do this exercise, we assumed that labour and cost correlation used in Ngeleza et al (2011) are correct, so improving the agricultural system in the cereal belt from traditional crops, that use only labour force with the use of labour and mechanization techniques will reduce the labour cost in 34,7 percent, because will improve the labour efficiency.

In a similar way we assume that changing agricultural techniques from traditional input in maize crops – 1 bag of 50 kilograms per hectare – to the so called "median input" fertilizer – 3 bags of 50 kilograms per hectare – they can increase the output goods in around 100 percent in SSA (FAO 2009).

But we did not change the "regional wage" because the demographic window does not allow it. So we faced the possible modification in this hypothetical scenario* (tables 5.14, 5.15, 5.16 and 5.17).

The next tables were calculated using the same methodology to decompose the efficiency. We followed the Farell (1957) and Bauer (1990) methodology and all databases are in appendix III, but the work force costs we changed following the Ngeleza et al (2011) data.

$E(Q,w,x,t) = C(Q,w,t) /C = w'xE(Q,w,t)/w'x$ where $0<E(q,w,x,t) \leq 1$, $C(Q,w,t)$

E is measure of efficiency economics

C is the observed total cost

Q is a vector of output quantities

w is a vector of input prices and

t is a time index

xE and x are the cost minimizing and the observed input vectors.

Table 5.14: Profitability from cost-effectiveness to maize crops

Region/ year	2001	2002	2003	2004	median
NORTHERN	493,8%	354,7%	272,2%	252,4%	343,3%
UPPER WEST	184,8%	60,8%	45,3%	80,0%	92,7%
UPPER EAST	54,7%	-1,0%	-19,9%	20,1%	13,5%

Source; MoFa data calculated by author

Table 5.15: New* profitability from cost-effectiveness to maize crops

Region / year	2001	2002	2003	2004	median
NORTHERN	1705,10%	1280,87%	652,82%	594,69%	1058,37%
UPPER WEST	765,83%	387,95%	315,94%	417,69%	471,85%
UPPER EAST	371,72%	201,50%	135,75%	254,32%	240,82%

Source; MoFa data and Ngeleza et at 2001 calculated by author

Table 5.16: Revenue per employee based on the % of the minimum wage

Region / year	2001	2002	2003	2004	median
NORTHERN	88,78%	75,06%	67,37%	65,34%	74,14%
UPPER WEST	58,25%	46,00%	44,55%	48,02%	49,21%
UPPER EAST	43,14%	39,94%	38,84%	41,16%	40,77%

Source; MoFa data calculated by author

Table 5.17: New* revenue per employee based on the % of the minimum wage

Region / year	2001	2002	2003	2004	median
NORTHERN	147,42%	119,97%	82,45%	78,10%	106,99%
UPPER WEST	86,36%	61,85%	58,78%	65,74%	68,18%
UPPER EAST	52,01%	45,61%	43,36%	48,00%	47,25%

Source; MoFa data and Ngeleza et al 2011calculated by author

The more interesting results, , shows that the growth of productivity may increase the efficiency but not resolve the low per capita revenues issue, stressing more the problem. Agricultural growth without others policies does not lead to poverty reduction.

Perhaps we were conservatives about yield growth in the our hypothesis*, as we know the Guinea savannah, offers to Ghanaian farmers a very similar agricultural environment to the Brazilian "cerrado" as rainfall, soil and temperature, but, the farmers using very different inputs as agricultural techniques and seeds.

However, it is clear that north region can increase the productivity, also the maize crop in north areas is efficient, but with our results it does not mean that the rural poverty line will decrease in cereal areas, as for cocoa or others cash crops in Ghana (Table 5.18).

Table 5.18: Ghana and Brazil yields

Ghana low technique	2001	2002	2003	2004
Northern yield (ton/ha)	1,490	1,661	1,127	0,889
Upper West yield (ton/ha)	0,714	0,587	0,622	0,662
Upper East yield (ton/ha)	0,666	0,620	0,585	0,754
Fertilizer used kg/ha	50	50	50	50
Ghana median technique*	2001	2002	2003	2004
Northern yield (ton/ha)	2,979	3,321	2,253	1,777
Upper West yield (ton/ha)	1,429	1,174	1,245	1,324
Upper East yield (ton/ha)	1,333	1,241	1,170	1,507
Fertilizer used kg/ha	150	150	150	150
Brazil	2001	2002	2003	2004
Mato Grosso yield (ton/ha)	3,396	2,978	3,671	3,450
Mato grosso do Sul yield (ton/ha)	3,984	2,796	4,331	3,818
Goias yield (ton/ha)	4,503	4,549	4,873	4,983
Fertilizer used kg/ha	151	163	158	189

Source; MoFa data, Ngeleza et al 2011 and CONAB calculated by author

6. METHODOLOGY OF THE ECONOMTRIC MODEL

In this chapter we described the previous evidence about rural poverty reduction in SSA, our proposed a model and explained the methodology step by step of all agricultural environment and their links and finally we showed the results.

6.1 Previous evidence for SSA countries

Based on previuos work, our assumption is that the poverty reduction at rural areas of Sub-Saharan Africa, namely in low-income countries that have no significant reserves of mineral resources, should happen through agricultural development.

A country that has huge mineral resources as petroleum, gas, gold, diamond, etc. usually does not have problems to make international trade with these commodities, since this normally improves the country current balance and provides a comfortable macroeconomic environment.

However, mineral activities have a low impact on poverty reduction in developing countries. It is more profitable and manageable; hence a country that has huge mineral resources can reduce poverty level very fast. Nevertheless, this hypothetical country should not follow our reasoning, because it could use others tools.

On the other hand, agricultural growth always led an agricultural country to the development, but the elasticity of the result achieved by each one was different, because the labor force growth, GDP growth and poverty reduction all depend on inner factors. However is truly striking that in a country that has relevant arable land and most of population working in agriculture, it has a better performance as far as the previous three items[12] are concerned (table 6.1), the so called "agricultural linkages". Small countries with a scarce quantity of arable land as Singapore, Hong Kong and Monaco are out of this rule, since the services sector led to their development.

[12] See Block ana Timer 1994, Mellor 1999 and 2001, Lipton and Ravallion 1993 and Quibria 2002

Table 6.1: SSA agricultural growth and GDP growth

Agriculture	GDP	Country	Authors
1%	0.92%	14	M. Roemer and M. K. Gugerty 1997
1%	2.75%	Burkina	C. Delgado J Hopkins and V A Kelly 1998
1%	1.96%	Niger	
1%	1.97%	Senegal	
1%	2.48%	Zambia	
1%	1.45%	Kenya	S Block and C P Timmer 1994

Source by author

All modern literature considers the linkages as part of the main tools to reduce poverty in rural areas around the world.

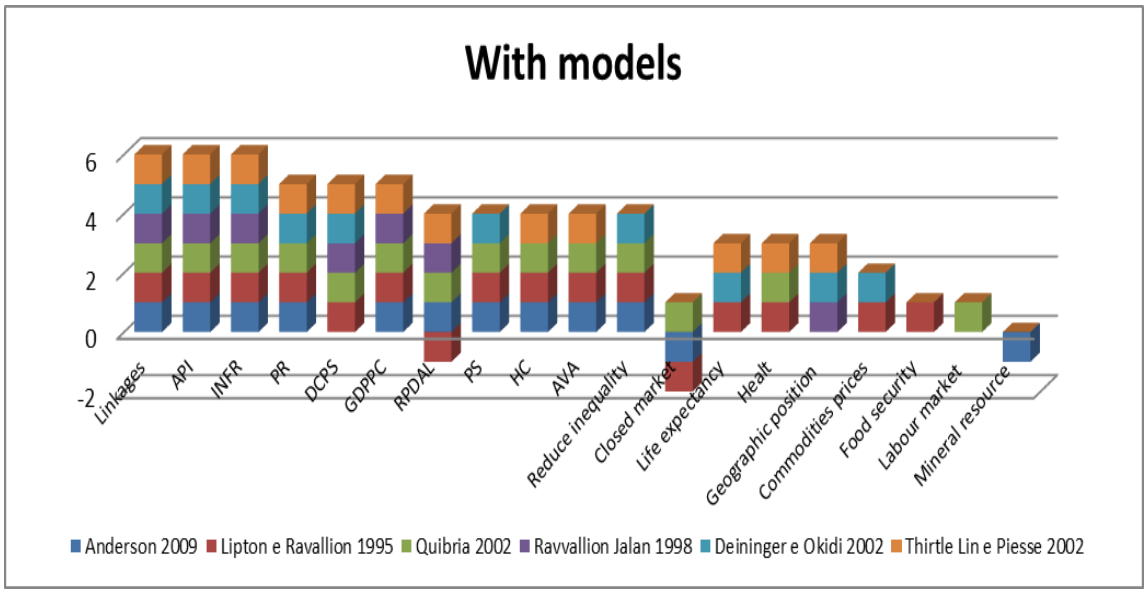
We selected here fourteen examples of research made by western institutions and universities, which focused on developing countries localized in Latin America, Africa and Asia within a time series from 1960 to 2000s.

Some authors created models to explain this phenomenon, others supplied academic explanations with empirical results about agricultural growth and poverty reduction. However all of them call attention to positive or negative effects that each inner factor could cause in an agricultural environment. In our model we substantially agree on the most popular ideas cited by these authors. The only exception is the inequality reduction issue.

Inequality reduction occurs as a consequence of various policies, and not as a result of the growth of the agriculture sector. At the beginning, agricultural growth in SSA meant increase of inequality, as illustrated by Bigsten (1984) in Kenya, Collier, Radwan and Wangwe (1986) in The U. R. of Tanzania, by Bigesten, Kayizzi-Mugerwa (1995) and Roemer and Gugerty (1997) in Uganda.

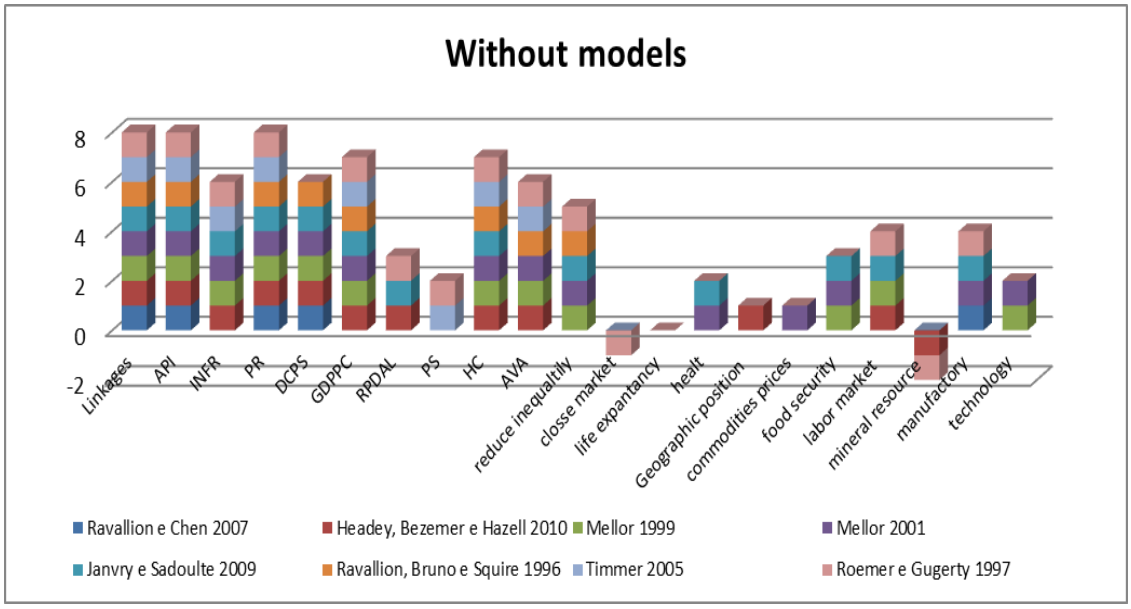
With the following two graphs, we are trying to summarise an immense quantities of ideas, referring to different situations, hence when one author talk about civil violence, other one in civil war or good democratic governments. We synthesized in the term “political stability” (PS), and so on (chart 6.1 and 6.2).

Chart 6.1: Authors with models



Source; author

Chart 6.2: Authors without models



Source; author

Even though we agree with the authors about the main tools that help the poverty reduction in rural areas, these instruments do not have the same performances in SSA – 9 as in the rest of the world. We added NPKL elements and we did previous test with fixed-effects and pooled OLS econometric models, and unfortunately was confirmed the researcher concern that agricultural linkages are not working in SSA. See results in the following paragraphs and variable list and abbreviations in the appendix 1. (block 1, 2, 4, and 4)

The idea, here, is to reproduce the metothodoly used by previous authors but using other data and different countries (Anderson 2009, Lipton and Ravallion 1995, Quibria 2002, Ravallion and Jalan 1998, Deininger and Okidi 2002 and Thirtle Lin and Piesse 2002) since we have applied these models to the SSA – 9.

First of all we have found a the negative relationship between HC e poverty reduction like previous author, World Bank 1998 and Easterly et al 2001.

In this part of the research we have used panel data since this methodology is the most useful given our data contraint, and since previous authors did the same; so we only tried to replicate the same approach using different data.

Table 6.2: Model test one using fixed-effects

Model Test 1 : Fixed-effects, using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: RPL					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
PR	-118.163	0.436484	-27.072	0.00774	***
PS	-0.254944	0.200577	-12.711	0.20607	
HCPRI	0.223263	0.0601518	37.117	0.00031	***
NPKL	-0.0332673	0.0429618	-0.7743	0.44019	
DCPS	0.0665262	0.0825942	0.8055	0.42208	
AVA	0.208835	0.124598	16.761	0.09622	*
GDPPC	-0.0537526	0.0102871	-52.253	<0.00001	***
API	-0.0688431	0.0693613	-0.9925	0.32286	
INFR	-0.293035	0.153225	-19.124	0.05811	*
RPDAL	0.0359981	0.0245772	14.647	0.14551	
R-squared				0.861056	
Adjusted R-squared				0.841049	

Table 6.3: Model test two using pooled OLS

Model test 2: Pooled OLS, using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: RPL					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
HCPRI	0.173258	0.0628876	27.550	0.00669	***
PS	0.600301	0.298125	20.136	0.04607	**
PR	-379.662	0.448878	-84.580	<0.00001	***
NPKL	0.223887	0.0465766	48.069	<0.00001	***
DCPS	0.132324	0.107436	12.317	0.22025	
AVA	-0.151522	0.153342	-0.9881	0.32488	
GDPPC	-0.0341378	0.01122	-30.426	0.00283	***
API	0.142735	0.0742017	19.236	0.05654	*
RPDAL	0.0451603	0.017203	26.251	0.00968	***
INFR	0.105129	0.143628	0.7319	0.46549	

Classics spill-overs have inverse relation that traditional effects, for example when human capital (HC) or domestic credit to private sector (DCPS) increase the rural poverty line grows also.

6.2 Towards a new model

Building up a model that answer how the agricultural gears in SSA – 9 were moving between 1990 and 2005, as well as assessing how the agricultural growth can reduce rural poverty, was very challenging. As we know, in the last 50 years the agricultural environment in SSA showed inability to build the linkages between farms and non-farming business in rural areas.

In the age of pre-colonial civilization between 1500 and 1799, among the four biggest areas or continents, SSA was the only area that did not have a food chain based on a type of crops. In the Americas had with based the maize. The Incas, Mayans and Aztecs developed your societies around the maize crops, the Mexican tortilla come from the Aztecs culture.

European and Mediterranean areas chose wheat as food base and the East Asia had chosen rice, Adam Smith wrote (The Wealth of Nations 1776), that China was more developed and had a bigger population than Europe because they had chosen rice

instead of wheat as food base, as rice crops was possible to have two harvests per year while wheat did not. All these crops are, nowadays, so called commodities.

Clark (1961) showed that, in Africa, only Mediterranean areas and the Nile zone had agriculture in 1300; after that, the agricultural techniques were spread well in Horn area – Ethiopia – but in west, central, east and south SSA areas the majority of people were living on hunting, fishing and extractives techniques mainly with roots and vegetables. In 2005 the roots crops as taro, yams, sweet potatoes and cassava, were used around 35 million hectares in SSA and the second type of crops was the maize with around 27 million hectares.

This agricultural rapport with so called non-tradable goods surely affects one agricultural country's development. De Melo and Robinson (1989) showed that Computable General Equilibrium (CGE) has a mismatch of results in SSA for many reasons, but, among the main problems, they indicated the following: domestically produced and imported goods are imperfect substitutes, domestically produced goods sold on the domestic market are imperfect substitutes for good sold on the export market.

Also they pointed out that aggregate production is virtually fixed and there is a balance of trade constraint, mainly for politics acts. Hence, it is transparent that there is not stimulus for farmers to increase productivity with non-tradable goods; furthermore, political implications have locked the so called "agricultural linkages".

Agricultural linkages are the economic relations between farmers and non-farmers businesses in rural areas, basically they are the services sectors such as the supply of manpower and sale of goods.

This happens because SSA countries have some asymmetric markets, and these do not allow development to follow like free market, again the SSA – 9 agriculture environments are suffering from non-tradable goods and cultural phenomena. So the traditional model cannot explain this picture, so, to resolve this conundrum, we were looking for a model that gives details about agriculture mechanisms and indicates a solution.

It is widespread accepted and relativity easy to list these factors; in this research we suggested that agricultural development should start from the farmer and all factors that he can manage were called "dependent factors" or "endogenous factors" they are:

education level so called human capital (HC), maintenance of the arable land and the efficiency of the crops.

The “independent” or “exogenous” factors, which have strong relation with endogenous factors, are: Political stability, land tenure system, macroeconomic policies, infrastructure and rural population density. Thus, a country which has an optimal combination between endogenous and exogenous factors reduced the poverty with a higher efficiency than others which have a shortage of such good combination.

Hence, we built a model that considers economic facts and also human behavior. It is clear that all the elements influence each other, so to understand this impact we used a system of recursive rather than simultaneous equations; a recursive model is a special case of an equation system where the endogenous variables are determined one at a time in sequence (Ducan and Berry 2010, Brito and Pearl 2002 and 2006, Chisholm 1990, Cooper 1972, Fox 2012, Kline 1970 and 2004, Liu 2004, Pearl 2012, Richardson 2008, Strotz and Wold 1960, Tenehaus 2009, Westland 2010).

In others words, the left-hand side of the equation for the first endogenous variable includes no endogenous variables, only exogenous variables; the second endogenous variable includes exogenous variables and the first endogenous variable, the third endogenous variable includes exogenous variable the second endogenous variable, and so on, block by block. But the last endogenous variable influence the first block (figure 6.1).

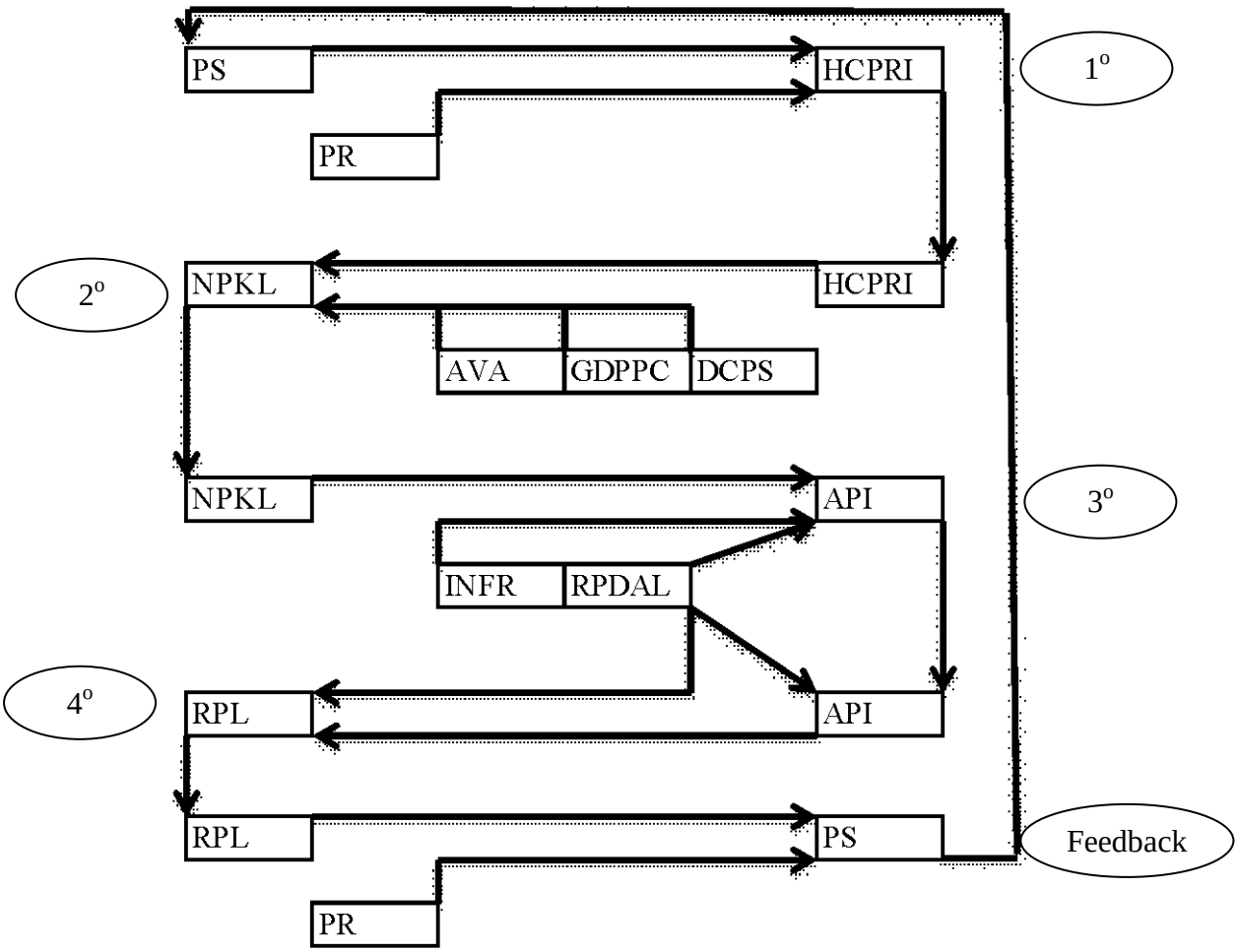
First block; the land property right (PR) and political stability (PS) influence human capital at primary school (HCPRI).

Second block; the HCPRI, the percentile of agricultural value added of GDP (AVA), GDP per capita income (GDPPC) and the percentage of domestic credit to the private sector of GDP (DCPS) influence the soil loss of nitrogen, phosphorus and potassium elements (NPKL).

Third block; the NPKL, the rural population density by arable land (RPDAL) and the infrastructure index (INFR) influence the Agricultural gross per capita production index (API)

Fourth block, the API, RPDAL and PR influence the rural poverty line (RPL), similarly RPL and PR influenced the PS in first block doing a feedback loop.

Figure 6.1: Econometric model proposal



6.3 The first block: Assessing human capital (HC)

We assumed that HC is narrowly influenced by political stability and land tenure system.

The relationship between educational and economic system is very strong, in the economy the educational and cultural qualities obtained will transform economical values. World Bank (1998) proved it in empirical work about the world education and socioeconomic development, from 1960 to 1996. However this relationship is not working well in SSA countries. The GDP per capita of SSA had a negative growth -6.5 and the percentile of primary enrollment grew 87 percent among 1960 – 1996.

On the other hand, the GDP per capita of the world grew 36 percent and the percentile of primary enrollment 19 percent. The world had a positive correlation and the SSA a negative correlation (figure 6.2).

Figure 6.2: World Bank; education growth and GDP growth

World Education and Socioeconomic Development, 1960–1996

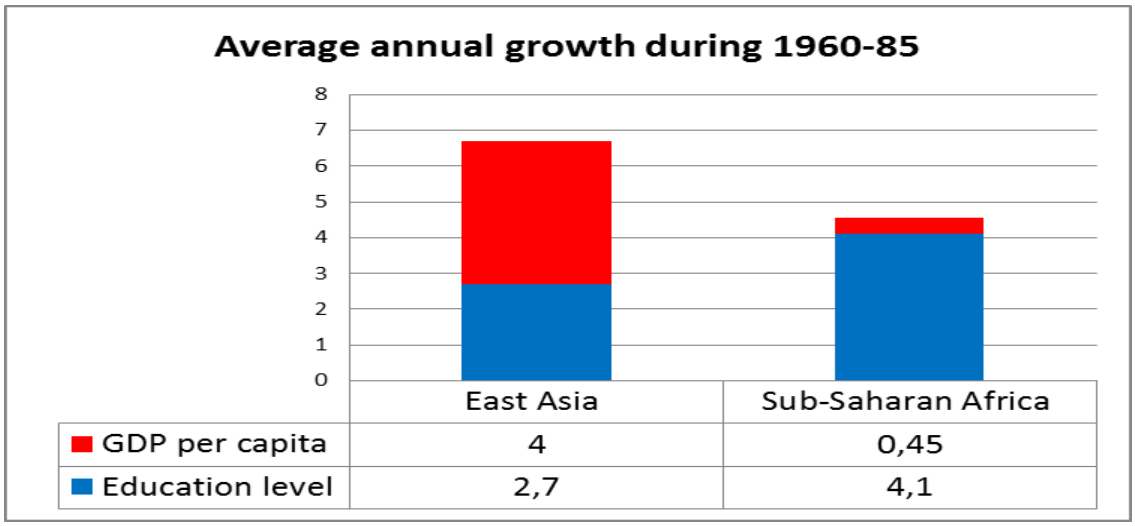
Region	Year	% Primary Enroll-ment	% Secondary Enroll-ment	Level of Indust-rialization	Level of Urban-ization	% with Radio	GNP per Capita (Constant 1987 US $)	Infant Mortality	Life Expec-tancy	Population Growth Rate	Total Fertility Rate
World											
	1960	86	27	39	33	.	.	.	.	.	.
	1970	83	31	45	37	9	$2,574	98	58.7	.	4.8
	1980	97	49	48	39	29	$3,037	80	62.7	1.7	3.7
	1990	103	54	51	43	36	$3,374	61	65.5	1.7	3.1
	1996	.	.	.	46	.	$3,502	54	66.7	1.4	2.8
Sub-Saharan Africa											
	1960	39	4	18	15	.	.	.	.	.	.
	1970	50	7	21	19	4	$508	137	44.2	2.7	6.6
	1980	78	14	28	23	9	$556	115	47.6	3.1	6.6
	1990	73	22	32	28	16	$488	100	50.7	2.9	6.0
	1996	.	.	.	32	.	$475	91	52.2	2.8	5.6
South Asia											
	1960	56	18	25	17	.	.	.	.	.	.
	1970	67	25	29	19	2	$233	139	48.8	2.4	6.0
	1980	76	27	31	22	4	$250	120	53.8	2.4	5.3
	1990	91	39	36	25	8	$348	89	59.2	2.2	4.0
	1996	.	.	.	27	.	$419	73	62.1	1.8	3.4
Middle East and North Africa											
	1960	54	12	41	33	.	.	.	.	.	.
	1970	68	24	50	41	11	.	134	52.8	2.7	6.8
	1980	87	42	53	48	17	$2,653	96	58.5	3.2	6.1
	1990	97	57	65	54	26	$2,016	61	64.5	2.8	4.9
	1996	.	.	.	57	.	.	50	67.0	1.9	4.0
East Asia and Pacific											
	1960	101	19	18	17	.	.	.	.	.	.
	1970	88	24	24	19	1	$147	79	59.2	2.7	5.8
	1980	111	43	28	21	7	$225	56	64.5	1.5	3.1
	1990	122	47	31	28	17	$391	42	67.3	1.6	2.4
	1996	.	69	.	32	.	$636	39	68.2	1.2	2.2
Latin America and Caribbean											
	1960	89	15	52	49	.	.	.	.	.	.
	1970	.	28	59	57	13	$1,396	84	60.6	2.6	5.2
	1980	106	42	66	65	26	$1,867	59	64.8	2.2	4.1
	1990	106	48	74	71	35	$1,675	42	68.1	1.9	3.2
	1996	.	.	.	74	.	$1,877	33	69.5	1.6	2.8
Europe and Central Asia											
	1960	.	.	54	45	.	.	.	.	.	.
	1970	.	.	67	52	.	.	.	.	.	2.6
	1980	97	84	73	58	.	$1,865	41	67.8	1.0	2.5
	1990	98	85	77	63	.	$2,154	27	69.3	0.7	2.3
	1996	.	.	.	66	.	$1,548	24	68.3	0.1	1.8
North America#											
	1960	113	66	90	69	.	.	27	.	.	3.7
	1970	101*	65*	94	75	.	$12,084	19	71.6	1.3	2.4
	1980	99	90	95	75	136	$15,079	12	74.2	1.1	1.8
	1990	103	97	97	76	155	$17,543	8	76.2	1.3	2.0
	1996	.	.	.	77	.	$18,265	7	77.9	1.0	1.9

Source World Bank (1998) World Development Indicator

Easterly et al (2001) show the other discouraging data, the growth in educational capital and economic growth, in East Asia and Sub-Saharan Africa, between 1960 – 1985. East Asia grew 1,48 percent of GDP per capita per 1 percent of educational capital growth

and SSA increased only 0,11 percent of GDP per capita per 1 percent of education capital growth between 1960 and 1985 in Easterly research (chart 6.3).

Chart 6.3: Average of annual growth during 1960 – 85



Source: Pritchett (1996), adapted from Easterly et al (2001).

Using the same methodology with World Bank data we found that East Asia showed a growth of 1,89 percent of income GDP per capita per only 1 percent of primary enrollment in the world.

First of all, African countries have a short independence history, except for Ethiopia, which has been free since the biblical time and Liberia from 1847; all another countries won the independence after second war: the first one was Egypt in 1951 and last one was Eritrea in 1993.

Around half of SSA countries achieved independence in the period 1960 – 1970, thus talking about GDP growth during an "independence war" is just gossip. In this period countries had a great social and political instability. Furthermore the macroeconomic condition drained down all economic sectors and depletes an entire country.

Unfortunately, the period between 1970 and 1995 was not peaceful, Ndulu (2008), demonstrated that there were 25 civil wars in SSA. These wars happened for different reasons and had distinct durations, between 1 and 25 years.

Thereby, we not agree that SSA has a different rapport between HC and development; of course, the relationship between education and development is not as simple as it appears to be, but it exists, education is considered as a social instrument for developing human resources and for human capital formation. People having reasonable literacy

and numeracy skills tend to produce more farm crops, have limited number of children and enjoy a relatively better quality of life as compared with uneducated families.

Although this is partly a season, why SSA countries had a different behaviour from the rest of the world in the past, we assumption that social and political instability were the roots of the problem throughout the years after independence. These countries lost HC with horrendous genocides or with successive migrations.

Psacharopoulos (1994), showed how difficult "HC stocks" mensuration, in a country, because people who improve their education level have more propensity to immigrate whether a country does not offer a well-off environment.

So it is, people invest in your education if they believe in a future, and when the formative path finishes they expect a good socio-economic environment to enjoy this investment. If the country has strong socio or political instability, people will invest less in education or will go away. In both cases the country loses the HC.

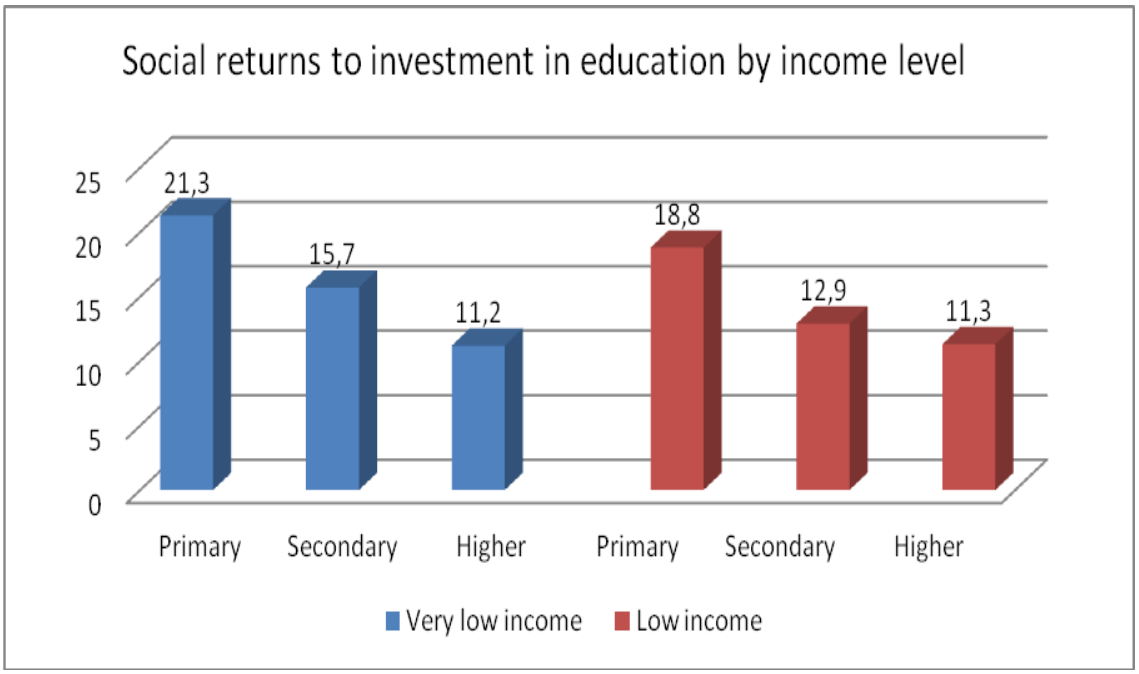
However, after 1990s this situation has been changing. In SSA countries, conflicts have decreased and the positive bond between education level, economic growth and per capita GDP income has been established. Moreover the education level has improved much faster after 1990 than in the past.

Our database measured years of school attainment, but we did not consider the quality of education, this research measured the local level of HC stocks. Albeit, each education system is only a continuation of family education and has the tendency to preserve the local values and the local culture. We would be important, in future works, to acknowledge the role of education quality.

Psacharopoulos and Patrinos (2004) confirmed that the improvement of the education level has benefices and great returns to investment, mainly in low and very low income countries. This return occurs at a social level and with the so called “private returns” one’s own reward is better than social returns (charts 6.4 and 6.5).

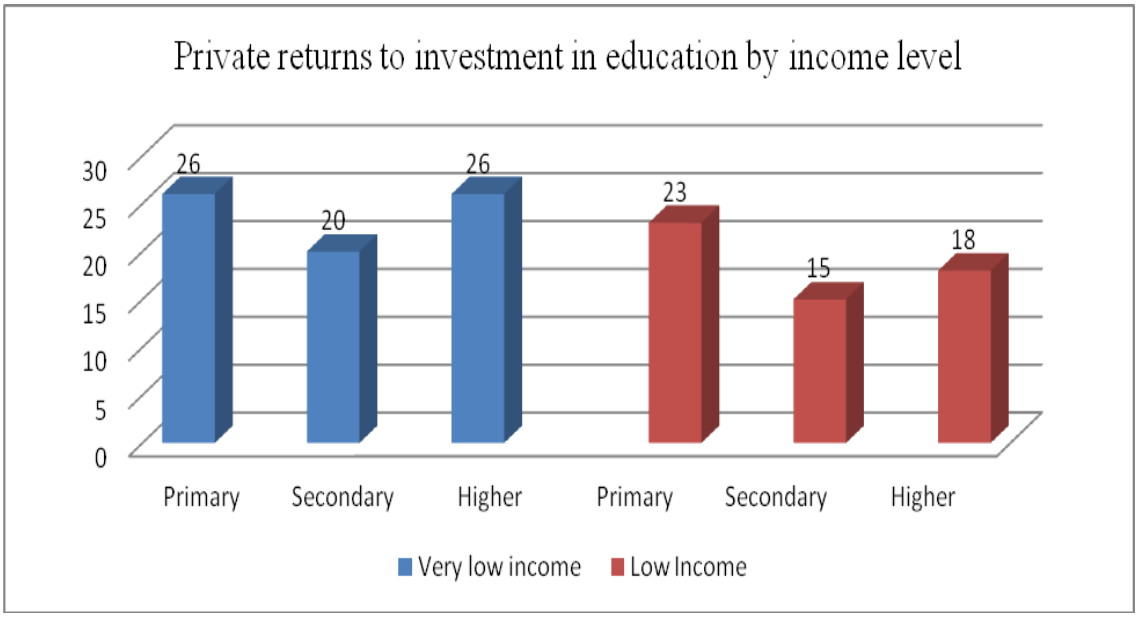
Our sample has a per capita income lower than USD 1000, and it fits the very low income countries category. Thus, the social returns to investment in education represent 2,2 percent of investment per year in higher level, 2,24 percent in secondary level and 4,26 percent at primary level.

Chart 6.4: Education social returns



Source Psacharopoulos and Patrinos (2004)

Chart 6.5: Education private returns



Source Psacharopoulos and Patrinos (2004)

The private returns are better than social returns. The own income growth is around 5,2 percent of investment per year in higher level, 2,85 percent in secondary level and 5,2 percent in primary level.

The rural environment has numerous problems to improve education level, typically rural areas have poor infrastructure, low government investments and logistical situation that forces pupils to move across the large distances to reach the nearest school.

However, if the agricultural areas have more problems to improve the education level, farmers have great benefices in agriculture output per year of primary school. Many authors researched many countries in SSA and all countries had a positive relation between education level and agricultural production (table 6.4).

Table 6.4: Education and agricultural output

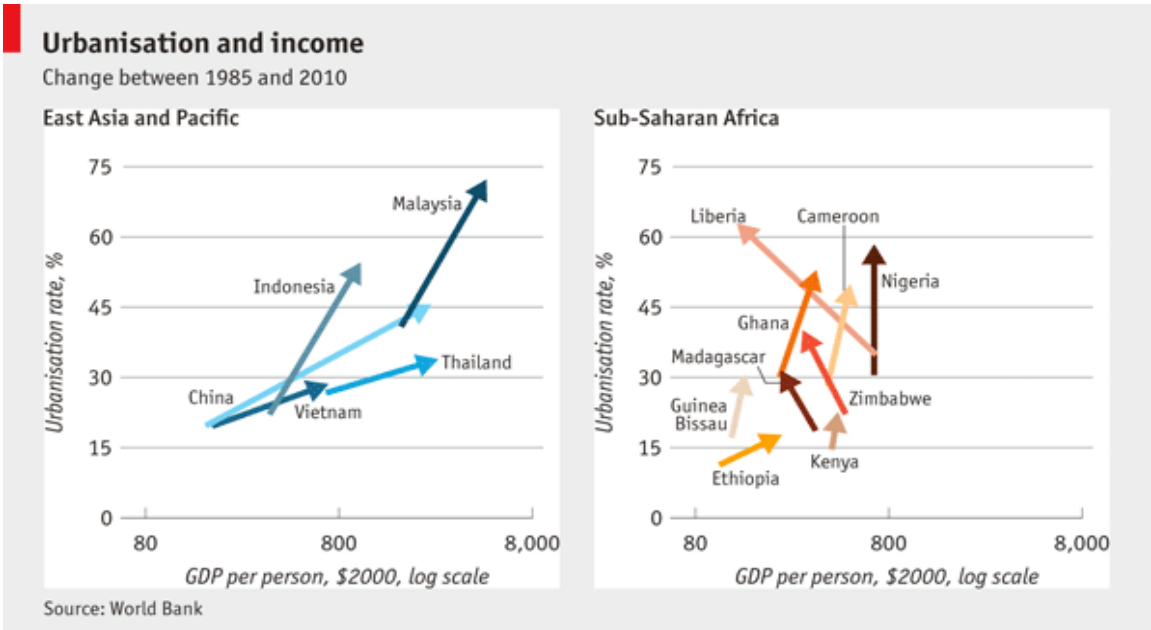
Area and Study	% increased in agricultural output for 4 years of primary schooling
Kenya (Bigsten 1984)	20
U. R. Tanzania (Collier, Radwan and Wangwe 1986)	19
Uganda (Bigsten and Kayizzi-Mugerwa 1995)	12
Uganda (Appleton and Balihuta 1996)	7
Zimbabwe (Owens and Hoddinott 1999)	2
Ethiopia (Weir 1999)	20

Source; by author

Consequently the HC, in rural areas, is led by farmer behaviours, because in a short or medium term it is unimaginably to see SSA governments make huge educational investments in rural areas. The agenda of SSA governments should include rebalancing the current account of country, improve macroeconomics data and enhancing urban infrastructure to avoid the chaos like in Lagos (Nigeria), Kinshasa (Congo Democratic Republic) or Khartoum (Sudan) cities.

The Economist on line (October 2012) showed that this chaos has happened in many SSA countries, they started the urbanization process but saw the slums increasing and the GDP income did not grow between 1985 and 2010. The lack of urban infrastructure created a type of “urbanization trap” in SSA countries; on the other hand, Asian countries that had done investments, solved this problem (figure 6.3).

Figure 6.3: Urbanization and income



Source; The economist on line

If African countries do urban investments, they will surpass the "urbanization trap" like Asian countries and will attract new international investments. However, the education scenario in rural areas will be caused by the same problem, an inadequate infrastructure, so, to improve HC, farmers must go toward an education level improvement.

As we saw in the past and as have happened nowadays, farmers behaviours are moving by the theory of behaviourism (Skinner, Maslow). The behaviourist theories by Skinner say that people respond to their environment – people encounters a stimulus and this stimulus has an effect – but they also operate on the environment to produce certain consequences. Hence they contribute to a kind of "feedback loop" which influence a larger system that impacts itself.

Maslow made one schema, the so called "the Hierarchy of Needs"; according to this theory, people, in the two first steps, need to feel safe and secure in a world with basic needs like, food and water in the first step, and to feel secure to make the next step. After it people begin to seek out friendships and education.

So, to overcome the "paradigm of stability", SSA governments should give SSA farmers the most important stimulus, that should make them feel safe and secure. Thereunto they should improve political stability and give the right to have a land or land tenure.

Political stability database in SSA 9 was taken from Center for Systemic Peace/Integrated Network for Social Conflict Research. This center created a task force that represents several of the US leading research institutions as Arizona State, Columbia, George Mason, Harvard, Maryland, Minnesota, Stanford and Texas universities.

It has a panel with the "political regime" characteristics and transitions among 1800 and 2010, cross-national, time series and polity-case formats in all independent countries with a total population greater than 500.000 people[13].

Land Tenure database in SSA 9, it was taken from International Property Rights Index (IPRI). It was built by World Bank Doing Business and World Economic Forum database. We picked up variables of "Physical Property Rights[14]", the protection of physical property rights and registering property that have a relation with property rights, because there does not exist a specific land tenure index in western institution. As a result, this index could not be perfect, but we analysed that is the best option to rank property rights in SSA – 9.

Our endogenous factor is HC, usually education can aggregate average income levels for all population, but normally the inequality grew the first time and was subsequently reduced, at the second moment, showing the mechanism of the original Kuznets curve (1955), which depicts the inequality dynamics along with growth by an inverted U-shaped, show up.

However, equality and poverty differ from each other, although inequality grows with improved education levels, all these population quintile groups are benefited. Empirical works brought up that the top one increased in terms of sources accumulation and productivity, while the last one grew thanks to new opportunities of occupation and labour (Barro and Lee 1993).

[13] See methodology on the site http://www.systemicpeace.org/

[14] See methodology on the site http://www.internationalpropertyrightsindex.org/data

Our proposal was to find out tools, or so called "inner factors", that take people from rural areas away from extreme poverty conditions. Albeit all education levels compose the so called HC, for our sample we used only primary school level for three clear motivations.

Firstly, many authors endorse the idea that the fourth years of primary schooling increase farmer incomes more than seven years of secondary schooling and high education has the same percentile of income increase as primary school. Also if SSA farmers' income rises more than 21 per cent the majority of them will leave the poverty line.

Secondly, we used Barro and Lee methodology, which need data about adult population which have primary education 15 years earlier than the first year of time series, to calculate all levels of HC. Our first year is 1990, thus we need 1975 data, but many countries of the sample did not have data in this period, because in these years we had the "stability paradigm".

Finally, the gross enrolment ratio of the secondary and tertiary level in SSA represented, in 2005, 31 and 5 per cent respectively, and the percentile of all the population on secondary and tertiary level was around 11 and 0.9 per cent (World Bank). So the impact of the removal of these people did not change much overall data because are small dimension were small and usually these people worked in the city or had immigrated.

The gross enrolment ration relates to the total number of students at a given level the population of the age group that, according to national regulation or custom, would be enrolled at that level.

The data set on educational attainment was supplied by UNESCO database and we used Barro and Lee[15] methodology, but we considered only HC stocks by primary school or HCPRI.

$$HCPRI \equiv H_{1t}/L_t$$

$$H_{1t} = H_{1t-5}*(1-\S_t)+L18_t*(1-PRI_{t-5}) \quad (1)$$

$$\S t \approx (L_{18t}+L_{t-5}-L_t)/L_{t-5} \quad (2)$$

$$H_{1t} \equiv H_{1t}/L_t=[1-(L18_t/L_t]*H_{1t-5}+(L18_t/L_t)*(1-PRI_{t-5}) \quad (3)$$

[15] See Barro and Lee 1993 International Comparisons of Educational Attainment

Where: HCPRI be result the quantity of H_1 people that has primary school dived by L quantity of adult people or labour age (more than 18 years old).

H_{1t-5} be the number of people within this adult population who have primary school

L18 be the population aged between 12 and 17 years old

PRI be the enrolment in primary school divided by total population aged between 6 – 11 years old

$§_t$ be the proportion of people aged 18 and over in year t-5 who did not survive to year t

Table 6.5: First block using fixed-effects

Step 1: Fixed-effects, using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: HCPRI					
	Coefficient	Std. Error	t-ratio	p-value	
PS	0.846789	0.302591	27.985	0.00590	***
PR	180.248	0.530459	33.980	0.00090	***
R-squared			0.663631		
Adjusted R-squared			0.638340		

Table 6.6: First block using random-effects

Step 1: Random-effects (GLS), using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: HCPRI					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
PS	0.862188	0.297191	29.011	0.00432	***
PR	176.206	0.519291	33.932	0.00090	***

6.4 The second block: assessing soil quality

We assumed that the NPKL is narrowly influenced by HCPRI, the agriculture value added (% of GDP), GDP per capita income, human capital and Domestic credit to private sector (% of GDP).

To start up, agriculture needs basic conditions: soil, water and human intervention, but, to develop, it needs the improvement deriving from the use of the main natural assets; the soil should offer more productivity through good management practices and water supply, if necessary, should be regulated by irrigations or drainages.

The so called “agricultural revolution” had the flash point around 10.000 BC in Middle Eastern Sumerian regions – between Iran and the coast of the Mediterranean –; this revolution changed human history: before mankind was of small mobile groups of hunters/fishermen; after it, our society was turned into sedentary societies based in villages and this modified radically all the natural environment. The techniques of domestication of plants were widespread around the world and the optimized during the "bronze age", that allowed new techniques to make new tools.

All it happened because the natural resources had been available, and man knew how to manage these resources. Nowadays the increasing population has pressured and increased demands for foods; moreover, they have threatened agricultural systems with land occupation. Between 1960 and 1990 the growth of productivity helped western countries to resolve this problem. But now the rising purchasing power of the so called “emerging markets” has changed the scenario.

Latin America, South and Southeast Asian have put millions of people in the consumer market every year. These people, who lived in extreme poverty before, can now eat every day, have immigrated to cities, also demanding another consumer goods like houses, thus putting in check the arable land around the cities. Perhaps for the first time in the history the sustainable management of the land sources is more import than the supply of land for development.

The cities were born from small villages that had been built in the best soils for agriculture, while the marginal lands, usually with low performances in agriculture, now are the majority of places where the farmers can found stock of land and increase the quantity of arable land.

However these areas need more inputs to maintain the productivity and the quality; only with these cares the marginal lands be useful in the present and perennial.

Nevertheless, all inputs have costs and, consequently, this increases the food prices or reduces the farmer's profit; also the capability of farmers of doing investments depends on the economic environment, in other words European's farmers have more opportunities than African's farmers in this case. Eurostat show that the farmers of EU's 27 had an average consumption of 76 kilograms of nutrients per hectare in 2005, on the other hand FAO demonstrated that African's farmers had a consumption average 12 kilograms per hectare.

We have to add that, among SSA countries, there exist differences of economic environment, thus the low income countries have a smaller consumption of inputs than the others African countries with a median income. Our sample, the SSA's – 9 farmers, have averagely consumed a third of the average SSA countries, with a mean of a modest 4 kilograms per hectare in 2005 (FAOstat).

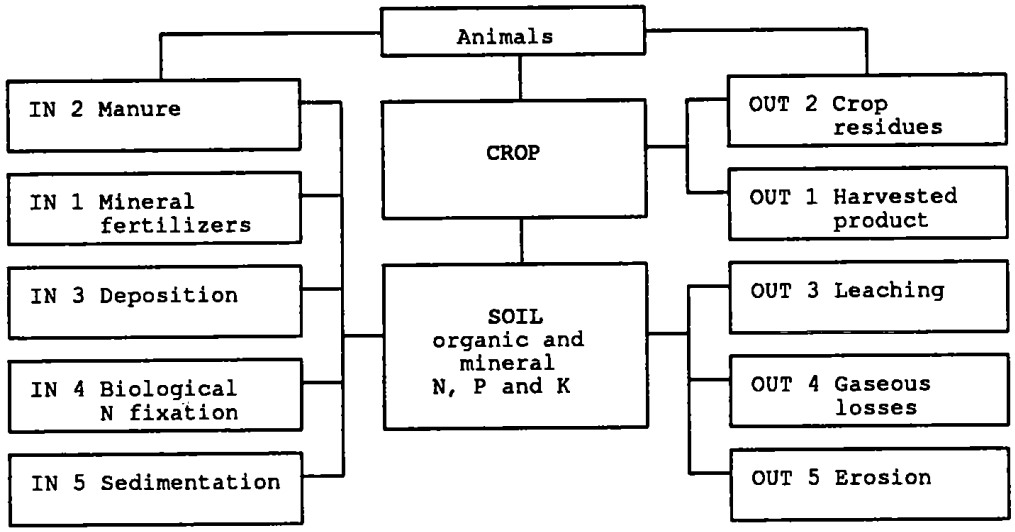
Of course, low levels of inputs affect straight the crops yield, but, more importantly, they jeopardize the future agriculture of these regions, because they create a vicious circle. The yield gap reduces farmer's profit, hence the following year he will have fewer financial resources to invest and the lack of soil nutrient balance will lead to a deterioration of soil quality, thus reducing productivity, increased erosion processes and provoking a reduction of the arable land.

Thereby, knowing the amount of inputs needed is the milestone of the process. Thereunto it is fundamental to identify the quality of the soil to measure the investments. Ones of the first classifications of the African soil was made by Peterson (1987), who created one index. This index put on the table the quality and costs of lands around the world and compared it with the US soils and prices.

Even though it was useful, the index did not provide a thorough picture of the agricultural situation: soil quality is dynamic and it is continuously changing, because the weather and agronomic activities have been influencing it all the time. In 1990 Smaling and Stoorvogel developed the "nutrient-budget" and "nutrient-balance" models, that to rely on a series of assumptions in order to deal with the complex nutrient systems.

Basically the models or the so called “black box” account for the foremost macronutrients, nitrogen (N), phosphorus (P) and potassium (K) of the soil [16] . With five major inputs process of nutrients – IN 1 to 5 – and five principal outputs processes of nutrients – OUT 1 to 5 – were identified below (figure 6.4).

Figure 6.4: NPK “black box”



Smaling and Stoorvogel (1990) pg 17

Despite the Smaling and Stoorvogel methodology is widespread accepted (Cobo et al 2010, Henao and Baanante 2006, Bindraban et al 2000, Pieri et al 1995 and FAO 2003), the principal criticism is about the soil data base. As pivotal phase they used the "Land Use Systems" (LUS) and the "Land Use Type" (LUT) data base (FAO 1976). These data bases are more homogeneous and consequently we can use the same forms to calculation the nutrient balance, but they created problems when they were used for small land (micro level), because they are general data.

Many institutions have been trying to resolve this problem: the Canadian government has the Canadian Soil Quality guidelines that do not only calculate NPK, but also do the calculations of soil contaminations and are very precisions for Canadian area, these tools are available online www.ccme.ca .

The United States Department of Agriculture (USDA) has two softwares with two methodologies that can be used to identify soil quality in US: The CQESTR model and RUSLE model.

[16] See Smaling and Stoorvogel 1990

The CQESTR's model was applied on Brazil's tropical soils in 2009, but without good results. The model's simulations in general underestimated soil organic carbon (SOC), they made mistakes when they did the conversion from native forest to croplands. The SOC showed a mismatch with the empirical results, thus is needed to evaluate the CQESTR model's performance in tropical soils (Leite et al 2009).

The RUSLE's model was applied in the south west of India in partnership with the University of Cambridge. Both institutions made RUSLE2, this upgrade allowed the software to be more useful in tropical areas. Pal and Al-Tabbaa (2009) confirmed that they had picked up good results and the software can be an alternative to local equations.

However, this research was looking for macro levels or national data, moreover we did not wish to develop a new software, hence we assumptions that the Smaling and Stoorvogel methodology is the best model to understand which path the SSA – 9 areas are following.

We believe the soil nutrient balance is the result, of the stress that the men cause to the rural environment; these outcomes can be good or bad. The use of fertilizers in the EU 27 produces a good yield and pollutes the environment, while, without fertilizers in SSA – 9, they have a terrible productivity and the arable lands have risk to shrink.

In this case excess or loss the NPK in the soil is the consequence of the acts of farmers. In this step we looked at farmers' behaviors and the society that they live in. To comprehend a society, all economists first of all look for macroeconomics data: with these data it is possible to do forecasts about the economic paths of the country.

Here, fatefully, we confronted with the same problem; when you talk about African countries, there is a lack or mismatch of information about, for instance, inflation, employment and public investment. All these facts are "drivers" of social and economic movability.

To resolve this problem, we were picked up economics mobility to make up the lack of information, in others words, the agriculture value added in percentile of GDP (AVA). We considered that SSA's – 9 economy should follow the same trend of developed and emerging countries. As agriculture develops, it creates potentials for all country develops. Thus, the services and industrial sectors can gain space in their GDP and the percentile of agriculture value should decrease.

The rural areas in SSA – 9 historically have been losing NPK (NPKL), so the both facts, the agricultural development and NPKL, must have the inverse relation. While the NPK is negative agribusiness cannot develop well, and, as result economic movability cannot happen. On the other hand the percentile move of GDP means that macroeconomics data are improving and will influence farmer's deeds that will reduce NPKL.

Another fact that shows an inverse relation is the GDP per capita income (GDPPC); this is not a surprises for three reasons: Firstly, all SSA – 9 countries have a low per capita income, and the farmers use elementary agricultural techniques, like intensive labour forces; moreover they have poor infrastructure, that create difficulties to carry out national or international trades, hence they depend the local market. Therefore the rise of income does not mean that the consumer market is improving: Usually in low income countries the consumer market is enlarged by demographic expansion.

Secondly, in SSA – 9, the farmer behaviour does not follow the western logic, some indigenous attitudes lead to an inverse relation between income and productivity, Dormon et al. (2004) showed that the "high cost of hired labour" associate with good cocoa price resulted in low productivity, because with this scenario the farmers preferred to use their families than hire labour to do cocoa harvesting, but they harvested only the necessary to pay the bills, they did cover all the cocoa fruits seasons.

The last issue, which is less complex and easier to deal with is the "dualism" economic theory, that does not work for SSA – 9; when the cost of labour force rises, farmers should invest in technology to use less workforce and rise the yield, but the farmer's investment to increase productivity are very few or do not exist in SSA – 9.

We believe that low income countries have the same dilemma as median income countries; structural problems do not allow median income countries to turn into developed countries, the so called "middle income trap". The low income countries paradigms are mainly education level (HC) and credit systems.

With more education farmers can perform better analyses of the market and find out solutions and opportunities, however without credit systems, many opportunities will be lost and the agricultural sector will have a low potential growth.

Whether AVA and per capita income have an inverse relation with NPKL, the HCPRI and domestic credit to private sector (DCPS) have a positive relation. The education level used in this step is the same methodology as the previous step.

We selected DCPS data from World Bank data bases, but unfortunately in these countries the rural credit does not have the same performances as the domestic credit to private sector in general. Frequently the agriculture credit represents a third of the performances. In others words, when the DCPS reaches 10 percent of GDP, the rural credit attains around 3 percent of agricultural GDP.

However we were not sure whether to use this percentage, because, despite the extreme relevance of the issue, only IFAD reports have scarce data about rural credit, and using their information only we cannot build a time series data about rural credit. As a result, we maintained the reason about credit system but used the domestic credit of all the private sector, the so called DCPS (World Bank data).

As to the agricultural value added in percentile of GDP (AVA), and GDP per capita income (GDPPC) we used the World Bank data base, while for the human capital (HC) we used the UNESCO data base.

Finally, for the NPKL data was used the Smaling and Stoorvogel (1990) data for 1983 and 2000, Henao and Baanante (2006) for 1995 and 2002 data. With "Smaling and Stoorvogel methodology" and FAOstat data, we created the NPKL 2009. So we did a trend of NPKL among 1990 and 2005 in SSA – 9 through a median.

Table 6.7: Second block using fixed-effects

Step 2: Fixed-effects, using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: NPKL					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
AVA	-0.797613	0.215273	-37.051	0.00031	***
GDPPC	-0.0384806	0.020262	-18.992	0.05974	*
HCPRI	0.176736	0.0969932	18.222	0.07071	*
DCPS	0.257647	0.172765	14.913	0.13828	
R-squared				0.874346	
Adjusted R-squared				0.862835	

Table 6.8: Second block using random-effects

Step 2: Random-effects (GLS), using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: NPKL					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
AVA	-0.891581	0.219317	-40.653	0.00008	***
GDPPC	-0.0283659	0.020019	-14.170	0.15873	
HCPRI	0.152849	0.0990776	15.427	0.12517	
DCPS	0.261412	0.174767	14.958	0.13698	

6.5 The third block: assessing agricultural productivity

We assumed that the agricultural productivity (API) is narrowly influenced by NPKL, rural population density by arable land (RPDAL), roads density and rail lines density (INFR).

Farms were the first firms in the history of humankind, man managed inputs as soil, water and knowledge and they obtained output like foods and feeds. This fact changed behaviours and it was possible to build the civilization that we know. Producing foods for the whole village meant autonomy and chances the progress.

Thereby ensuring a minimal amount food for everybody, despite the demographic growth, was the main goal of each village, region or kingdom. The consumption per capita of calories in the first years of new human civilizations are inaccurate, historians talk of an intake between one thousand and 1500 caloric per day. But after industrial revolution the consumption per capita grew in Europe and decreased in Asia and remained stable others regions until 1900.

Currently we can see that each region in the world has different approach about calorie consumption, because each region has a different degree of development and the agricultural sector has a different weight and function in their economies. Nowadays these regions are divided by international institutions into: developed countries, Latin America, south and central Asia, East and south East Asia, Middle East and North Africa and Sub-Saharan Africa.

Consumption of caloric in SSA countries rose by 7,2 percent between 1990 and 2005 and they had an average consumption of 2100 calories per capita in 2005, but the SSA agricultural gross per capita production index (API) fell by 8,72 percent from 1990 to 2005 and increased the gap between consumption and production in SSA. In others words SSA was more dependences the food importation in 2005 than in 1990.

Moreover, the SSA – 9 has a similar trend of average consumption of daily calories, which rose from 1974 caloric per day in 1990 to 2137 caloric in 2005, on the other hand SSA – 9 API grew only by 3,95 percent, even though they had a performance which was a little better than SSA (FAOstat).

Differently of SSA, other regions in the world showed growth of the API indexes or it remained stable. In developed countries the index grew by 3 per cent – despite the EU 27 fell by 12% –, Latin America increased by 7,1 percent, south Asia was only 0,05 percent positive, middle east and north Africa surge by 27.23 percent and east and south east Asia the API rocketed by 32,59 percent, between 1990 and 2005.

In this research we are looking for evidences that agriculture can reduce rural poverty as well as what tools are more efficient to optimizes this relations. For this, the third step is crucial to check the agriculture firms prospective within SSA – 9 contexts, i.e. what the capability of farmers are to increase productivity inside low income countries.

As everybody knows productivity does not means profit; to bring up the return of investment we should do the cost function and to kwon of constant returns to scale and efficiency performing a TFP analysis is more appropriated, therefore farmers can find out the breakeven point for their investment.

Thereunto we need information that does not exist, so, despite our caution when choosing the sample, some information about SSA countries had to be based on assumption. We hypothesized that, when yield growth of corps occurs, that reduces costs and farmers will have more profit, then they will reduce their level of poverty.

Many other authors did the same reasoning, when the agricultural sector grows in low income countries reduces the poverty (Timmer 2005), (Lipton and Ravallion 1993), (Mellor 2001 and 1999), (Quibria 2002), (Roemer and Gugerty 1997), (Janvry and Sadoulet 2009), (Anderson 2009), (Headey et al 2010) and (Thirtle 2003). However, poverty reduction depends in part on the environment and the economy's poverty profile.

In others words, we can classify the "poverty profile" in urban and rural areas and sub-classify it in poverty – PPP 2005, income of USD 2.25 daily – and extreme poverty – PPP 2005, income of USD 1.25 per day –. So to be more exact each group must be calculated apart, because the needs of each one are according to the profile. This research puts its emphasis on the economic problem of extreme poverty in rural areas.

The environment in rural areas certainly helped or hindered the agricultural growth and poverty reduction; among many factors we can synthesize the agro-ecological zoning (AEZ), that included weather, soil, crops choose and management skills. Among the many output that AEZ has, NPKL data is the main measurable result. We added the rural population density of arable land and the infrastructure to complete the rural areas scenario.

The rural population density is one of the key factors, because agriculture's powerful poverty reducing effect in rural areas come substantially through the links between farmers and non-farm activities (Mellor 2001), hence poor countries with poor infrastructure and high rural density can have better linkages in regional level, which means that high population density is better than low population density to develop non-farm activities.

According to Mellor, the agricultural growth effect has two rounds: the first one mainly benefits farmers and in many cases it can concentrate the income, in spite of this collateral effect; the second round happens next, as the non-farming rural business, besides contributing to increase the rural population density, has welfare effects for all rural societies and poverty reduction is three time larger than during the first round.

Roemer and Gugerty (1997) emphasized the effect of rural density with some important research, supported by empirical results they said that large rural economies based on small scale farming, as in African and Asian countries, showed the different results in poverty reduction, because the countries with a high rural population density responded better than countries with a low rural population density.

In their opinion, the East Asian countries had a comparative advantage, to reduce the rural poverty, because, although their land is poorer than Africa's soil, the Asians had abundant labour force to supply services and goods for emerging agribusiness.

Headey et al (2010) put on the table not only the density of population but also the infrastructure system, they compared Latin American, Asian and African agricultural countries. Firstly, they confirmed that rural population density facilitated the startup of agriculture and accelerated the development of a rural non-farming economy, but these benefices turning into a problem when the countries had poor infrastructure.

Between 1960 and 2000, Nepal, India, Indonesia and Thailand had different performances in the rural poverty reduction and non-farm economy development, even though all countries had high rural population density. The rural infrastructures in Nepal and India stopped the rural development, while Indonesia and Thailand, which have better infrastructure than both previous countries, presented the good numbers.

To follow similar reasoning of the majority of authors, the first step was to determine what how exactly gauged the rural population density. Asian countries used practically all marginal lands to agriculture (Quibria 2002), albeit marginal land had a worsen yield than Asian countries on average.

On the other hand, African countries have exploited around a third of their agriculture area (FAO 2001); practically, only good quality soils were being used and the so called marginal land were not used. Furthermore, in our sample, we have countries like Mozambique and Zambia that have almost a third of their areas truly unsustainable for agriculture.

Consequently, we assumed that, if there were areas where it was possible to develop agriculture form the point of view of natural resources, and still it was not done, that was because infrastructure or the socio-economic environment did not allow to do it. Thereby these lands cannot contribute to API; on the other hand, the sites having so called “arable land” or were agricultural activities are possible are the only ones that can be part of the model.

Hence, we used the so called “rural population density of arable land” index (RPDAL) from the FAO data base. The RPDAL index was calculated, took all rural population and divided it by arable land used on base year

Identifying exactly the best combination between RPDAL and needs of infrastructure to support the agriculture development is a crucial point, but, once more, the absence of accurate data bases prevented us from doing a deeper analysis.

In an ordinary least squares test (OLS) only Zambia and Zimbabwe have a positive correlation between RPDAL and API implying that their infrastructure can support the rural population and their goods, nevertheless we know that, as the data superficial, we cannot to have deep results.

However, SSA – 9 has a narrow relation between API and RPDAL, as suggested by literature, but with negative effects, we therefore affirm, that despite the SSA's demographic windows, that it will has until 2050, their agriculture won't develop without investments in infrastructure. The most important investments, would be logistic system as roads, rail lines and ports.

Notwithstanding their importance, between 1990 and 2005 international institutions practically did not assess the ports performances of SSA – 9. It is well known that ports are the most important tools to access international market and can helped the agricultural countries with a small domestic market to develop.

However without the ports data, we sought for road and rail line data: the best free data base is the World Bank data base, but these data are at national level and we know that it would be better if we had the rural road density and the agricultural merchandises transported by railroad.

Unfortunately, the road investments in SSA – 9 were done mainly in urban areas like Ghana: moreover, rail companies usually transported mineral resources and not agricultural goods, as in Zambia and Mozambique cases. Anyhow we used, as infrastructure data base, only road density and rail line density (World Bank data).

Table 6.9: Third block using fixed-effects

Step 3: Fixed-effects, using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: API					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
NPKL	-0.11172	0.0569351	-19.622	0.05184	*
RPDAL	-0.0955184	0.0275439	-34.679	0.00071	***
INFR	0.227076	0.212495	10.686	0.28719	
R-squared				0.513679	
Adjusted R-squared				0.473152	

Table 6.10: Third block using random-effects

Step 3: Random-effects (GLS), using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: API					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
NPKL	-0.119292	0.0517227	-23.064	0.02256	**
RPDAL	-0.0692854	0.0220525	-31.418	0.00205	***
INFR	0.389327	0.182615	21.320	0.03476	**

6.6 The fourth block: assessing the rural poverty

We assumed that the Rural Poverty Line (RPL) is narrowly influenced by API, RPDAL and land tenure system (PR).

Some institutions exist to fight against poverty, some sociologists like to give explanations about privation and the rural people hate of misery. In rural areas, misery or extreme poverty means that people are being deprived of eating despite having contact with the field, all the time. It is terribly, sad seeing you and your family suffer in the present and without future.

To get rid of misery, rural populations always have responded quickly for all stimuli. Classic and modern literatures[17] have indicated as main factors, RPDAL, PR and API. In the last step of the model we agree with the authors, but we highlighted that these exogenous elements, that influenced the reduction of rural poverty, affect and are affected by others "inner factors" and creating a feedback-loop.

Therefore, for SSA – 9 and probable for most of low-income agricultural countries, a higher RPDAL optimizes poverty reduction when API grows and PR improves, similarly the growth or reduction of API is affected by the mix of factors that can be positive or negative such as: RPDAL, local infrastructure and agro-ecological zoning (AEZ) in this model represented by the NPKL outputs.

[17] (Lipton 1977), (Lipton and Ravallion 1993), (Roemer and Gugerty 1997), (Delgado et al 1998), (Mellor 1999 and 2001), (FAO 2001), (Quibria 2002), (Thirtle et al 2003), (World Bank 2004), (Timmer 2005), (Janvry and Sadoulet 2009), (Anderson 2009), (Larsen et al 2009), (Headey et al 2010) and (IFAD 2011).

NPKL was the outcome of the combination the natural resources as AEZ, the socio-economic environment by macroeconomic index and the intellectual capacity of farmers descripted in this thesis as human capacity (HC). In its turn HC has narrow linkages with PR and political stability.

In others words, the right of property or land tenure showed as pivot the process, but is not the essence. Poverty reduction happened in rural areas without PR, because in the core of this process is the fight against hunger of rural people.

Aided by techniques inherited from the local culture to manage the AEZ, "saved" by lack of infrastructure that prevents the entry of agricultural goods and forgotten by rulers when the soil does not have mineral resources, the farmers have been trying to improve their life conditions.

But, we suggested that this circle is not sufficient to assure the rural poverty reduction; the governments of SSA – 9 should improve, first of all, land tenure system. That change would touch the rural population, the farmers would change their behaviour and the poverty reduction process would be more efficient.

Table 6.11: Fourth block using fixed-effects

Step 4: Fixed-effects, using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: RPL					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
API	-0.136445	0.0752567	-18.131	0.07209	*
PR	-130.882	0.350597	-37.331	0.00028	***
RPDAL	-0.019211	0.0257769	-0.7453	0.45743	
R-squared				0.801489	
Adjusted R-squared				0.784947	

Table 6.12: Fourth block using random-effects

Model 4: Random-effects (GLS), using 144 observations					
Included 9 cross-sectional units					
Time-series length = 16					
Dependent variable: RPL					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
API	-0.0866034	0.0695377	-12.454	0.21506	
PR	-157.825	0.318587	-49.539	<0.00001	***
RPDAL	0.00606864	0.0184908	0.3282	0.74325	

6.7 Results of the complete econometric Model

As we said, we built a model that considers economic facts and also human behavior. It is clear that all the elements influence each other, so to understand this impact we used a system of recursive rather than simultaneous equations, a recursive model is a special case of an equation system where the endogenous variables are determined one at a time in sequence.

In others words, the left-hand side of the equation for the first endogenous variable includes no endogenous variables, only exogenous variables, the second endogenous variable includes exogenous variables and the first endogenous variable, the third endogenous variable includes exogenous variable the second endogenous variable, and so on, block by block. But the last endogenous variable influence the first block.

One the most popular systems to create recursive and non-recursive models is the Structural Equation Models (SEM), because it allow to develop both confirmatory and exploratory modeling, meaning they are suited to both theory testing and theory development. Other attractive of SEM models is their simple causal interpretation that consents to identify direct and indirect effects.

The different between recursive and simultaneous models is that one simultaneous regression uses the independent elements as Xs and dependents variable Ys and one equation explain the variance of Y such as: $\mathbf{Y_i} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 \mathbf{X_{1i}} + \boldsymbol{\beta}_2 \mathbf{X_{2i}} + \boldsymbol{\beta}_3 \mathbf{X_{3i}} + \boldsymbol{\varepsilon_i}$

On the other hand SEM model also used unidirectional causal effects but they do it block by block, so they can evaluate the weight of each block as:

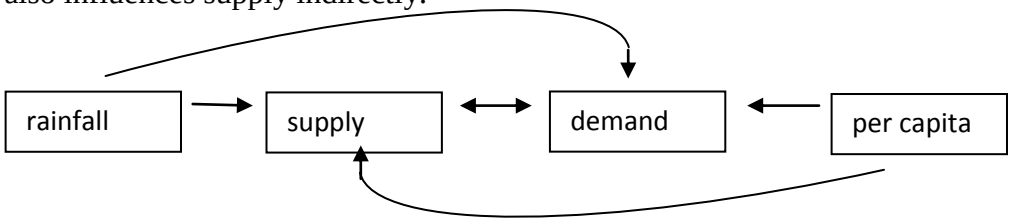
$$Y_i = \beta_0 + \beta_1 Y_{2i} + \beta_2 X_{1i} + \varepsilon_i$$

$$Y2_i = Ø_0 + Ø_1 X_{1i} + Ø_2 X_{2i} + Ø_3 X_{3i} + \varepsilon 1_i$$

$$X3_i = C_0 + C_2 X_{2i} + C_3 Y_i + \varepsilon 2_i$$

For example; in a simple agriculture environment with supply and demand function:

Rainfall might affect the supply of agricultural goods but it not directly affect the demand for then. Similarly per capita income might affect demand but not directly affect supply. However rainfall has an indirect influence on demand and per capita income also influences supply indirectly.



The SEM have been implicit in almost all of causal modeling. It was built by the Sewell Wright (1921) one geneticist and it was followed by many authors as Simon (1953) Blalock (1964), Duncan (1975), Pearl (2000) and Kline 2005. The SEM model started to be used for models of health / disease, but nowadays it is also used to model behaviour, economic systems and diseases.

In SEM, the qualitative causal assumptions are represented by the missing variables in each equation, as well as vanishing covariance among some error terms. These assumptions were tested in our research and to confirm our thesis.

We used SEM by Stata software, again with follow assumptions;

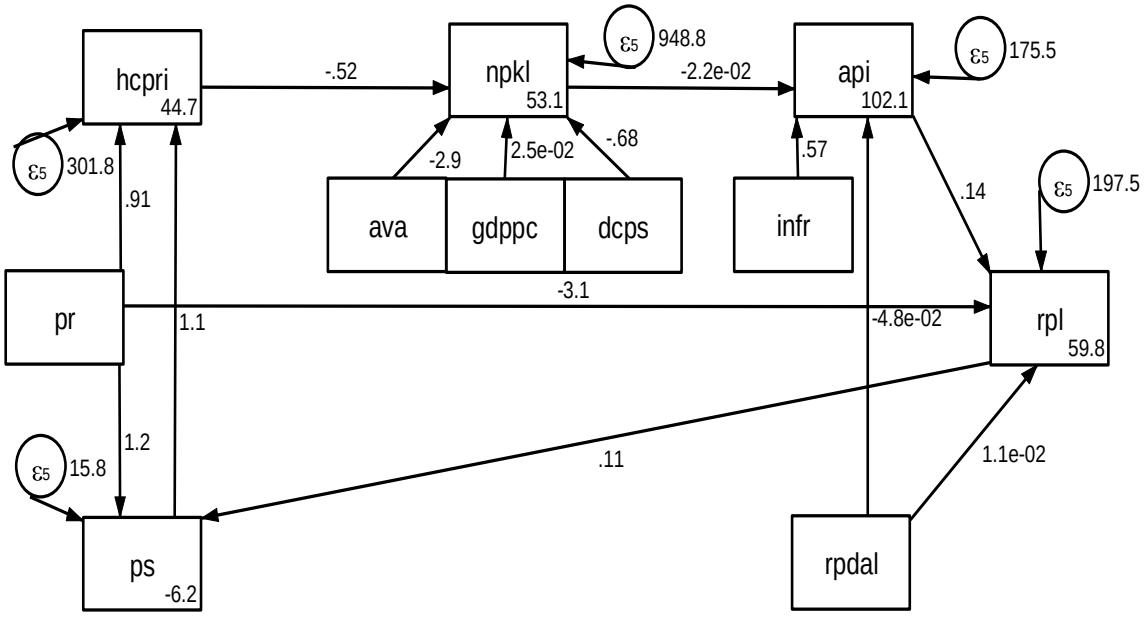
First block; the land property right (PR) and political stability (PS) influence human capital at primary school (HCPRI).

Second block; the HCPRI, the percentile of agricultural value added of GDP (AVA), GDP per capita income (GDPPC) and the percentage of domestic credit to the private sector of GDP (DCPS) influence the soil loss of nitrogen, phosphorus and potassium elements (NPKL).

Third block; the NPKL, the rural population density by arable land (RPDAL) and the infrastructure index (INFR) influence the Agricultural gross per capita production index (API)

Fourth block, the API, RPDAL and PR influence the rural poverty line (RPL), similarly RPL and PR influenced the PS in first block doing a feedback loop.

Figure 6.5: Results of the econometric model



The estimated results the following; **the first block** the improvement in of 1 point of PR and PS meant the improvement of HCPRI in 0.91 and 1.1 point respectively. This confirmed the classics school of human behaviours. As much as I feel safe and secure today, I will invest more for my future (Skinner and Maslow).

The second block showed that the loss of soil nutrient NPKL changed, when HCPRI, AVA and DCPS increase by one point in the following order -0,52, -2,9 and -0,68. With simple reasons we arrived in these conclusions: with the better education level, farmers acquired more knowledge to manage natural resources and to use new techniques, consequently the soil quality improved.

The decrease of agriculture value added in percentile of GDP (AVA) means that agriculture was following well and pulled out all national GDP, hence the others sectors of the country grew also, so the AVA index decreased. As a result, agriculture was doing well in the time it needed take care of soil quality. Finally when the Domestic Credit to the private sector (DCPS) grows, it produces more possibilities to entrepreneurs, who can invest in fertilizers and improve soil quality.

However, the most interesting factor is that, when GDP per capita income (GDPPC) grows by one point the NPKL increases loss in 0.02 points. Literature points out that the "high cost of hired labour" in SSA induced farmers to hire less work force (Dormon et al 2004).

Even though it is not clear why this trend occurred, in this specific subject deeper research on the elasticity of supply and demand should be carried out. In others words, it should be investigated how much the earnings should increase to push the domestic demand and offset the worth paid to keep the soil quality.

The third block showed that, when NPKL and INFR progressed by one point meant 0,02 and 0,57 point of API enhancement correspondingly. On the other hand when RPDAL increase by one point API declined by 0,04 point.

In this step we should be open minded to understand the nuances of this tripod that was supporting API. First of all NPKL is the collateral effect of the mixes between human intervention and the local natural resources. As we knew it can be positive, negative or equal to the NPK balances, i.e. if the farmers use fertilizer in excess this produces a positive NPK and causes pollution in the environment like many developed countries and nowadays some Asian countries.

If we get the equal balance of NPK, we will arrive the so called "sustainable agriculture". That means we will produce the max of goods possible without contaminating the soil and to ensure the future for the next generation.

On the other hand, what we have seen in SSA – 9 and practically in all SSA countries in the last 20 years, is the NPKL phenomenon. The negative balance of NPK does not mean the slump the API like a cutting axe. NPKL is slowly weakening the foundations of current production and reducing the changes of future sustainability form an economic and social point of view. As a skin cancer that does not kill itself, but kills because of its side effects.

Infrastructure instead of NPKL has strong and quick effects: good roads and rail lines are the main link between regions and have a significant impact to reduce the costs and improve the trade of goods; it certainty can help farmers to leap from subsistence agriculture to cash crops trades (Amoatey 2007).

Furthermore, building infrastructure in marginal areas creates jobs and spreads welfare immediately. In our research we picked up only roads and rail lines data, but this maybe also true for energy and water supplies, health and telecommunication systems, and so on.

We called RPDAL the last foot of the tripod; when RPDAL is low the domestic agricultural development is less provable because it does not produce the linkages (Mellor 2001 and Roemer and Gugerty 1997). On the other hand a high RPDAL without adequate infrastructure blocks the agricultural development and it could be interpreted as a problem (Headey et al 2010).

Our data confirm the strong relation between RPDAL and API, but also demonstrate that now in SSA – 9 this relation is negative. The increase of rural population stress the NPK balance because the food demand continue to grow, but the infrastructure that can reduce this pressure is very poor to support the rural population growth.

Empirical results in Asia countries among 1960 and 2000 indicated that when infrastructure improved the high RPDAL converted into positive effect for API.

The fourth block; the rural poverty line (RPL) decrease very well when PR increase. The correlation amounting to more than one point of PR resulted in less 3.1 points of RPL, but the other two main factors had to inverse relationship. When RPDAL and API increased one point, the RPL also increased 0,01 and 0,14 point respectively.

With a title of land the farmers have more security to work and produce more, can access to credit system and improve their business or yet they can sell their lands and go to the cities. In all these cases the index of RPL will fall.

The negative effect that RPDAL has on RPL was expected; some countries of SSA – 9 have low infrastructure as we saw from the previous block. Furthermore the lack of land tenure system and the high birth rate produced the “micro-land” phenomenon or trap. The farms were divided between heirs but as was impossible to sell their land, the successors become ever more people to be supported by less land.

But API has a negative effect on RPL called our attention; this is the most import point in this research, in SSA – 9, when the API grew by one point, RPL increased by 0.14. In others words the agricultural growth increased the rural poverty.

By a thorough analysis for each country of the sample, we saw one dichotomy of results; countries with low agricultural develop and good performance in poverty reduction as Uganda, or countries enjoying the improvement of API but with the rural poverty growing as Malawi.

It is because between 1990 and 2005 the prices of agriculture remained stable, thus the internal policies as land tenure, rural credit and infrastructure proved the main actors to optimize the agricultural results toward the rural poverty reduction.

Finally in the feedback loop, PS level has inverse relationship with RPL in 0,11 point and positive linkage the PR in 1,2 points.

Table 6.13: SSA – 9 model robust test

Robust test					
HCPRI	coef.	std. erro	Z	P>(Z)	
PS	1,09072	0,38693	2,82	0,005	***
PR	0,91072	0,38103	2,39	0,017	***
NPKL	coef.	std. erro	Z	P>(Z)	
HCPRI	-0,5178	0,11978	-4,32	0,000	***
AVA	-2,8931	0,31366	-9,22	0,000	***
GDPPC	0,02492	0,02286	1,09	0,276	
DCPS	-0,6822	0,18117	-3,77	0,000	***
API	coef.	std. erro	Z	P>(Z)	
NPKL	-0,0222	0,03661	-0,61	0,544	
RPDAL	-0,0481	0,01543	-3,12	0,002	***
INFR	0,56907	0,13741	4,14	0,000	***
RPL	coef.	std. erro	Z	P>(Z)	
API	-0,0222	0,03661	-0,61	0,544	
PR	-3,0816	0,45845	-6,72	0,000	***
RPDAL	0,01142	0,00695	1,64	0,100	*
PS	coef.	std. erro	Z	P>(Z)	
RPL	0,11155	0,02232	5	0,000	***
PR	1,15632	0,11872	9,74	0,000	***

Table 6.14: SSA – 9 model R-square observed

observed	R-squared	mc	mc2
HCPRI	0,13704	0,37019	0,13704
PS	0,33169	0,57593	0,33169
RPL	0,30648	0,55361	0,30648
NPKL	0,55047	0,74193	0,55047
API	0,13503	0,36746	0,13503
overall	0,8066		

mc = correlation between depvar and its prediction
mc2 = mc^2 is the Bentler-Raykov squared multiple correlation coefficient

7. MAIN RESULTS AND POLICY IMPLICATIONS

All this work had as goal assessing the role of agricultural productivity and the socio-economic environment to in rural poverty reduction in SSA – 9. Thus find out the efficient tools for their domestic societies to help the rural population overtake the poverty line meant also reducing food security problems, with more food supply and with more income for farmers and non-farmers in rural areas.

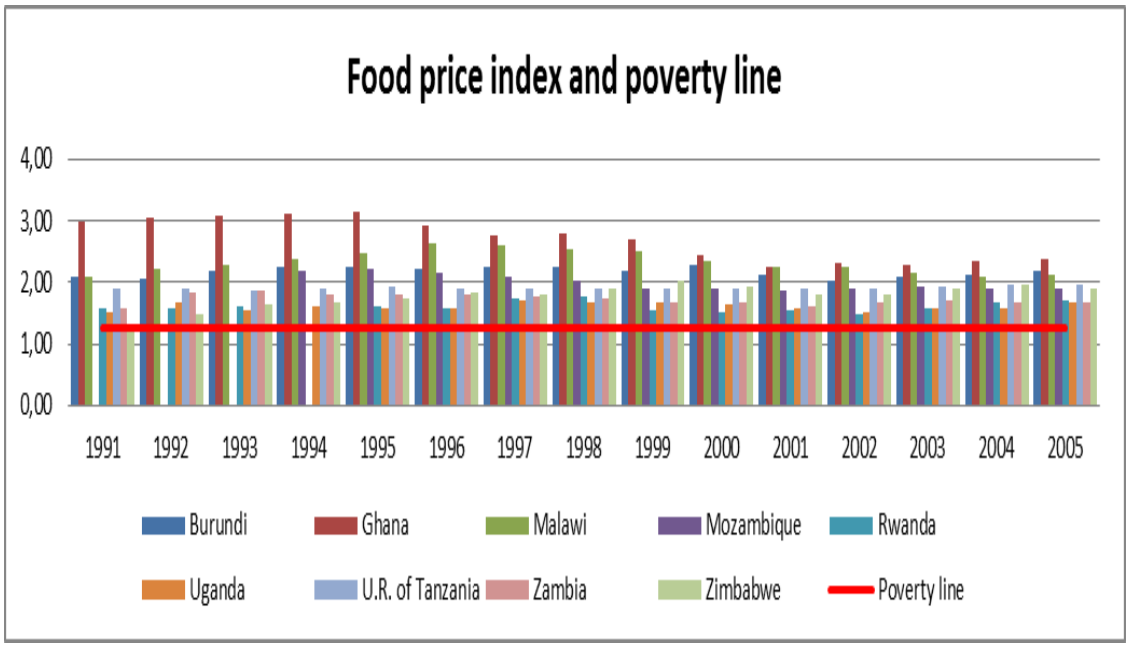
However the lack of data in many areas, we forced estimates some data and assume several conditions, future research can help sharpen the model and also the estimates such as the FAO (October 2012) that brought up for the first time the Purchasing Power Parity (PPP) food price index by country (chart 7.1).

Anderson (2009) hypothesized that, where the cost of living is higher the poverty line must be higher than USD 1,25, similarly it should be lower than USD 1,25 where the cost of living is better, not only by country but for each region, mainly differentiating urban and rural areas.

The definition the extreme rural poverty refers to those people who would still not be able to eat the minimum amount of nutrition necessary for their daily life, if they to use their entire budget to buy food. And the World Bank fixed the poverty line in USD 1,25 a day PPP, but current report of FAO showed that each country has different food prices, consequently each country should be dissimilar poverty line.

Again is was worthwhile to make all considerations, and to try improve the assessment methodology, but we judged it would be prudent to play with mature methodology and with the available data during our research, and we contributed to the subject for these reasons.

Chart 7.1: Food prices index and poverty line



Source; food price index by FAO and poverty line by World Bank

7.1 Main results for the nine SSA countries

In this paragraph we examined the model for each single country; in other words we confronted the model results of SSA – 9 with results for each one of the nine countries separately, block by block. The next tables show the starting point levels – 1990 –, the data of last year – 2005 – and the average of these sixteen years. The complete database is in appendix III of chapter 6.

This approach is important for two reasons; first, because these results support the idea that future research could possibly analize single countries with this model.

Second, it has made possible to identify and measure the improvements and the main policy implications in every single For example: the results of the first block show that the improvement in of 1% point of PR and PS mean the improvement of HCPRI in 0.91 and 1.1 point respectively. This confirmed the results of classical school of human behaviours: as soon as farmers start to feel safe and secure, they also begin to invest more for the future (Skinner and Maslow).

However, PR index shows itself to be much more efficient than PS in a singular analysis; this means that rural population believe more in the future and will invest more in education when they have land rights; only Rwandan population had different trend, but we supposed that the genocides of Rwanda explain this behaviors.

On the other hand, when the HCPRI and PR and PS indexes of one country are very low, and PR and or PS had a fast pickup, the HCPRI reacted very well as Malawi, Rwanda and Uganda that had had HCPRI levels below of the SSA – 9 average, and finished in 2005 with numbers higher than the cluster.

Table 7.1: Relationship among PS and PR indexes and HCPRI.

Country	PS > HCPRI	PR > HCPRI
SSA - 9	1,1	0,91
Burundi	-0,17	8,1
Ghana	0,32	1,8
Malawi	-18	44
Mozambique	0,4	-0,4
Rwanda	13	-0,0008
Uganda	-7	5
Tanzania	-3	2,6
Zambia	-0,0008	-0,6
Zimbabwe	0,98	4

Source: Calculated by author

Table 7.2: Individual levels of HCPRI, PS and PR.

	HCPRI level			PS level			PR level		
Country	1990	2005	average	1990	2005	average	1990	2005	average
SSA - 9	54,3	64,9	56,6	3,56	10,44	6,58	4,05	7,40	5,44
Burundi	30,5	41,7	41,4	3,00	9,00	5,94	4,32	4,56	4,55
Ghana	58,8	63,5	60,6	3,00	12,00	7,50	8,29	10,03	8,97
Malawi	43,4	115,1	84,7	1,00	16,00	7,63	1,00	8,61	4,40
Mozambique	57,0	44,6	41,5	3,00	15,00	9,19	2,00	8,19	5,00
Rwanda	43,2	84,8	57,9	3,00	6,00	3,56	3,00	5,27	3,86
Uganda	46,7	76,3	51,0	3,00	6,00	4,69	1,83	8,62	5,17
Tanzania	50,0	40,8	43,0	4,00	9,00	6,06	4,00	8,75	5,97
Zambia	67,6	60,9	64,2	1,00	15,00	9,69	1,00	8,51	3,88
Zimbabwe	94,0	56,2	65,3	11,00	6,00	4,94	11,00	4,06	7,18

Source: Calculated by author

With respect to the second block, the SSA – 9 model, shows that the loss of soil nutrient NPKL changed, when HCPRI, AVA and DCPS increase by one point in the following order: -0,52, -2,9 and -0,68. When we look to each country, it is possible to see different trends mainly in the NPKL, HCPRI and DCPS factors.

First of all, as we know NPKL is the collateral effect human intervention and the local natural resources, and NPKL indicate the sustainability of agriculture in the long term.
The human intervention plays a role, but the start point of soil quality is also very important: thus country as Uganda, with a very good soil quality, has a comparative advantages.
HCPRI (human capital) is a social instrument for developing countries, because people with better education tend to produce more farm crops and manage better the NPKL using good agricultural techniques; however the model analyzed only quantitative data and not qualitative levels of education, thus it could happened that two countries with the same numbers had really different levels of human capital.
Furthermore the DCPS is essential tool; in other words it does matter if I have or not access to the credit system.

Table 7.3: Relationship among HCPRI, AVA, GDPPC and NPKL.

Country	HCPRI> NPKL	AVA> NPKL	GDPPC>NPKL	DCPS>NPKL
SSA - 9	-0,52	-2,9	0,0025	-0,68
Burundi	-0,37	-1,6	-0,47	-0,12
Ghana	-0,0009	1	-0,0008	1,9
Malawi	0,23	-1,5	0,35	2,7
Mozambique	-0,2	1,5	-0,0008	0,58
Rwanda	2,3	-0,62	-0,0006	-6,6
Uganda	0,23	-0,55	-0,0001	-1,6
Tanzania	0,55	-0,3	0,11	0,19
Zambia	-1,6	-0,3	-0,0009	0,92
Zimbabwe	0,0002	-0,15	0,0004	-0,0002

Source: Calculated by author

Table 7.4: Individual levels of NPKL, HCPRI and AVA.

	NPKL level			HCPRI level			AVA level		
Country	1990	2005	average	1990	2005	average	1990	2005	average
SSA - 9	-82,52	-66,61	-78,90	54,3	64,9	56,6	39,5	30,5	35,0
Burundi	-153,00	-83,40	-125,28	30,5	41,7	41,4	55,9	34,8	46,4
Ghana	-72,75	-63,60	70,35	58,8	63,5	60,6	45,1	40,9	41,7
Malawi	-118,80	-75,28	-115,08	43,4	115,1	84,7	45,0	32,6	36,9
Mozambique	-28,35	-54,20	-40,15	57,0	44,6	41,5	37,1	27,0	31,5
Rwanda	-134,48	-85,58	-131,13	43,2	84,8	57,9	32,5	38,4	39,4
Uganda	-82,16	-84,30	-82,51	46,7	76,3	51,0	56,6	26,7	39,9
Tanzania	-80,03	-65,04	-75,41	50,0	40,8	43,0	46,0	31,8	40,1
Zambia	-21,60	-31,02	-18,63	67,6	60,9	64,2	20,6	23,3	21,7
Zimbabwe	-51,50	-57,04	-51,53	94,0	56,2	65,3	16,5	19,2	17,3

Source: Calculated by author

Table 7.5: Individual levels of GDPPC and DCPS.

	GDPPC level			DCPS level		
Country	1990	2005	average	1990	2005	average
SSA - 9	333,36	348,34	292,06	10,54	12,40	12,41
Burundi	199,27	107,87	137,84	8,61	22,27	17,88
Ghana	393,25	489,17	372,18	4,93	15,54	9,00
Malawi	198,99	201,80	184,04	10,95	7,91	8,26
Mozambique	181,88	315,75	208,90	17,59	11,84	13,03
Rwanda	361,43	287,05	256,75	6,92	11,21	8,67
Uganda	242,76	313,60	242,91	0,00	8,63	5,36
Tanzania	167,31	362,54	246,94	13,90	10,18	7,71
Zambia	415,71	609,69	387,33	8,88	7,72	7,02
Zimbabwe	839,66	447,56	591,65	23,04	16,28	34,76

Source: Calculated by author

The third block shows that, when NPKL and INFR increase by one point, this implies a corresponding increase by 0,02 and 0,57 point of API . On the other hand when RPDAL increase by one point, API declines by 0,04 point.

The negative balance of NPK does not mean the slump the API like a cutting axe. NPKL is slowly weakening the foundations of current production and reducing the changes of future sustainability form an economic and social point of view.

INFR has strong and quick effects on API: good roads and rail lines are the main link between regions and have a significant impact to reduce the costs and improve the trade of goods. Furthermore, building infrastructure in marginal areas creates jobs and spreads welfare immediately.

On the other hand, RPDAL should be supported by INFR and influence directly the NPKL; RPDAL without adequate infrastructure the agricultural development could not happen.

Table 7.6: Relationship among NPLK, INFR, RPDAL and API

Country	NPKL> API	INFR> API	RPDAL> API
SSA - 9	-0,0002	0,57	-0,0004
Burundi	-0,41	-6,1	-0,39
Ghana	-1,3	3	-0,31
Malawi	-0,0004	6,4	-0,53
Mozambique	-0,81	-2,6	0,0001
Rwanda	0,0005	-0,72	-7
Uganda	0,43	-0,0007	-0,0005
Tanzania	0,32	-16	-0,16
Zambia	-0,27	-1,1	0,0002
Zimbabwe	-3,6	-0,39	1,1

Source: Calculated by author

Table 7.7: Individual levels of API and NPKL.

	API level			NPKL level		
Country	1990	2005	Average	1990	2005	average
SSA - 9	96,25	97,10	96,44	-82,52	-66,61	-78,90
Burundi	128,68	99,58	110,45	-153,00	-83,40	-125,28
Ghana	55,15	99,97	86,20	-72,75	-63,60	70,35
Malawi	71,13	85,57	87,19	-118,80	-75,28	-115,08
Mozambique	91,80	94,60	93,07	-28,35	-54,20	-40,15
Rwanda	95,54	100,70	95,51	-134,48	-85,58	-131,13
Uganda	112,28	99,89	106,22	-82,16	-84,30	-82,51
Tanzania	92,22	100,34	85,14	-80,03	-65,04	-75,41
Zambia	98,88	100,14	92,85	-21,60	-31,02	-18,63
Zimbabwe	120,59	93,11	111,39	-51,50	-57,04	-51,53

Source: Calculated by author

Table 7.8: Individual levels of INFR and RPDAL

	INFR level			RPDAL level		
Country	1990	2005	Average	1990	2005	average
SSA - 9	19,70	23,73	20,51	376,16	408,54	391,10
Burundi	52,03	44,28	50,58	572,40	705,84	617,84
Ghana	16,39	24,56	17,82	352,57	285,99	309,65
Malawi	9,28	14,50	13,49	371,34	376,41	373,35
Mozambique	3,37	4,17	3,72	309,73	303,26	311,31
Rwanda	49,84	53,00	51,13	768,66	645,09	698,20
Uganda	8,29	29,46	11,75	315,25	465,03	393,77
Tanzania	9,46	8,99	9,50	229,37	311,24	277,18
Zambia	4,86	9,04	7,79	209,15	354,22	286,02
Zimbabwe	23,79	25,57	18,85	257,00	229,79	252,65

Source: Calculated by author

The fourth block; the rural poverty line (RPL) decrease very well when PR increase. The correlation amounting to more than one point of PR resulted in less 3.1 points of RPL, but the other two main factors have a different relationship. When RPDAL and API increased one point, the RPL also increased 0,01 and 0,14 point respectively.

With title quantity of land farmers have more security to work and produce more, can access to credit system and improve their business or yet they can sell their lands and go to the cities. In all these cases the index of RPL will fall.

The negative effect that RPDAL has on RPL was expected; some countries of SSA – 9 have low infrastructure as we saw from the previous block. Furthermore the lack of land tenure system and the high birth rate produced the "micro-land" phenomenon or trap.

However, when the API grew by one point, RPL increased by 0.14. In others words the agricultural growth increased the rural poverty.

By a thorough analysis for each country of the sample, we saw one dichotomy of results: there are countries with low agricultural development but good performance in poverty reduction as Uganda, or countries enjoying the improvement of API but with the rural poverty growing as Malawi.

The role of domestic policies like the one about land tenure, rural credit and infrastructures followed different paths and provided different outputs.

Table 7.9: Relationship among API, RPDAL, PR and RPL

Country	API> RPL	RPDAL>RPL	PR>RPL
SSA - 9	0,14	0,0001	-3,1
Burundi	-0,51	-0,00005	1,7
Ghana	-0,046	0,22	2.3
Malawi	0,33	0,0009	-0,89
Mozambique	0,0003	0,0008	-3,9
Rwanda	-0,19	-0,0003	2,4
Uganda	0,34	-0,16	-0,31
Tanzania	0,0004	-0,0004	-0,0005
Zambia	-0,0005	-0,0008	-1,3
Zimbabwe	0,0006	-0,9	-3,1

Source: Calculated by author

Table 7.10: Individual levels of RPL and API

	RPL level			API level		
Country	1990	2005	Average	1990	2005	average
SSA - 9	53,43	53,06	57,73	96,25	97,10	96,44
Burundi	36,20	70,68	75,92	128,68	99,58	110,45
Ghana	48,00	20,87	37,09	55,15	99,97	86,20
Malawi	51,70	54,14	59,24	71,13	85,57	87,19
Mozambique	83,90	47,90	66,62	91,80	94,60	93,07
Rwanda	51,70	64,20	61,89	95,54	100,70	95,51
Uganda	65,00	34,20	48,25	112,28	99,89	106,22
Tanzania	41,35	37,74	39,40	92,22	100,34	85,14
Zambia	83,00	76,80	83,12	98,88	100,14	92,85
Zimbabwe	20,00	71,00	48,03	120,59	93,11	111,39

Source: Calculated by author

Table 7.11: Individual levels of RPDAL and PR

	RPDAL level			PR level		
Country	1990	2005	average	1990	2005	average
SSA - 9	376,16	408,54	391,10	4,05	7,40	5,44
Burundi	572,40	705,84	617,84	4,32	4,56	4,55
Ghana	352,57	285,99	309,65	8,29	10,03	8,97
Malawi	371,34	376,41	373,35	1,00	8,61	4,40
Mozambique	309,73	303,26	311,31	2,00	8,19	5,00
Rwanda	768,66	645,09	698,20	3,00	5,27	3,86
Uganda	315,25	465,03	393,77	1,83	8,62	5,17
Tanzania	229,37	311,24	277,18	4,00	8,75	5,97
Zambia	209,15	354,22	286,02	1,00	8,51	3,88
Zimbabwe	257,00	229,79	252,65	11,00	4,06	7,18

Source: Calculated by author

7.2 Policy implication

In this chapter we examined the main tools that had strong relation with poverty reduction; the PR index, DCPS, HCPRI and finally INFR.

This debate about the weight of policies implication is very propitious because our timeline is between 1990 and 2005, in this period the international agricultural prices were relativity constant. So, excluding this very important element, price, we can analyzes what the low-income countries in SSA may do to develop their agriculture.

Our sample was composted by nine agricultural countries, we used the serial times between 1990 and 2005; all of them have had low incomes during this time, that means less than USD 1000 per capita, but they had different performances about rural poverty reduction.

The PR index has solid link with the rural poverty but also the robust linkage with PS. Albeit both indexes were made by two different institutions, they have similar parameters in SSA, so some comments are fit for both and it could be redundant to talk twice the same topics.

Property right (PR) is the basic of all capitalism system, also in the agricultural business farmers do their best, accept risks when there could be reward in the future. Those efforts produce wealth and can spread welfare to all society. The SSA – 9 societies had different rules about PR and they produced different results between 1990 and 2005.

Basically we have three groups: the winners where the poverty fell significantly, like Ghana (-56%), Uganda (-47%) Mozambique (-43%), the losers where the poverty grew like Rwanda (+23%), Burundi (+93%) and Zimbabwe (+255%) and those which who remained more or less stable on the poverty line, like Zambia (-8%), Tanzania (-8%) and Malawi (+4%).

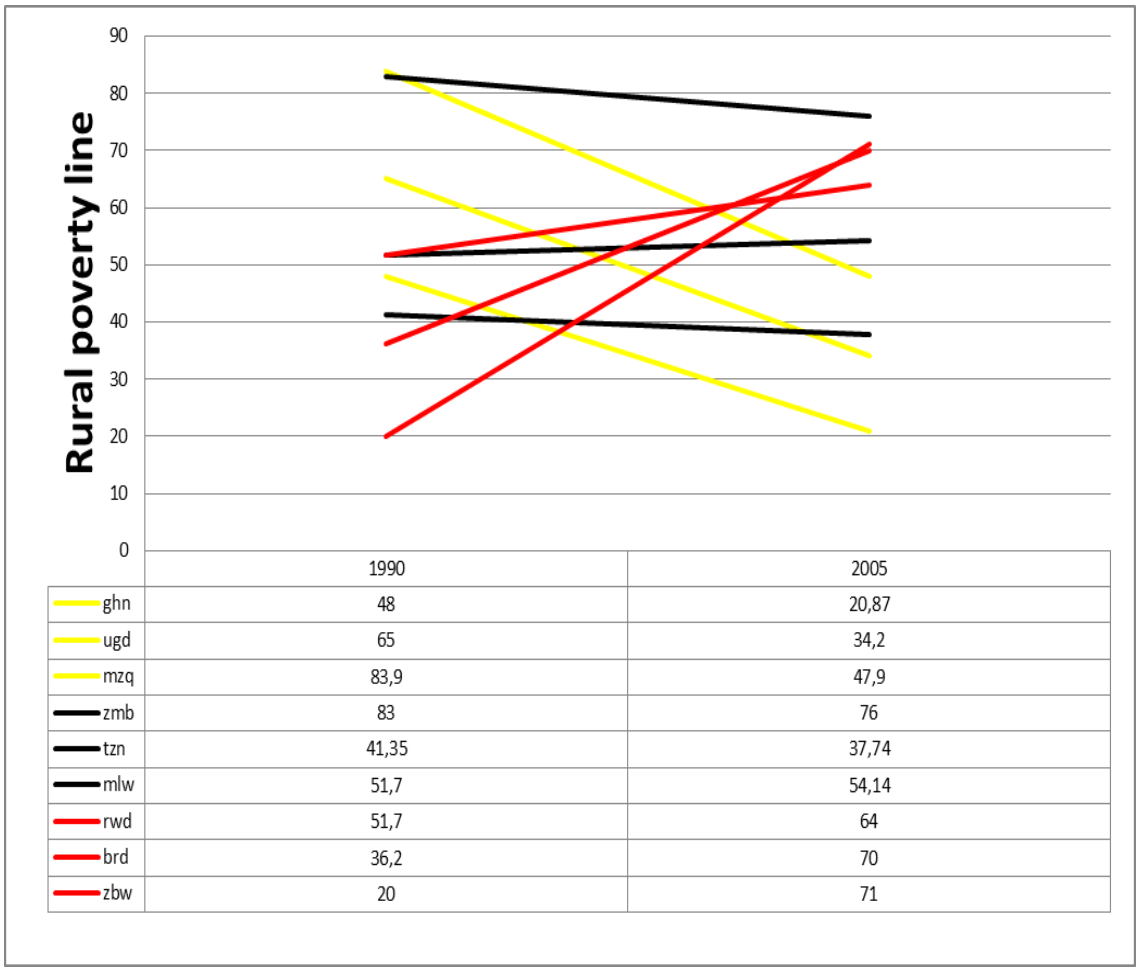
The first highlight of the our research is about the starting point, 1990 and the deadline, 2005, when the search began we realized that the rural poverty line has a strong link with PR, in other words all countries that had a PR index higher than the average of group (level 4 or more), also had the poverty line better than average (smaller than 50 per cent). We made a PR index based on International Property Rights Index (IPRI) with a score from 1 to 15, and the rural poverty line used the World Bank data.

In 1990 Zambia had the worst performance; around 83 per cent of the rural population was living below the poverty line and the Zambia's PR index was 1; on the other hand the best performance was the Zimbabwe's where the poverty line represented 20 per cent of rural population and PR index was 11.

In 2005 Mozambique that likewise had in 1990 around 83 per cent of rural poverty had a PR index was 2. In 2005 it reached 47 per cent of the rural poverty line and PR index was 8.18; similarly, Ghana's PR index, when the research started, was 8.28, and in 2005 it had the best performance among the countries: the poverty line decreased by 56 per cent and Ghana had very similar figures to those of Zimbabwe in 1990, the rural poverty line was around 20 per cent and PR index was worth 10 points (chart 7.2).

We should add that PR improvement has strong effects to reduce poverty when rural poverty level are highs like Mozambique, where poverty fell from 83% to 47,9 %. Moreover PR increased from 2 to 8,18, but it is less influenced when the poverty level is better, as in the United Republic of Tanzania. There poverty decreased from 41,35% to 37,74 and the PR level grew from 4 to 8,75 points.

Chart 7.2: Three groups inner SSA – 9



	1990	2005
ghn	48	20,87
ugd	65	34,2
mzq	83,9	47,9
zmb	83	76
tzn	41,35	37,74
mlw	51,7	54,14
rwd	51,7	64
brd	36,2	70
zbw	20	71

Source: calculated by author

Thus we assumed that in one scenario without land tenure agriculture cannot develop the extreme poverty is prevalent in a rural setting, as in Mozambique in 1990 or Zimbabwe in 2005. However, if between losers and winners the PR influence is clear, in the so called "stable countries" it is not.

In 1990 Zambia had a poverty line of 83 per cent and the PR index was 1, but in 2005 PR was 8,5 points, thus similar to Mozambique (8,18) and Uganda (8,62), but the rural poverty line did not fall well and remained in a percentile of 76,8.

Even though PR had good improvement in Zambia, other important indexes as DCPS and HCPRI decreased their performances. DCPS fell by 12% from 8,8 per cent of GDP in 1990 to 7,72 per cent in 2005, HC fell around 10 percent from 67,50 percent to 66,88 % in the same period.

Furthermore, the rail lines in the country, after privatization program, practically banned the transport of agricultural goods. Before that the state-owned railway had carried out the transportation of agricultural goods in marginal areas with a strong program of subsidies.

Hence, it was obvious that PR is very important, but it cannot improve the rural environment alone. Other policies must exist to enhance the opportunities for the rural population; however, in our assessment PR is the pivot of the process for three reasons:

Firstly the DCPS of GDP is very important to entrepreneurs; when they do not have access to the credit system farmers lose many opportunities to develop, but here we should express two basic concerns, the banking system cannot grant loans to the farmers who are deprived of the title land or another kind of guarantee.

The other matter is that some governments, to solve the credit access problem without changing the PR, use state banks or other types of financial maneuver to expand the credit: in this way the country will usually have high inflation and liquidity problems, so at the end of this cycle poverty will probably increase.

Secondly, if the access to credit was resolved, the human capital should have good levels, because the higher the level of education, the higher the probability to succeed in a venture for a farmer. However, in our models it is understandable that HCPRI was influenced by the PR level, thus without an acceptable level of security in rural areas the farmers won't invest in education.

We added that HCPRI is the unique endogenous factor that influences the NPKL. And the NPKL is the main tool to measure agriculture's possibilities in the long term, so if the soil resources are managed better agriculture will thrive. Thereunto the DCPS increase should follow, lead by HCPRI.

In others words, if we want the sustainable development of agriculture to happen and this progress to contribute to reduce poverty, both HCPRI and DCPS data should run together: the winning countries or the virtual group would have harmony between the two policies, while the stable group would have one dichotomy with low DCPS levels and the losers would try to lead the development through DCPS while reducing the education level.

Finally, the enhancement of infrastructure can give good short-term effects and better outcomes in the long-term. When building the infrastructure the first impact is the

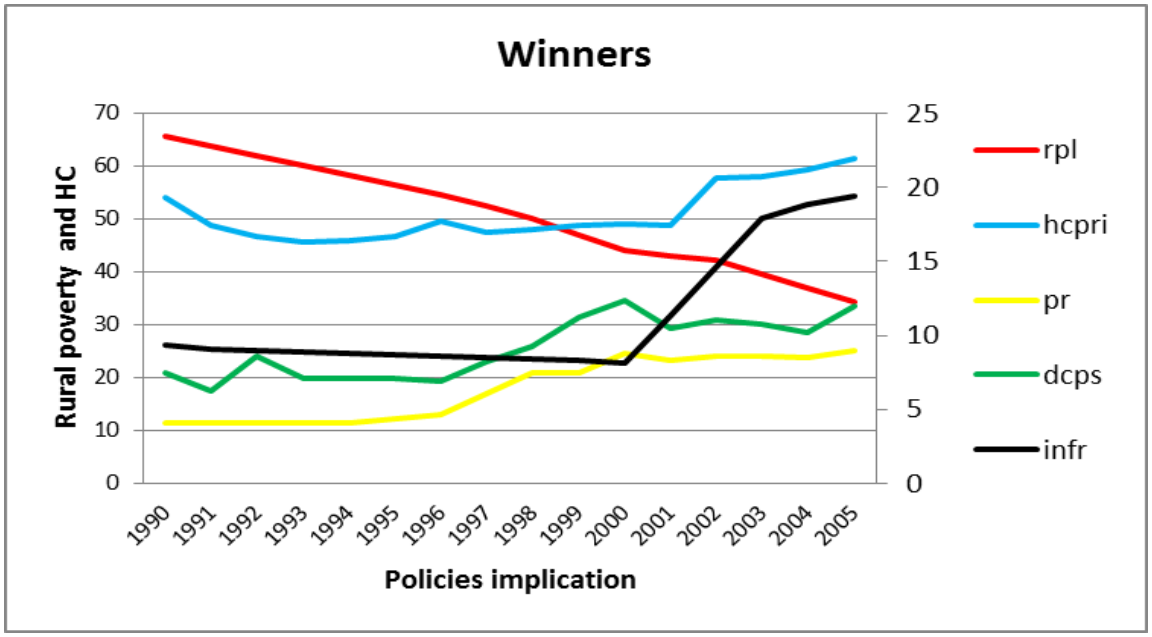
creation of jobs and the improvement of the local demand for goods, but in the long term, good infrastructures reduce the costs, facilitates the trades and spread welfare.

The first assumption about infrastructure is that the landlocked countries depend on their infrastructure and, at the same time, the neighboring countries infrastructures reach the international market, thus, perhaps, the methodology cannot reflects 100 percent the real economy country by country. However, it is undeniable that constructing of infrastructure as well as other factors can help also landlocked countries and their agricultural environment i.e. Uganda's case that has the second best performance in the sample.

Nevertheless, the second round of effects, which is more important, can be destroyed by mismatching the other factor like PR, HCPRI and DCPS. In SSA – 9 the countries with the best level of infrastructures are also those which have the worst performance for poverty reduction – Rwanda, Burundi and Zimbabwe.

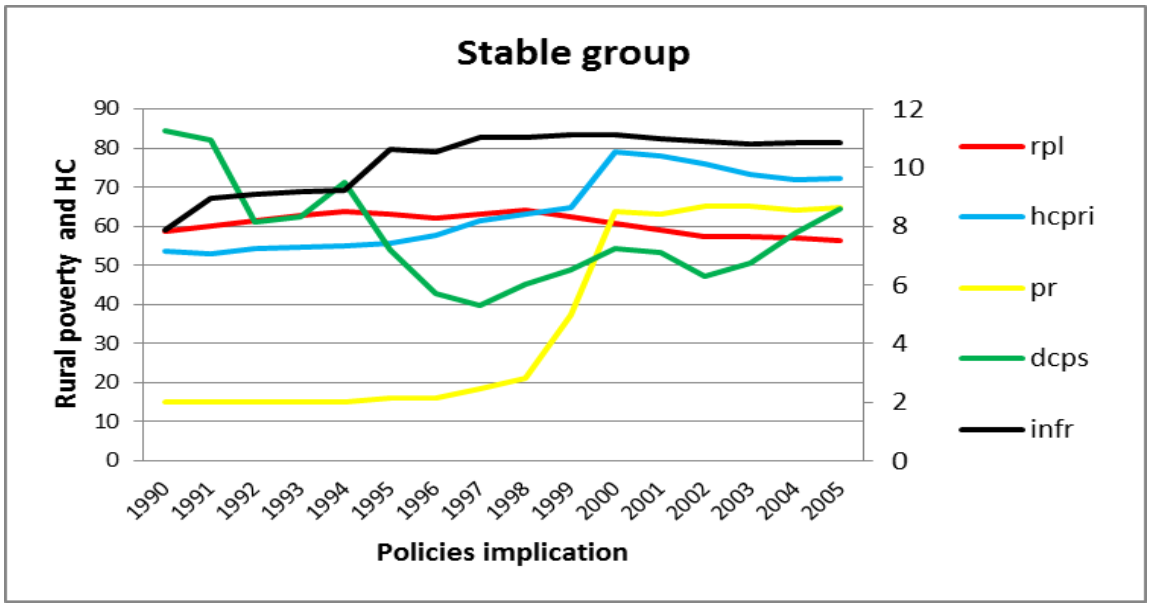
The next graphs show the average of performances of the three groups: the winners with Ghana, Uganda and Mozambique. The "stable group" with Zambia, the United Republic of Tanzania and Malawi, and finally the so called Losers with Rwanda, Burundi and Zimbabwe (charts 7.3, 7.4 and 7.5).

Chart 7.3: Winner group



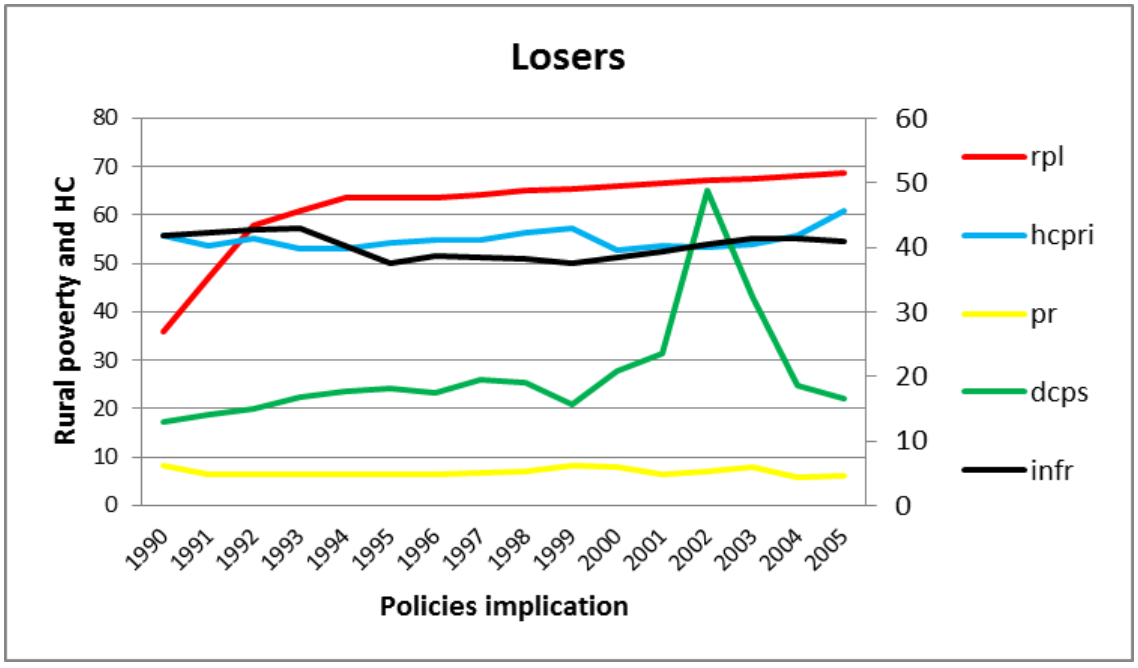
Source; calculated by author

Chart 7.4: Stable group



Source; calculated by author

Chart 7.5: Loser Group



Source; calculated by author

Thereby, with empirical results we can affirm that these implication policies are essential to reduce poverty in rural areas. But PR, HCPRI, DCPS and INFR can drive poverty reduction up to levels of 30 to 40 percent; subsequently, the countries needing the other kind of position should guide the agricultural development to the open market. During this delicate step we saw good and bad examples, and we highlighted three cases in SSA – 9.

7.3 The case of United Republic of Tanzania

The United Republic of Tanzania changed after the end of the Nyerere era, the Mwinyi new president made a new democratic constitution in 1992, but as we said land tenure system was changing.

The national land policy was enacted in 1995 and amended in 1997; the law became operational in 2001, but the three main laws were enacted only in 2007 – the land use plan, the town and country planning and the registration board act –; in 2008 the unit titles law followed and finally, in 2009, the mortgage financing act law was also enacted Thereby, after 17 years, Tanzania has a land tenure system very close to that of western countries.

While the land tenure changed slowly because it depended on many political agreements, the agricultural market was opened with one single law, together with a new constitution in 1992. Many western institutions congratulated with the government of Tanzania. But, as we saw, the rural poverty line remained practically at the same level.

The U. R. of Tanzania never had a free market before, agriculture had never developed by itself. As we described, East Africa didn't have agriculture in the pre-colonial era; in 1500 approximately the Portuguese explorer Vasco da Gama colonized the island of Zanzibar to use it as a bridge between European and Asian trades. The Portuguese introduced the cassava there in around 1600.

After the Portuguese came the Germans, after Germans the British and finally the independence and the communist government. So the agricultural production has been driven by someone that allowed or prohibited to do anything. Then, with the beginning of the free market in 1992, agricultural prices fell to the international level, the flux of imports and exports grew well.

The exports increased because farmers could sell on the free market and the government prices were lower than international prices, although the domestic prices were higher than the international ones. Imports grew, and for the same reason domestic government prices were higher than international prices.

Without a monopolistic government position the trade market grew and after three harvests the market started to collapse in 1997 and many small farmers broke-down.

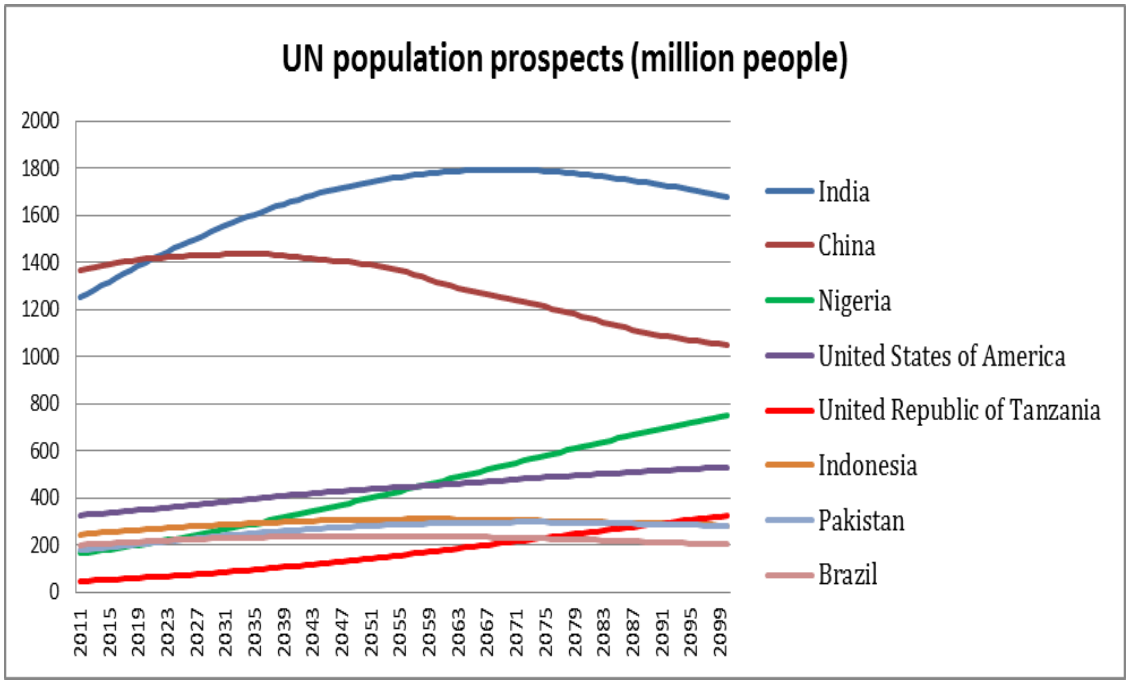
Due to the lack of a government to buy the goods, having no access to the credit market before the end of land tenure by 2007, many farmers sold their land and the rural poverty line did not grow because the urban poverty level had increased with the immigration flows.

However, after the land tenure system was established, the U. R. of Tanzania was one of the countries with a greater FDI in the country. This FDI came mainly from China and UAE; the agricultural yield had grown well but rural poverty remained stable. That situation induced the FAO, IIED and IFAD to produce in 2009 a report alerting about the African land grab situation (Cotula et al 2009).

The U. R. of Tanzania has an ambitious agricultural program, the government is trying to attract the FDI to the country to transform Tanzania into the main food supply to the Asian continent. Furthermore, Tanzania is the most important economy of East Africa and will be the ninth most populous country in the world by 2050 and the fifth in 2100 (UN data) (chart 7.6).

So, fixing the agricultural problem now and starting to reduce rural poverty will be essential to guarantees stability in the future. Because, despite the clear improvement of the agricultural environment, those benefices are not reaching the entire rural population.

Chart 7.6: UN population prospects



Source U.N data

7.4 The case of Uganda

Uganda is situated in one of the most fertile soils of SSA, has good rainfall conditions and reached a good civil stability after the Amin dictatorship. Between 1980 and 1986, Uganda had five presidents and the civil environment was very hostile, but Museveni brought stability and improved human rights protection and in 1993 the civil war was over and the country made a new constitution which restored the traditional kings.

The traditional Kingdoms of Uganda came from before the pre-colonial era and had enjoyed cultural autonomy. The government supported by the six Kingdoms made the new Constitution in 1995. This Constitution recognized the four tenure systems existing before and the rural peace was installed.

Simultaneously, the improvement of human rights allowed the liberalization of the agricultural market: the first one was the coffee market, after which other openings took place for tea, tobacco and cotton crops. The rural environment answered well and was modernized. Even though the rural population density increased from 315,25 people per one square kilometer of arable land in 1990 to 465,03 people in 2005, the national average of farm size remained of 2,2 hectares.

Avoiding the "micro land" phenomenon is very important to develop agriculture and the main tool to prevent this event is improving the non-agricultural sector in rural areas. Surely, the coffee harvest is the most important actor of this process, however we should point out that the liberalization of coffee and others crops means that farmers have the right to plant these crops but the government, unlike Tanzania, is very present in all practices.

The governmental presence has had good and bad results, the best one perhaps was the "coffee-banana techniques", which were spread to all the rural environment allowing small farmers to use the same soil for food crops and cash crops: this method ensured the food supply and the farmers earned at the same time.

The bad and good news, depending on the point of view, is that government prices can be bad because the gap between Ugandan prices and farm gate prices was – 20 percent for Arabica coffee and – 47 percent for Robusta coffee between 1992 and 2005. At the same time it can be good because, without the government intervention, almost all small farmers would be out of the coffee market like in Tanzania.

But the bad news indeed is that the Ugandan coffee price is lower than international prices because the quality of coffee in Uganda continues to go down. With the opening of the coffee market in 1991, the number of exporters increased and jumped from 18 in 1991 to 120 in 1994, after that the market started to concentrate again and in 2005 there were only 30 coffee exporters in Uganda.

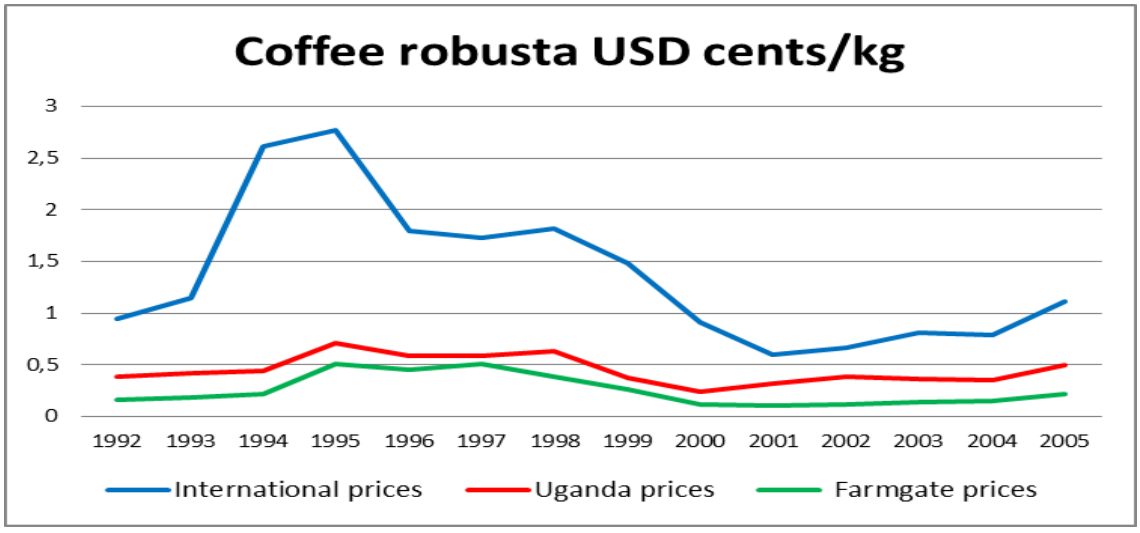
After the end of the state farms monopoly in cash crops like coffee, Uganda spread welfare and reduced poverty from 65 percent of rural population in 1990 to 34,2 percent in 2005. But the inefficiency in managing the cash crops surplus blocked the progress of poverty reduction: two different paths could resolve this dilemma.

First, the gap between Ugandan export prices and farm gate prices in Robusta coffee plantations should be decreased. Almost all the farmers who harvested Robusta are small and living in marginal areas. Thus, to decrease the gap, (chart 7.7) Ugandan authorities needed to reduce the inner costs of transportation and internal bureaucracy, and probably it meant a huge political problem.

Second, the Arabica crops are usually planted by farmers with more land and in non-peripheral areas, so the gap between Ugandan export prices and farm gate prices practically does not exist anymore (chart 7.8). But the quality of Ugandan coffee is very low; in this situation the improvement of agricultural, storage and transportation techniques can resolve the second gap, that between Uganda and international prices.

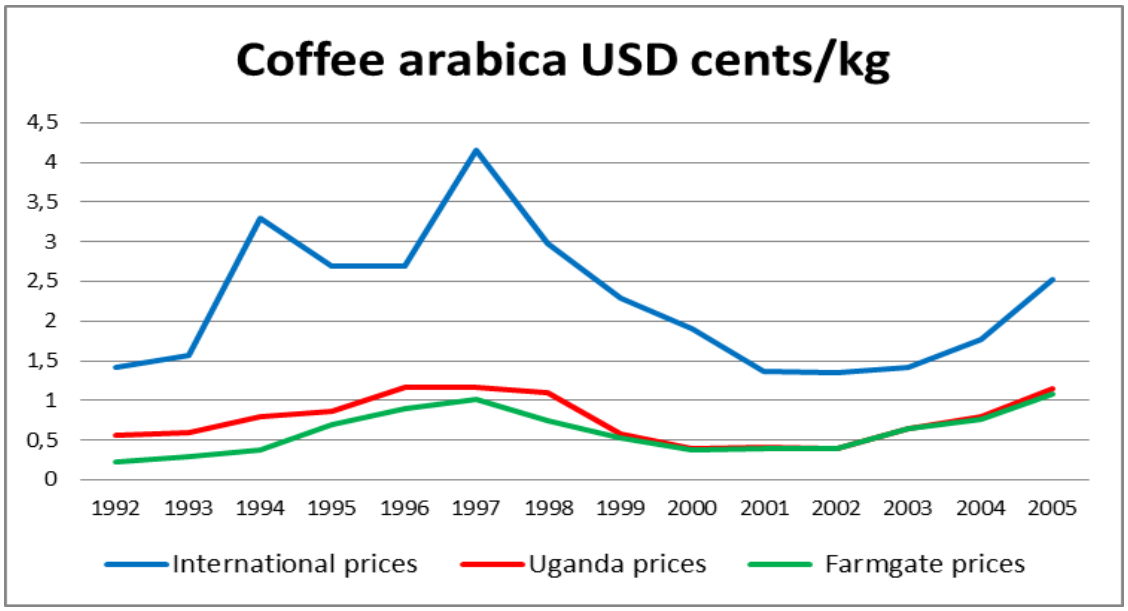
There doesn't exist a right or wrong side, but the inertia of authorities has, as main output, the apathy of rural social mobility that has slowed down poverty reduction.

Chart 7.7: Coffee robust prices



Source; Kleih et al 2006

Chart 7.8: Coffee Arabica prices



Source; Kleih et al 2006

7.5 The case of Ghana

The agricultural history of Ghana blends with the cocoa crop. A typical Amazonian tree, the cocoa crops was introduced in Ghana in 1800-50 by European missionaries. In 1947 the government created the Ghana Cocoa Board (COCOBOD) an agency responsible for the development of cocoa crops and cocoa industry.

Unlike Uganda, for which we had no regional data, in Ghana the difference between cocoa crops and traditional commodities as maize and sorghum is clear. Maize, for example, suffered from international competition, and Ghana was disadvantaged in productivity and technological and financial systems, compared with those of traditional producers in north America, south America and Europe, only because it had poor infrastructure, but it has saved the north Ghanaian farmers.

On the other hand, Ghanaian cocoa crops have great natural advantages: are localized near the ports and have a good quality, acknowledged by buyers. They historically paid a premium price, furthermore these prices increased from 3 percent in 1990 to 4,9 percent in 2005.

Other advantages happened when farmers mixed cocoa in their farms with another food crop, cassava. This mix produced similar effects as the “coffee-banana techniques” in Uganda.

As a result, cocoa farmers were the biggest winners in Ghana's agricultural environment between 1990 and 2005. The extreme poverty among cocoa farmers plummeted from 50 percent in 1990 to 6 percent in 2005, similarly the extreme rural poverty in Ghana fell from 48 percent to 20 percent.

We must emphasize that success as one important cause and one significant collateral effect.

Cause: the COCOBOD have managed well the surplus of cocoa income, the quality of cocoa beans in Ghana is the best in the world, the agency finances new crops and provides seedling trees; after 1991 it withdrew a historical exchange rate charged to farmers and finally the gap between farmer gate and Ghana export prices shrunk.

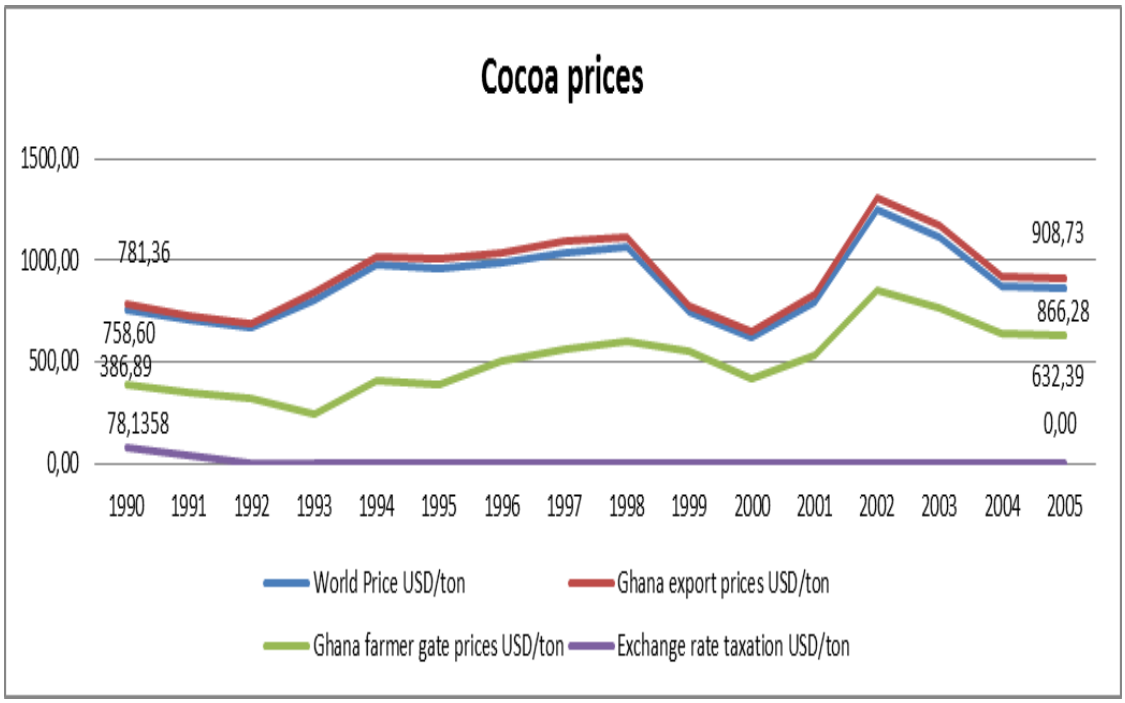
The gap in 1990 was 50,4 percent. Added to the exchange rate tax the real gap was 60,5 percent; in 2005 this gap fell to 30,40 percent. Hence we can say that the prices for cocoa farmers in Ghana had in 2005 a gap corresponding to 26 percent of the world price, which meant that they had similar farm prices paid in the "free market" of cocoa as Brazil, Ecuador and Indonesia (chart 7.9).

The world price of cocoa is based on Cote d'Ivoire prices, the biggest exporter in the world. The majority of producing countries have cocoa quality lesser than Cote d'Ivoire, consequently the prices pay for your goods are smaller than international price, Ghana is an exceptional case.

Collateral effect: the other tree crops have gained weight in Ghanaian agriculture, the fruits of palm oil tree are used to make biodiesel and , as well as these farmers are planting groundnuts that are being used for food, cooking – vegetable oil – and also for biodiesel.

Although this tropical commodity was born without one monopsony actor, Ghana's government allowed the existence of private buyers and sellers, thus year after year the agricultural environment in Ghana has obtained a new victory and produces more welfare, but as all almost SSA countries, Ghana's government has taxed the exportation goods.

Chart 7.9: Cocoa prices



Source; cocoa world price by ICCO, the export prices, farmer gate and exchange rate taxation of Ghana by COCOBOD

7.6 Future for SSA – 9

The SSA – 9 agricultural data confirmed what seems obvious: low-income agricultural countries are much more sensitive to international prices, their rural environment supported the majority of the entire population and different policies can improve gradually or deteriorate very quickly the agricultural business.

Hence, the speed the country is running at does not matter, the most important element is the path, which means that western institutions should evaluate SSA – 9 agriculture for its steps towards land tenure system, infrastructure investment etc., differently on the past were the financial aid was conditioned simply on market opening.

However, it is obvious that without a market opening domestic policies cannot resolve extreme rural poverty, because these countries are living one demographic phase with strong rate birth and they do not have the money to resolve rural and urban problems for the next two decades.

Thus, doing the right choices is the most important phase for SSA – 9 governments, by assessing what crops have advantages in the international market, how to unburden agricultural chains and modernize the domestic market.

In other words, for some tropical commodities like cocoa, coffee, tea, tobacco, sugar cane and so on, it is advisable to build the route to the real free market, while for international commodities such as maize, soy beans, rice, wheat and so on, it is prudent to look for inner factors that threat local farmers and to withdraw charges as soon as possible, or whether or when it is possible.

Finally, modernizing domestic market would mean to exploit, in the future, the good geographic position and export fruits and vegetable to European and Asian market.

8 CONCLUSIONS

8.1 Final considerations

Very different from the current days, where agricultural prices are highlighted around the world combined with alleged collateral effects as hunger and malnutrition, our research picked up a time series where agricultural business was ostracized. Between 1990 and 2005 was possible to analyze the begging of agriculture globalization, the international prices was stabled at low level and contemporaneously it was happening the most severe level of the extreme poverty of the SSA history, around 64,6 percent of rural population was living below poverty line, nowadays this level is around 47,5 percent.

The literature said that rural poverty in SSA would be resolved through agriculture. It had not occurred because during 1990s the productivity was very low and the linkage between farmers and non-farmers business had not happened, thus without this process the rural poverty had not decreased. We seek to assess why this scenario remained.

The first assertion is that we cannot look for only one answer to resolve rural poverty, find out a panacea for all SSA would be a "work of Hercules". The countries should be divided by profiles as GDP per capita, the dependences of mineral and agriculture resources.

Secondly, the agriculture in SSA is influenced by immeasurable factors interconnected, from the bad weather condition to the international aid coming from a SMS of a Norwegian citizen. Therefore the model is limited only to implications of local factors that can be managed, endogenous and exogenous factors with narrow relationship with agriculture.

Following this limits, we saw that the agricultural countries with low-income had diverse performances in poverty reduction between 1990 and 2005, and agricultural growth had a weak link with poverty reduction.

The agricultural environment gears are more complex that this simplistic assumption; poverty reduction showed sensitive to many other factors in a country as land tenure system or property rights (PR), infrastructure, rural density population, access to credit, mobility of GDP share and so on.

Moreover, a country as good macroeconomic performance could hide many inner problems; Ghana's case of poverty trap brought up to us three affirmations, which agro-ecological zones have a great weight in developing countries, to increase of productivity not means income growth, and high birth rate combined with low infrastructure level avoid the poverty reduction.

Thus, the new model showed fit to use in low-income agricultural countries, but the empirical results showed that exist an hierarchy of priority that whether respected optimizes the agriculture linkages and consequently improves the process of poverty reduction.

Property rights or land tenure (PR) together with political stability (PS) always started or destroyed the progression of the rural poverty reduction. The different trends of poverty reduction between two countries with the same level of PR and PS happen on behalf of some gears.

Firstly the time factor, meaning how long this level of PR or PS is being maintained

Secondly, whether the macroeconomic data, mainly the credit system (DCPS), is following the improvement of education level (HCPRI)

Thirdly how is the infrastructure installed and in which path is it going? Is it sufficient to support the density of rural population?

As much better are the answers, more efficient is the country in reducing the poverty.

This hierarchy explain the dichotomy of results and an apparent dilemma between education level and poverty reduction in SSA, it happened because, the insistent aim of international aid in improve education levels but at the same time forgetting to assess the socio-economic environment context created the so called "education dilemma in SSA". We considering that this mistake created an artificial stress to education level and it will continue not helping the poverty reduction.

8.2 Future developments

With the available database the model has been quite useful in order to identify the so called "inner factors" to reduce rural poverty.

However many questions remained without answer and the future research may try to explain, also by upgrading the model in different ways.

For example, the PR index was taken from International Property Rights Index (IPRI). It was built by World Bank Doing Business and World Economic Forum database. We picked up variables of “Physical Property Rights ”, the protection of physical property rights and registering property that have a relation with property rights, because there does not exist a specific land tenure index in western institution. Hence to build a land tenure index will be more fit to model.

With respect to HCPRI (human capital) nowadays it is very difficult to assess the education quality in these countries and thus, the improvement of HCPRI numbers not necessary means the improvement of human capital and social development.

Access to credit system is essential tool to develop a agriculture, but we have considered the domestic credit to the private sector level (DCPS) from the World Bank database as representing the entire system; but the agricultural credit system could not following this index, so a index that show agricultural credit would be welcome to renew the model.

Finally, and the most interesting relationship without a clear answer is the per capita GDP growth and the NPKL decreases. Despite of various support in many references, it is still not clear why this trend occurred, and a specific deeper research on the elasticity of supply and demand should be carried out. In others words, it should be investigated how much the earnings should increase to push the domestic demand and offset the worth paid to keep the soil quality.

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Appendix I

Abbreviations and acronyms

AGRISYSTEM – The Doctoral School of Università Cattolica del Sacro Cuore.

ADMARC – The Agricultural Development and Marketing Corporation in Malawi.

AEC – African Economic Community.

AEZ – Agro-ecological Zone.

API – The agricultural gross per capita production index.

APP – Agricultural Perspective Plan (The government of Nepal)

AVA – The agriculture value added in percentile of GDP.

AW – Tropical savanna climate (Kö ppen climate classification).

BRD – Burundi.

CAW – Humid subtropical climate (Kö ppen climate classification).

CGE – Computable General Equilibrium Model.

CHS – Cedi

CIA – Central Intelligence Agency.

COCOBOD – The Ghana Cocoa Board.

COMESA – Common Market for Eastern and Southern Africa.

DCPS – Domestic credit to private sector.

EAC – East African Community.

EAP – East Asia and Pacific.

EU 27 – European Union of 27 member states.

EUROstat – European Statistical System.

FAO – Food and Agriculture Organization.

FAOstat – Statistics of Food and Agriculture Organization.

FDI – Foreign direct investment.

FRELINO – The Front for the Liberation of Mozambique.

GDP – Gross domestic product.

GDPPC – Gross domestic product per capita.

GHN – Ghana.

GLSS – Ghana Living Standards Survey.

HC – Human Capital.

HCPRI – Human capital at primary school.

IAASTD – International Assessment of Agricultural Knowledge, Science and Technology of Development.

ICCO – International Cocoa Organization.

IEA – International Energy Agency.

IFAD – International Fund for Agricultural Development.

IIED – International Institute for Environment and Development.

IMF – International Monetary Fund.

INFR – Infrastructure (roads density and rail lines density)

IPRI – International Property Rights Index.

LAC – Latin America and Caribbean.

LUS – land Use Systems.

LUT – Land Use Type.

MLW – Malawi.

MNA – Median East and North African.

MoFa – Ministry of Food & Agriculture Republic of Ghana.

MZQ – Mozambique.

NGO – Nongovernmental organization.

NPK – Nitrogen, phosphorus and potassium.

NPKL – Loss of nitrogen, phosphorus and potassium.

OAPEC – Organization of Arab Petroleum Exporting Countries.

OECD – Organization for Economic co-operation and Development.

PPP – Purchasing Power Parity.

PR – Property right (land).

PS – Political stability.

RENAMO – The Mozambican National Resistence.

RPDAL – Rural population density by arable land.

RPF – Rwanda patriotic Front.

RPL – Rural poverty line.

RWD – Rwanda.

SADC – Southern African Development Community.

SAS – South Asia.

SEM – Structural Equation Models

SOC – Soil organic carbon.

SOEs – State-Owned Enterprise.

SSA – 9 – Burundi, Ghana, Malawi, Mozambique, Rwanda, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe.

SSA – Sub-Saharan Africa.

TFP – Total factor productivity.

TZN – United Republic of Tanzania.

UAE – United Arab Emirates.

UGD – Uganda.

UK –United kingdom.

UN – The United Nations.

UNAIDS – The United Nations Programme on HIV/AIDS.

UNESCO – United Nations Educational, Scientific and Cultural Organization.

US – United States.

USD – Dollar.

USDA – United States Department of Agriculture.

USSR – Union of Soviet Socialist Republics.

WLD – Developing World.

WWF – World Wildlife Fund.

ZANU – Zimbabwe African Nation Union.

ZAPU – Zimbabwe African People's Union.

ZBW – Zimbabwe.

ZMB – Zambia.

Appendix II

Model 1: Fixed-effects, using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: HCPRI

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	41.249	2.31636	17.8077	<0.00001	***
PS	0.846789	0.302591	2.7985	0.00590	***
PR	1.80248	0.530459	3.3980	0.00090	***

Mean dependent var	56.62715	S.D. dependent var	18.77939
Sum squared resid	16963.50	S.E. of regression	11.29359
R-squared	0.663631	Adjusted R-squared	0.638340
F(10, 133)	26.23986	P-value(F)	6.44e-27
Log-likelihood	-547.6956	Akaike criterion	1117.391
Schwarz criterion	1150.059	Hannan-Quinn	1130.666
Rho	0.782271	Durbin-Watson	0.339392

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(8, 133) = 25.6231
with p-value = P(F(8, 133) > 25.6231) = 1.4268e-023

Model 1: Random-effects (GLS), using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: HCPRI

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	41.3677	5.78745	7.1478	<0.00001	***
PS	0.862188	0.297191	2.9011	0.00432	***
PR	1.76206	0.519291	3.3932	0.00090	***

Mean dependent var	56.62715	S.D. dependent var	18.77939
Sum squared resid	43500.67	S.E. of regression	17.50265
Log-likelihood	-615.4989	Akaike criterion	1236.998
Schwarz criterion	1245.907	Hannan-Quinn	1240.618

'Within' variance = 127.545
'Between' variance = 265.41
theta used for quasi-demeaning = 0.826694

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 356.499
with p-value = 1.62905e-079

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(2) = 0.263894
with p-value = 0.876387

Model 2: Fixed-effects, using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: npkl

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	-52.963	13.3889	-3.9557	0.00012	***
Ava	-0.797613	0.215273	-3.7051	0.00031	***
Gdppc	-0.0384806	0.020262	-1.8992	0.05974	*
Hcpri	0.176736	0.0969932	1.8222	0.07071	*
Dcps	0.257647	0.172765	1.4913	0.13828	

Mean dependent var	-78.89604	S.D. dependent var	40.07448
Sum squared resid	28856.89	S.E. of regression	14.84189
R-squared	0.874346	Adjusted R-squared	0.862835
F(12, 131)	75.96184	P-value(F)	6.43e-53
Log-likelihood	-585.9481	Akaike criterion	1197.896
Schwarz criterion	1236.504	Hannan-Quinn	1213.584
Rho	0.871977	Durbin-Watson	0.336096

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(8, 131) = 55.005
with p-value = P(F(8, 131) > 55.005) = 3.13026e-038

Model 2: Random-effects (GLS), using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: npkl

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	-51.3242	15.9857	-3.2106	0.00165	***
Ava	-0.891581	0.219317	-4.0653	0.00008	***
Gpdpc	-0.0283659	0.020019	-1.4170	0.15873	
Hcpri	0.152849	0.0990776	1.5427	0.12517	
Dcps	0.261412	0.174767	1.4958	0.13698	

Mean dependent var	-78.89604	S.D. dependent var	40.07448
Sum squared resid	189618.5	S.E. of regression	36.80242
Log-likelihood	-721.5000	Akaike criterion	1453.000
Schwarz criterion	1467.849	Hannan-Quinn	1459.034

'Within' variance = 220.282
'Between' variance = 608.329
theta used for quasi-demeaning = 0.849561

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 289.888
with p-value = 5.26058e-065

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(4) = 13.9665
with p-value = 0.00740288

Model 3: Fixed-effects, using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: api

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	120.33	12.3122	9.7732	<0.00001	***
Npkl	-0.11172	0.0569351	-1.9622	0.05184	*
Rpdal	-0.0955184	0.0275439	-3.4679	0.00071	***
Infr	0.227076	0.212495	1.0686	0.28719	

Mean dependent var	96.44472	S.D. dependent var	14.60903
Sum squared resid	14842.32	S.E. of regression	10.60386
R-squared	0.513679	Adjusted R-squared	0.473152
F(11, 132)	12.67505	P-value(F)	4.09e-16
Log-likelihood	-538.0777	Akaike criterion	1100.155
Schwarz criterion	1135.793	Hannan-Quinn	1114.637
Rho	0.509282	Durbin-Watson	0.901967

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(8, 132) = 13.6178
with p-value = P(F(8, 132) > 13.6178) = 2.88712e-014

Model 3: Random-effects (GLS), using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: api

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	106.144	8.52443	12.4518	<0.00001	***
Npkl	-0.119292	0.0517227	-2.3064	0.02256	**
Rpdal	-0.0692854	0.0220525	-3.1418	0.00205	***
Infr	0.389327	0.182615	2.1320	0.03476	**

Mean dependent var	96.44472	S.D. dependent var	14.60903
Sum squared resid	30506.58	S.E. of regression	14.70914
Log-likelihood	-589.9508	Akaike criterion	1187.902
Schwarz criterion	1199.781	Hannan-Quinn	1192.729

'Within' variance = 112.442
'Between' variance = 126.339
theta used for quasi-demeaning = 0.764151

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 139.102
with p-value = 4.18339e-032

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 4.59916
with p-value = 0.203615

Model 4: Fixed-effects, using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: rpl

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	85.5245	13.9338	6.1379	<0.00001	***
Api	-0.136445	0.0752567	-1.8131	0.07209	*
Pr	-1.30882	0.350597	-3.7331	0.00028	***
Rpdal	-0.019211	0.0257769	-0.7453	0.45743	

Mean dependent var	57.72889	S.D. dependent var	17.40644
Sum squared resid	8600.830	S.E. of regression	8.072038
R-squared	0.801489	Adjusted R-squared	0.784947
F(11, 132)	48.45009	P-value(F)	5.99e-41
Log-likelihood	-498.7928	Akaike criterion	1021.586
Schwarz criterion	1057.223	Hannan-Quinn	1036.067
Rho	0.740888	Durbin-Watson	0.257722

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(8, 132) = 38.065
with p-value = P(F(8, 132) > 38.065) = 9.46569e-031

Model 4: Random-effects (GLS), using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: rpl

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	72.2969	11.4232	6.3290	<0.00001	***
Api	-0.0866034	0.0695377	-1.2454	0.21506	
Pr	-1.57825	0.318587	-4.9539	<0.00001	***
Rpdal	0.00606864	0.0184908	0.3282	0.74325	

Mean dependent var	57.72889	S.D. dependent var	17.40644
Sum squared resid	33469.66	S.E. of regression	15.40693
Log-likelihood	-596.6250	Akaike criterion	1201.250
Schwarz criterion	1213.129	Hannan-Quinn	1206.077

'Within' variance = 65.1578
'Between' variance = 154.784
theta used for quasi-demeaning = 0.837796

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 379.77
with p-value = 1.39655e-084

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 6.38147
with p-value = 0.094456

Model Test 1 : Fixed-effects, using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: rpl

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	56.7092	15.3256	3.7003	0.00032	***
pr	-1.18163	0.436484	-2.7072	0.00774	***
ps	-0.254944	0.200577	-1.2711	0.20607	
hcpri	0.223263	0.0601518	3.7117	0.00031	***
npkl	-0.0332673	0.0429618	-0.7743	0.44019	
dcps	0.0665262	0.0825942	0.8055	0.42208	
ava	0.208835	0.124598	1.6761	0.09622	*
gdppc	-0.0537526	0.0102871	-5.2253	<0.00001	***
api	-0.0688431	0.0693613	-0.9925	0.32286	
infr	-0.293035	0.153225	-1.9124	0.05811	*
rpdal	0.0359981	0.0245772	1.4647	0.14551	

Mean dependent var	57.72889	S.D. dependent var	17.40644
Sum squared resid	6019.975	S.E. of regression	6.939726
R-squared	0.861056	Adjusted R-squared	0.841049
F(18, 125)	43.03587	P-value(F)	8.27e-45
Log-likelihood	-473.1049	Akaike criterion	984.2099
Schwarz criterion	1040.636	Hannan-Quinn	1007.138
rho	0.627068	Durbin-Watson	0.502157

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(8, 125) = 30.1884
with p-value = P(F(8, 125) > 30.1884) = 8.30511e-026

Model test 2: Pooled OLS, using 144 observations
Included 9 cross-sectional units
Time-series length = 16
Dependent variable: rpl

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	62.3388	12.1568	5.1279	<0.00001	***
Hcpri	0.173258	0.0628876	2.7550	0.00669	***
Ps	0.600301	0.298125	2.0136	0.04607	**
Pr	-3.79662	0.448878	-8.4580	<0.00001	***
Npkl	0.223887	0.0465766	4.8069	<0.00001	***
Dcps	0.132324	0.107436	1.2317	0.22025	
Ava	-0.151522	0.153342	-0.9881	0.32488	
Gdppc	-0.0341378	0.01122	-3.0426	0.00283	***
Api	0.142735	0.0742017	1.9236	0.05654	*
Rpdal	0.0451603	0.017203	2.6251	0.00968	***
Infr	0.105129	0.143628	0.7319	0.46549	

Mean dependent var	57.72889	S.D. dependent var	17.40644
Sum squared resid	17650.91	S.E. of regression	11.52014
R-squared	0.592609	Adjusted R-squared	0.561978
F(10, 133)	19.34680	P-value(F)	1.41e-21
Log-likelihood	-550.5557	Akaike criterion	1123.111
Schwarz criterion	1155.779	Hannan-Quinn	1136.386
rho	0.876187	Durbin-Watson	0.250142

| Robust test

| Coef. Std. Err. z P>|z| [95% Conf. Interval]

Structural |

hcpri <- |

ps | 1.090719 .3869292 2.82 0.005 .3323513 1.849086

pr | .9107207 .381026 2.39 0.017 .1639235 1.657518

_cons | 44.74863 3.378096 13.25 0.000 38.12768 51.36957

---

ps <- |

rpl | .1115463 .0223155 5.00 0.000 .0678088 .1552838

pr | 1.156319 .1187188 9.74 0.000 .923635 1.389004

_cons | -6.192064 1.18529 -5.22 0.000 -8.51519 -3.868939

---

rpl <- |

api | .1427542 .0805356 1.77 0.076 -.0150927 .3006012

pr | -3.081554 .4584549 -6.72 0.000 -3.980109 -2.182999

rpdal | .0114159 .0069469 1.64 0.100 -.0021997 .0250315

_cons | 59.83396 8.573743 6.98 0.000 43.02973 76.63819

---

npkl <- |

hcpri | -.5178058 .1197777 -4.32 0.000 -.7525657 -.2830458

ava | -2.893115 .3136594 -9.22 0.000 -3.507876 -2.278354

gdppc | .0249204 .0228588 1.09 0.276 -.0198821 .0697229

dcps | -.6821757 .1811656 -3.77 0.000 -1.037254 -.3270976

_cons | 53.11861 19.49988 2.72 0.006 14.89955 91.33766

```
 api <-     |
       npkl |  -.0222176    .036613    -0.61   0.544    -.0939777    .0495426
      rpdal |  -.0481085   .0154333    -3.12   0.002    -.0783573   -.0178597
       infr |   .5690708   .1374125     4.14   0.000     .2997472    .8383945
      _cons |   102.0619    3.70535    27.54   0.000     94.79958    109.3243
-------------+----------------------------------------------------------------
Variance     |
    e.hcpri |    301.801   51.60952                      215.8544     421.969
       e.ps |   15.80868   2.680677                      11.33855    22.04113
      e.rpl |   197.4635   17.26461                      166.3661    234.3738
     e.npkl |   948.8345   107.7087                      759.5647    1185.267
      e.api |   175.4519    19.2042                      141.5759    217.4337
------------------------------------------------------------------------------
```

estat eqgof

Equation-level goodness of fit

```
             |            Variance            |
    depvars |    fitted  predicted   residual | R-squared       mc      mc2
-------------+--------------------------------+----------------------------
observed     |                                |
       hcpri |   349.727   47.80535    301.801 |  .1370383  .3701871  .1370385
          ps |  23.65486   7.839863   15.80868 |  .3316943  .5759291  .3316943
         rpl |  284.7275   87.18505   197.4635 |  .3064824  .5536086  .3064825
        npkl |  2110.703   1161.489   948.8345 |  .5504651  .7419334  .5504651
         api |  202.8404   27.31839   175.4519 |   .135025  .3674577  .1350252
     overall |                                |  .8066027
```

mc = correlation between depvar and its prediction

mc2 = mc^2 is the Bentler-Raykov squared multiple correlation coefficient

Appendix III

Chapter 2 data.

MONTHLY FOOD PRICE INDICES (2002-2004=100) Source FAO							
Date	Food Price Index	Date	Food Price Index	Date	Food Price Index	Date	Food Price Index
1/1990	106,9	10/1992	105,9	7/1995	126,5	4/1998	111,4
2/1990	108,1	11/1992	107,9	8/1995	124,2	5/1998	109,8
3/1990	106,4	12/1992	103,9	9/1995	125,3	6/1998	106,7
4/1990	112,8	1/1993	105,2	10/1995	129,1	7/1998	105,1
5/1990	109,9	2/1993	105,1	11/1995	127,9	8/1998	102,8
6/1990	107,4	3/1993	106,7	12/1995	126,8	9/1998	101,2
7/1990	104,2	4/1993	105,5	1/1996	128,8	10/1998	102,7
8/1990	100,9	5/1993	105,5	2/1996	129,3	11/1998	103,1
9/1990	102,4	6/1993	103,0	3/1996	130,8	12/1998	102,6
10/1990	101,4	7/1993	103,3	4/1996	134,1	1/1999	101,1
11/1990	101,1	8/1993	101,3	5/1996	137,3	2/1999	96,8
12/1990	103,9	9/1993	101,9	6/1996	134,5	3/1999	94,7
1/1991	103,1	10/1993	103,5	7/1996	133,1	4/1999	92,4
2/1991	105,0	11/1993	106,5	8/1996	132,3	5/1999	91,7
3/1991	103,6	12/1993	107,9	9/1996	127,0	6/1999	91,0
4/1991	100,7	1/1994	109,1	10/1996	122,8	7/1999	88,3
5/1991	99,5	2/1994	108,3	11/1996	119,9	8/1999	91,1
6/1991	100,8	3/1994	107,9	12/1996	119,7	9/1999	91,7
7/1991	100,9	4/1994	105,3	1/1997	118,1	10/1999	90,9
8/1991	101,4	5/1994	108,5	2/1997	119,6	11/1999	90,4
9/1991	103,6	6/1994	108,0	3/1997	122,3	12/1999	88,5
10/1991	106,9	7/1994	105,7	4/1997	122,4	1/2000	87,8
11/1991	108,9	8/1994	109,0	5/1997	122,0	2/2000	89,1
12/1991	108,8	9/1994	113,4	6/1997	118,0	3/2000	89,0
1/1992	108,8	10/1994	114,4	7/1997	115,1	4/2000	89,2
2/1992	110,4	11/1994	118,4	8/1997	116,7	5/2000	89,3
3/1992	109,1	12/1994	118,5	9/1997	116,1	6/2000	90,3
4/1992	108,7	1/1995	118,2	10/1997	117,6	7/2000	90,7
5/1992	109,8	2/1995	120,5	11/1997	118,5	8/2000	90,5
6/1992	111,9	3/1995	121,8	12/1997	115,1	9/2000	90,2
7/1992	109,7	4/1995	118,3	1/1998	113,6	10/2000	91,9
8/1992	107,6	5/1995	118,6	2/1998	113,2	11/2000	91,9
9/1992	108,1	6/1995	120,8	3/1998	112,8	12/2000	94,4

1/2001	92,2	7/2004	113,0	1/2008	199,8	7/2011	231,2
2/2001	93,0	8/2004	112,4	2/2008	215,4	8/2011	230,6
3/2001	94,3	9/2004	112,8	3/2008	218,3	9/2011	225,1
4/2001	92,7	10/2004	112,1	4/2008	217,3	10/2011	215,8
5/2001	94,2	11/2004	113,7	5/2008	218,5	11/2011	216,4
6/2001	93,0	12/2004	114,4	6/2008	224,4	12/2011	210,8
7/2001	95,5	1/2005	114,9	7/2008	220,4	1/2012	212,8
8/2001	95,2	2/2005	114,2	8/2008	208,9	2/2012	215,6
9/2001	93,7	3/2005	117,0	9/2008	196,7	3/2012	216,0
10/2001	91,7	4/2005	114,8	10/2008	172,6	4/2012	213,0
11/2001	92,6	5/2005	116,0	11/2008	157,3	5/2012	204,7
12/2001	92,2	6/2005	117,1	12/2008	148,1	6/2012	200,4
1/2002	90,1	7/2005	117,0	1/2009	146,3	7/2012	212,8
2/2002	88,3	8/2005	116,9	2/2009	141,3	8/2012	212,6
3/2002	88,3	9/2005	118,8	3/2009	143,1		
4/2002	86,7	10/2005	120,4	4/2009	147,4		
5/2002	85,2	11/2005	119,2	5/2009	157,6		
6/2002	86,0	12/2005	121,5	6/2009	158,1		
7/2002	88,1	1/2006	121,2	7/2009	154,2		
8/2002	89,6	2/2006	125,7	8/2009	159,5		
9/2002	92,9	3/2006	123,2	9/2009	159,9		
10/2002	93,4	4/2006	124,9	10/2009	163,0		
11/2002	95,1	5/2006	125,6	11/2009	174,9		
12/2002	94,6	6/2006	124,8	12/2009	178,1		
1/2003	95,5	7/2006	127,8	1/2010	180,0		
2/2003	97,2	8/2006	126,0	2/2010	176,1		
3/2003	95,3	9/2006	125,2	3/2010	168,5		
4/2003	94,5	10/2006	128,4	4/2010	170,2		
5/2003	95,4	11/2006	132,6	5/2010	169,6		
6/2003	95,7	12/2006	134,5	6/2010	168,2		
7/2003	94,8	1/2007	134,0	7/2010	172,7		
8/2003	96,3	2/2007	136,6	8/2010	183,0		
9/2003	98,2	3/2007	137,4	9/2010	194,2		
10/2003	100,8	4/2007	140,7	10/2010	205,0		
11/2003	103,6	5/2007	144,8	11/2010	212,9		
12/2003	105,3	6/2007	154,1	12/2010	223,3		
1/2004	108,5	7/2007	160,3	1/2011	231,3		
2/2004	109,6	8/2007	166,6	2/2011	237,9		
3/2004	113,2	9/2007	175,5	3/2011	232,0		
4/2004	113,4	10/2007	178,5	4/2011	234,9		
5/2004	111,9	11/2007	185,4	5/2011	231,6		
6/2004	114,0	12/2007	191,0	6/2011	233,4		

incidence of extreme rural poverty	1990	1998	2005
EAP	63,6	44,1	15,3
LAC	25,7	21,8	8,8
MNA	9,5	6,6	3,6
SAS	55,9	53,8	45,2
SSA	51,7	64,6	61,6
WLD	54	48,4	34,2

Chapter 4 data.

date	country	rural poverty line	agricultural trade balance (million USD)	gross per capita production index	GDP per capita (USD)
1990	Brd	36,20	46,72	128,68	199,27
1991	Brd	60,22	62,19	129,36	201,05
1992	Brd	84,24	44,80	130,54	183,01
1993	Brd	84,06	29,56	124,41	156,06
1994	Brd	83,89	56,92	107,97	151,71
1995	Brd	83,72	44,08	109,73	162,22
1996	Brd	83,54	14,75	110,29	139,67
1997	Brd	83,37	36,03	109,08	155,26
1998	Brd	83,20	53,72	101,76	141,60
1999	Brd	81,41	28,28	103,92	126,72
2000	Brd	79,62	11,96	98,07	109,55
2001	Brd	77,83	8,92	103,80	100,30
2002	Brd	76,04	-7,68	105,86	92,82
2003	Brd	74,25	-5,77	102,66	85,54
2004	Brd	72,46	-27,33	101,54	92,78
2005	Brd	70,68	17,62	99,58	107,87
1990	Ghn	48,00	225,56	55,15	397,88
1991	Ghn	46,90	150,03	79,92	433,72
1992	Ghn	45,80	69,75	76,87	409,60
1993	Ghn	44,70	125,90	81,03	370,41
1994	Ghn	43,60	149,75	74,44	328,64
1995	Ghn	42,50	181,84	82,93	379,92
1996	Ghn	41,40	599,38	87,94	397,35
1997	Ghn	40,30	370,83	84,39	385,55
1998	Ghn	39,20	357,33	89,69	408,84
1999	Ghn	36,58	265,71	93,18	411,94
2000	Ghn	33,96	215,11	89,66	259,71
2001	Ghn	31,34	-9,05	90,33	270,43
2002	Ghn	28,72	177,39	96,88	306,23

2003	Ghn	26,10	525,37	97,59	369,91
2004	Ghn	23,48	532,18	99,29	420,07
2005	Ghn	20,87	149,49	99,97	495,40
1990	Mlw	51,70	303,70	71,13	198,99
1991	Mlw	53,55	378,25	75,74	227,62
1992	Mlw	55,40	198,37	62,05	183,45
1993	Mlw	57,25	130,15	78,98	209,46
1994	Mlw	59,10	123,25	64,29	118,41
1995	Mlw	60,95	291,20	77,10	137,76
1996	Mlw	62,80	329,42	87,63	219,48
1997	Mlw	64,65	404,42	83,37	248,68
1998	Mlw	66,50	372,70	90,44	158,05
1999	Mlw	64,73	427,74	98,48	155,00
2000	Mlw	62,96	380,55	111,59	147,36
2001	Mlw	61,19	317,35	116,27	140,77
2002	Mlw	59,43	155,41	90,59	212,32
2003	Mlw	57,66	309,83	100,48	187,79
2004	Mlw	55,90	299,61	101,31	197,72
2005	Mlw	54,14	307,33	85,57	201,80
1990	Mzq	83,90	-170,01	91,80	181,88
1991	Mzq	81,80	-199,77	80,38	194,40
1992	Mzq	79,70	-242,68	68,74	137,51
1993	Mzq	77,60	-193,58	74,72	136,47
1994	Mzq	75,50	-338,68	71,17	140,29
1995	Mzq	73,40	-220,84	93,50	140,90
1996	Mzq	71,30	-171,17	100,84	193,45
1997	Mzq	68,60	-128,16	104,89	222,16
1998	Mzq	65,90	-171,76	108,64	244,69
1999	Mzq	63,25	-152,59	106,76	250,20
2000	Mzq	60,60	-164,25	93,39	232,82
2001	Mzq	57,95	-187,94	100,34	217,38
2002	Mzq	55,30	-238,84	98,60	218,14
2003	Mzq	52,83	-189,11	99,78	235,86
2004	Mzq	50,36	-305,22	100,89	280,54
2005	Mzq	47,90	-273,23	94,60	315,75
1990	Rwd	51,70	45,40	95,54	361,43
1991	Rwd	53,57	39,59	111,45	277,66
1992	Rwd	55,45	13,12	123,86	316,94
1993	Rwd	57,33	-31,66	96,66	333,02
1994	Rwd	59,21	-79,48	70,18	135,90
1995	Rwd	61,09	-50,69	88,14	237,75
1996	Rwd	62,97	-38,71	93,82	244,22
1997	Rwd	64,85	-18,25	88,28	301,02
1998	Rwd	66,73	-46,29	89,84	292,52

1999	Rwd	66,41	-5,09	89,33	259,46
2000	Rwd	66,10	-14,28	93,87	218,02
2001	Rwd	65,72	-32,11	88,48	201,53
2002	Rwd	65,34	-36,53	104,80	192,14
2003	Rwd	64,96	-20,35	97,37	212,56
2004	Rwd	64,58	-36,69	95,77	236,84
2005	Rwd	64,20	-11,08	100,70	287,05
1990	Ugd	65,00	144,79	112,28	242,76
1991	Ugd	62,65	138,51	111,43	180,92
1992	Ugd	60,30	90,00	106,08	150,40
1993	Ugd	57,98	126,74	109,32	163,94
1994	Ugd	55,66	159,19	105,66	196,62
1995	Ugd	53,34	312,50	106,76	274,69
1996	Ugd	51,02	382,11	102,12	279,62
1997	Ugd	48,70	244,97	99,50	281,28
1998	Ugd	44,93	226,02	104,11	286,61
1999	Ugd	41,16	177,82	106,97	253,24
2000	Ugd	37,40	126,94	105,14	253,48
2001	Ugd	40,05	74,36	108,14	231,62
2002	Ugd	42,70	98,92	109,68	237,31
2003	Ugd	39,86	-107,98	107,77	235,65
2004	Ugd	37,03	40,89	104,59	304,87
2005	Ugd	34,20	49,66	99,89	313,60
1990	Tzn	41,35	196,75	92,22	167,31
1991	Tzn	41,35	135,03	91,83	188,36
1992	Tzn	40,80	130,35	84,91	169,02
1993	Tzn	40,52	136,13	82,30	151,22
1994	Tzn	40,25	192,39	76,53	155,12
1995	Tzn	39,97	263,41	81,79	175,34
1996	Tzn	39,70	295,07	80,92	210,76
1997	Tzn	39,42	227,83	74,69	242,82
1998	Tzn	39,15	-10,95	79,05	287,96
1999	Tzn	38,87	194,56	80,65	291,44
2000	Tzn	38,60	118,20	76,80	298,43
2001	Tzn	38,42	64,10	83,36	296,45
2002	Tzn	38,25	68,26	97,23	300,51
2003	Tzn	38,08	86,68	84,67	315,71
2004	Tzn	37,91	52,30	94,89	338,01
2005	Tzn	37,74	181,61	100,34	362,54
1990	Zmb	83,00	-38,42	98,88	415,71
1991	Zmb	85,50	-2,63	101,25	414,75
1992	Zmb	88,00	-110,28	82,13	380,06
1993	Zmb	90,10	-37,33	107,52	380,16
1994	Zmb	92,20	-26,95	93,37	377,95

1995	Zmb	88,20	-53,59	80,89	381,83
1996	Zmb	84,20	-29,28	94,57	348,93
1997	Zmb	85,60	-12,77	88,50	405,36
1998	Zmb	87,00	-125,20	83,20	326,16
1999	Zmb	83,82	44,39	96,09	306,98
2000	Zmb	80,65	1,44	89,29	309,32
2001	Zmb	77,47	0,57	87,26	339,15
2002	Zmb	74,30	-14,08	87,22	338,68
2003	Zmb	75,80	-38,32	97,08	389,86
2004	Zmb	77,30	185,85	98,20	472,72
2005	Zmb	76,80	129,07	100,14	609,69
1990	Zbw	20,00	628,16	120,59	839,66
1991	Zbw	27,00	662,26	117,77	803,98
1992	Zbw	34,00	149,47	83,48	612,82
1993	Zbw	41,00	347,12	109,00	582,57
1994	Zbw	48,00	1045,40	114,16	599,24
1995	Zbw	46,00	696,02	91,41	607,11
1996	Zbw	44,00	884,60	120,35	718,06
1997	Zbw	44,50	894,85	123,53	705,40
1998	Zbw	45,00	710,17	119,38	522,71
1999	Zbw	48,71	627,54	117,01	547,46
2000	Zbw	52,42	926,09	132,88	530,42
2001	Zbw	56,14	815,79	125,06	540,63
2002	Zbw	59,85	351,63	102,25	502,60
2003	Zbw	63,57	511,49	103,15	452,27
2004	Zbw	67,28	381,43	109,04	453,98
2005	Zbw	71,00	181,25	93,11	447,56

Chapter 5 data

Date	Maize	Production	Area	Yield	Fertilizer use bag 50kg	Fertilizer prices	Labour ha used	Labour salary CHS	Farmgate prices CHS
2001	Western	75000	54099	0,7213	1	500	4,2354	148500	962543,74
2002	Western	86200	61570	0,7142	1	800	4,2354	193050	860015,28
2003	Western	86520	61800	0,7142	1	8000	4,2354	248400	959568,47
2004	Western	85479	59634	0,6976	1	9000	4,2354	302400	1358139,07
2001	Central	118000	91012	0,7712	1	500	4,2354	148500	962543,74
2002	Central	199670	91010	0,4558	1	800	4,2354	193050	860015,28
2003	Central	247110	94740	0,3833	1	8000	4,2354	248400	959568,47
2004	Central	159622	87160	0,5460	1	9000	4,2354	302400	1358139,07
2001	Eastern	201000	147744	0,7350	1	500	4,2354	148500	962543,74
2002	Eastern	332690	201530	0,6057	1	800	4,2354	193050	860015,28
2003	Eastern	244000	150600	0,6172	1	8000	4,2354	248400	959568,47
2004	Eastern	241621	141950	0,5874	1	9000	4,2354	302400	1358139,07
2001	Volta	63840	43350	0,6790	1	500	7,3019	89100	962543,74
2002	Volta	63850	45100	0,7063	1	800	7,3019	115830	860015,28
2003	Volta	58630	45500	0,7760	1	8000	7,3019	149040	959568,47
2004	Volta	53868	40730	0,7561	1	9000	7,3019	181440	1358139,07
2001	Ashanti	170000	119473	0,7027	1	500	4,2354	148500	962543,74
2002	Ashanti	269480	170120	0,6312	1	800	4,2354	193050	860015,28
2003	Ashanti	193920	119620	0,6168	1	8000	4,2354	248400	959568,47
2004	Ashanti	183032	113639	0,6208	1	9000	4,2354	302400	1358139,07
2001	Brong Ahafo	168000	99277	0,5909	1	500	3,0424	148500	962543,74
2002	Brong Ahafo	268980	160730	0,5975	1	800	3,0424	193050	860015,28
2003	Brong Ahafo	295680	176800	0,5979	1	8000	3,0424	248400	959568,47
2004	Brong Ahafo	281267	167900	0,5969	1	9000	3,0424	302400	1358139,07
2001	Northern	69878	104088	1,4895	1	500	4,0566	59400	962543,74
2002	Northern	94560	157020	1,6605	1	800	4,0566	77220	860015,28
2003	Northern	79050	89060	1,1266	1	8000	4,0566	99360	959568,47
2004	Northern	74566	66255	0,8885	1	9000	4,0566	120960	1358139,07
2001	Upper West	50738	36250	0,7144	1	500	4,0566	59400	962543,74

2002	Upper West	62560	36730	0,5871	1	800	4,0566	77220	860015,28
2003	Upper West	60710	37790	0,6224	1	8000	4,0566	99360	959568,47
2004	Upper West	60801	40260	0,6621	1	9000	4,0566	120960	1358139,07
2001	Upper East	15000	9995	0,6663	1	500	6,9719	59400	962543,74
2002	Upper East	18390	11410	0,6204	1	800	6,9719	77220	860015,28
2003	Upper East	20370	11920	0,5851	1	8000	6,9719	99360	959568,47
2004	Upper East	14650	11040	0,7535	1	9000	6,9719	120960	1358139,07

Date	Cocoa	Production	Area	Yield	Fertilizer use bag 50kg	Fertilizer prices USD 50 kg	Pest used 50kg	pest prices USD 50kg
2001	Western	203,627	648,64	0,3139	0,45	0,070	0,14	0,14
2002	Western	181,658	578,66	0,3139	0,45	0,100	0,14	0,21
2003	Western	276,586	728,11	0,3798	5,14	0,920	0,94	1,94
2004	Western	419,71	1104,88	0,3798	5,14	1,000	0,94	2,10
2001	Ashanti	72,994	229,91	0,3174	0,45	0,070	0,14	0,14
2002	Ashanti	57,011	179,57	0,3174	0,45	0,100	0,14	0,21
2003	Ashanti	82,445	223,13	0,3694	5,14	0,920	0,94	1,94
2004	Ashanti	121,233	328,11	0,3694	5,14	1,000	0,94	2,10
2001	Brong Ahafo	33,109	107,29	0,3085	0,45	0,070	0,14	0,14
2002	Brong Ahafo	31,432	101,86	0,3085	0,45	0,100	0,14	0,21
2003	Brong Ahafo	45,309	125,57	0,3608	5,14	0,920	0,94	1,94
2004	Brong Ahafo	69,688	193,13	0,3608	5,14	1,000	0,94	2,10
2001	Central	32,136	146,20	0,2198	0,45	0,070	0,14	0,14
2002	Central	30,039	142,79	0,2103	0,45	0,100	0,14	0,21
2003	Central	39,989	183,01	0,2185	5,14	0,920	0,94	1,94
2004	Central	56,631	167,58	0,3379	5,14	1,000	0,94	2,10
2001	Eastern	46,225	210,30	0,2198	0,45	0,070	0,14	0,14
2002	Eastern	39,343	187,01	0,2103	0,45	0,100	0,14	0,21
2003	Eastern	51,604	236,17	0,2185	5,14	0,920	0,94	1,94
2004	Eastern	67,804	200,64	0,3379	5,14	1,000	0,94	2,10
2001	Volta	1,68	7,64	0,2198	0,45	0,070	0,14	0,14
2002	Volta	1,079	5,12	0,2103	0,45	0,100	0,14	0,21

2003	Volta	0,913	4,17	0,2185	5,14	0,920	0,94	1,94
2004	Volta	1,909	5,64	0,3379	5,14	1,000	0,94	2,10
2001	Ghana	398,771	1350	0,2953	0,45	0,070	0,14	0,14
2002	Ghana	340,562	1195	0,2849	0,45	0,100	0,14	0,21
2003	Ghana	496,846	1500	0,3312	5,14	0,920	0,94	1,94
2004	Ghana	736,975	2000	0,3684	5,14	1,000	0,94	2,10

Date	Cocoa	Labour ha used	Labour salary USD	Farmgate prices USD
2001	Western	5,03	21	533,26
2002	Western	5,03	24	848,75
2003	Western	1,69	29	769,56
2004	Western	1,69	34	639,78
2001	Ashanti	5,03	21	533,26
2002	Ashanti	5,03	24	848,75
2003	Ashanti	1,69	29	769,56
2004	Ashanti	1,69	34	639,78
2001	Brong Ahafo	5,03	21	533,26
2002	Brong Ahafo	5,03	24	848,75
2003	Brong Ahafo	1,69	29	769,56
2004	Brong Ahafo	1,69	34	639,78
2001	Central	5,03	21	533,26
2002	Central	5,03	24	848,75
2003	Central	1,69	29	769,56
2004	Central	1,69	34	639,78
2001	Eastern	5,03	21	533,26
2002	Eastern	5,03	24	848,75
2003	Eastern	1,69	29	769,56
2004	Eastern	1,69	34	639,78
2001	Volta	5,03	12,6	533,26
2002	Volta	5,03	14,4	848,75
2003	Volta	1,69	17,4	769,56
2004	Volta	1,69	20,4	639,78
2001	Ghana	5,03		533,26
2002	Ghana	5,03		848,75
2003	Ghana	1,69		769,56
2004	Ghana	1,69		639,78

Chapter 6 data.

date	Country	hcpri	ps	pr	npkl	dcps	ava	Gdppc
1990	Brd	30,485008	3	4,317838	-153	8,614541	55,8787	199,26
1991	Brd	33,895710	3	4,317838	-155	10,74847	54,31071	201,04
1992	Brd	40,640968	3	4,317838	-157	10,72101	53,53346	183,01
1993	Brd	36,839887	3	4,317838	-160	14,0312	52,6187	156,05
1994	Brd	37,261564	3	4,317838	-153,3	14,73612	46,77811	151,71
1995	Brd	50,004356	3	4,317838	-146,68	12,26566	48,1446	162,22
1996	Brd	50,826972	3	4,317838	-140	14,23341	57,2216	139,66
1997	Brd	48,594000	7	5,062126	-133,37	11,8717	49,19258	155,26
1998	Brd	52,956066	10	5,620342	-126,7	13,53521	46,32378	141,59
1999	Brd	55,442488	10	5,620342	-120	15,39021	43,69426	126,72
2000	Brd	41,148960	10	5,620342	-113,4	24,97746	40,39854	109,54
2001	Brd	38,759767	5	3,573247	-104,3	25,91138	39,52496	100,30
2002	Brd	36,400538	5	4,689982	-95,2	31,1032	40,53309	92,82
2003	Brd	34,120851	9	3,945694	-86,1	29,27067	40,07917	85,54
2004	Brd	33,630811	9	3,945694	-77	26,37291	40,07917	92,77
2005	Brd	41,732166	9	4,563713	-83,4	22,26747	34,84865	107,87
1990	Ghn	58,757334	3	8,286258	-72,75	4,928698	45,06752	393,25
1991	Ghn	55,798483	3	8,286258	-75	3,65734	45,55957	428,50
1992	Ghn	56,511026	3	8,286258	-77,25	4,941929	44,96376	404,50
1993	Ghn	56,511037	3	8,286258	-79,5	4,838176	41,36654	365,63
1994	Ghn	60,056262	3	8,286258	-77,85	5,250033	41,97789	324,17
1995	Ghn	57,893646	3	8,286258	-76,21	5,073565	42,70311	374,44
1996	Ghn	63,690618	6	9,138610	-74,57	6,005079	43,87821	391,20
1997	Ghn	63,389837	9	9,990962	-72,92	8,195094	40,05235	379,13
1998	Ghn	62,380970	9	9,990962	-71,28	9,358847	40,23304	401,60
1999	Ghn	63,089182	9	9,990962	-69,64	12,56208	39,92779	404,36
2000	Ghn	61,577502	9	9,990962	-68	13,97149	39,41372	254,87
2001	Ghn	60,876123	12	8,593966	-65,5	11,88439	39,32504	265,46
2002	Ghn	62,757512	12	8,593966	-63	12,14954	39,2114	300,83
2003	Ghn	61,702697	12	8,722160	-60,5	12,49305	40,23846	363,84
2004	Ghn	60,544670	12	8,722160	-58	13,17249	41,54732	413,89
2005	Ghn	63,518821	12	10,025187	-63,6	15,54407	40,93535	489,17
1990	Mlw	43,36953	1	1,00000	-118,8	10,94942	45,00002	198,99
1991	Mlw	46,33245	1	1,00000	-115,2	11,55163	43,72188	227,62
1992	Mlw	53,04434	1	1,00000	-111,6	14,69475	38,81648	183,45
1993	Mlw	55,49504	1	1,00000	-108	9,393337	48,9042	209,46

1994	Mlw	55,87594	1	1,00000	-113,57	12,5602	25,07651	118,41
1995	Mlw	56,43569	1	1,00000	-119,14	6,496234	30,39803	137,76
1996	Mlw	61,15695	1	1,00000	-124,71	4,509538	34,6901	219,48
1997	Mlw	76,26039	1	1,00000	-130,28	4,289617	32,58982	248,67
1998	Mlw	82,85438	2	2,00000	-135,85	7,108802	35,58186	158,05
1999	Mlw	89,79562	16	8,60269	-141,42	7,960646	37,84101	155,00
2000	Mlw	133,38654	16	8,60269	-147	9,075887	39,53955	147,36
2001	Mlw	130,11229	16	8,60269	-128,25	8,420598	38,78214	140,77
2002	Mlw	123,60955	16	8,60269	-109,5	5,802062	36,73927	212,31
2003	Mlw	116,95058	16	8,66122	-90,75	5,460706	35,73723	187,78
2004	Mlw	114,80251	16	8,66122	-72	6,042057	34,63307	197,71
2005	Mlw	115,10938	16	8,60632	-75,28	7,912583	32,63406	201,79
1990	Mzq	57,023342	3	2,000000	-28,35	17,58611	37,11874	181,87
1991	Mzq	46,512491	3	2,000000	-26,4	14,9875	39,14283	194,39
1992	Mzq	36,804886	3	2,000000	-24,45	16,94389	34,51174	137,50
1993	Mzq	31,041645	3	2,000000	-22,5	12,13511	38,26789	136,47
1994	Mzq	30,573383	3	2,000000	-26,85	11,56524	33,25365	140,29
1995	Mzq	37,528595	4	3,000000	-31,21	11,48171	34,79753	140,90
1996	Mzq	41,277685	4	3,000000	-35,57	9,435957	35,22374	193,45
1997	Mzq	40,678091	4	3,000000	-39,92	11,75394	34,85253	222,15
1998	Mzq	40,964018	15	7,261203	-44,28	12,73895	30,84486	244,69
1999	Mzq	42,605104	15	7,261203	-48,64	14,88582	28,56484	250,20
2000	Mzq	44,975609	15	7,261203	-53	16,74163	24,0098	232,81
2001	Mzq	43,739467	15	7,261203	-52,5	12,55739	22,50525	217,37
2002	Mzq	42,230248	15	7,791731	-52	12,88452	27,82138	218,14
2003	Mzq	40,632275	15	7,791731	-51,5	11,40441	28,03652	235,86
2004	Mzq	42,678298	15	8,186166	-51	9,465281	27,41313	280,54
2005	Mzq	44,617574	15	8,186166	-54,2	11,8419	26,96016	315,75
1990	Rwd	43,166847	3	3,000000	-134,48	6,920656	32,54599	361,43
1991	Rwd	46,842046	3	3,000000	-135,12	5,1197	32,13271	277,66
1992	Rwd	47,855810	3	3,000000	-135,76	5,675161	33,23762	316,94
1993	Rwd	48,359407	3	3,000000	-136,4	6,329145	33,73489	333,01
1994	Rwd	48,824387	3	3,000000	-139,48	9,88228	49,75875	135,89
1995	Rwd	48,553139	3	3,000000	-142,57	8,414883	44,00045	237,74
1996	Rwd	50,100632	3	3,000000	-145,65	6,806436	47,18929	244,22
1997	Rwd	54,510837	3	3,000000	-148,74	8,090274	45,96095	301,02
1998	Rwd	56,049706	3	3,000000	-151,82	8,759214	45,51746	292,52
1999	Rwd	57,516828	4	5,953936	-154,91	9,34216	41,93518	259,46
2000	Rwd	58,810365	4	5,953936	-158	10,41283	37,18671	218,01

2001	Rwd	65,214283	4	4,025602	-137,75	10,3719	37,33604	201,52
2002	Rwd	67,112167	4	4,025602	-117,5	10,87657	35,49449	192,13
2003	Rwd	71,557793	4	4,791062	-97,25	9,768594	37,00705	212,55
2004	Rwd	77,385944	4	4,791062	-77	10,80417	38,56196	236,84
2005	Rwd	84,787286	6	5,268421	-85,58	11,20636	38,39036	287,04
1990	Ugd	46,690058	3	1,827611	-82,16	0	56,5769	242,76
1991	Ugd	43,999830	3	1,827611	-84,04	0,000000	52,82168	180,91
1992	Ugd	47,074698	3	1,827611	-85,92	4,001072	51,12052	150,40
1993	Ugd	49,562088	3	1,827611	-87,8	4,42597	51,5401	163,94
1994	Ugd	46,852119	3	1,827611	-87,4	4,366991	49,92329	196,61
1995	Ugd	44,894842	3	1,827611	-87	4,589903	49,39077	274,69
1996	Ugd	43,973837	3	1,827611	-86,6	5,287803	45,14212	279,61
1997	Ugd	38,467464	6	5,179327	-86,2	4,831661	41,98402	281,28
1998	Ugd	40,606984	6	5,179327	-85,8	5,617737	42,07154	286,61
1999	Ugd	40,415497	6	5,179327	-85,4	6,355036	38,45645	253,24
2000	Ugd	41,000287	6	9,212607	-85	6,234175	29,38456	253,48
2001	Ugd	41,506756	6	9,212607	-80,25	7,108612	29,69154	231,61
2002	Ugd	68,273933	6	9,325654	-75,5	7,949801	24,90403	237,31
2003	Ugd	71,527263	6	9,325654	-70,75	8,402405	26,14874	235,64
2004	Ugd	74,965571	6	8,622546	-66	7,971469	22,91541	304,86
2005	Ugd	76,348603	6	8,622546	-84,3	8,630845	26,70464	313,59
1990	Tzn	49,976639	4	4,000000	-80,03	13,902	45,95766	167,30
1991	Tzn	45,787600	4	4,000000	-83,32	14,03012	48,13969	188,35
1992	Tzn	43,641356	4	4,000000	-86,61	9,74467	47,9969	169,02
1993	Tzn	41,683618	4	4,000000	-89,9	10,79704	48,10843	151,21
1994	Tzn	41,815917	4	4,000000	-86,91	9,699474	44,98056	155,11
1995	Tzn	43,634025	4	4,000000	-83,92	6,655024	47,14438	175,33
1996	Tzn	44,535365	4	4,000000	-80,94	3,093606	48,03032	210,75
1997	Tzn	42,960421	5	5,000000	-77,95	3,545348	46,7994	242,81
1998	Tzn	42,561293	5	5,000000	-74,97	3,861583	33,76269	287,96
1999	Tzn	42,495649	5	5,000000	-71,98	4,183627	34,12771	291,44
2000	Tzn	42,526153	9	9,000000	-69	4,087733	33,48266	298,42
2001	Tzn	42,443505	9	8,728765	-67	5,381469	32,86714	296,45
2002	Tzn	42,447451	9	8,728765	-65	6,83473	32,45784	300,51
2003	Tzn	40,789533	9	8,628638	-63	8,083006	32,52526	315,71
2004	Tzn	40,689873	9	8,628638	-61	9,240734	33,32772	338,00
2005	Tzn	40,757688	9	8,752319	-65,04	10,18105	31,75921	362,54
1990	Zmb	67,570608	1	1,000000	-21,6	8,875596	20,6048	415,70
1991	Zmb	66,535186	1	1,000000	-24,4	7,257744	17,42769	414,74

1992	Zmb	65,884532	1	1,000000	-27,2	0	23,81227	380,06
1993	Zmb	66,622499	1	1,000000	-30	4,789315	34,10152	380,15
1994	Zmb	66,804006	1	1,000000	-26,71	6,267216	15,49243	377,94
1995	Zmb	66,637685	16	1,396328	-23,42	8,451328	18,40538	381,82
1996	Zmb	67,298282	16	1,396328	-20,14	9,463993	17,57157	348,92
1997	Zmb	65,390083	16	1,396328	-16,85	7,998531	18,65556	405,36
1998	Zmb	63,945241	16	1,396328	13,57	7,025409	21,13795	326,16
1999	Zmb	62,439788	16	1,396328	-10,28	7,401809	24,18489	306,98
2000	Zmb	61,208701	11	7,891818	-7	8,551136	22,31072	309,31
2001	Zmb	61,446551	11	7,891818	-11,5	7,484198	22,12078	339,15
2002	Zmb	61,998726	11	8,728454	-16	6,290813	22,06894	338,68
2003	Zmb	61,817157	11	8,728454	-20,5	6,725026	22,57418	389,86
2004	Zmb	60,646974	11	8,403201	-25	8,082964	23,02555	472,72
2005	Zmb	60,885171	15	8,508889	-31,02	7,72088	23,31833	609,69
1990	Zbw	93,972910	11	11	-51,5	23,03992	16,4763	839,66
1991	Zbw	79,833670	4	7,309740973	-50	26,16616	15,26726	803,97
1992	Zbw	76,771205	4	7,309740973	-48,5	28,77094	7,413793	612,81
1993	Zbw	73,691187	4	7,309740973	-47	29,84063	15,03891	582,57
1994	Zbw	72,777138	4	7,309740973	-48	28,40845	18,9734	599,24
1995	Zbw	64,444683	4	7,309740973	-49	33,83775	15,23519	607,10
1996	Zbw	63,859238	4	7,309740973	-50	31,23235	21,77111	718,05
1997	Zbw	61,182109	4	7,309740973	-51	38,59646	18,93408	705,40
1998	Zbw	60,447107	4	7,309740973	-52	34,70909	21,78853	522,71
1999	Zbw	59,004019	4	7,309740973	-53	22,56969	19,41935	547,45
2000	Zbw	57,919959	4	6,638664492	-54	27,45365	18,49225	530,41
2001	Zbw	56,768819	4	6,638664492	-53,75	34,61456	17,35378	540,62
2002	Zbw	56,170936	4	7,308399631	-53,5	104,4689	14,14226	502,59
2003	Zbw	56,170936	7	8,889939214	-53,25	57,73111	16,79741	452,27
2004	Zbw	56,170936	7	4,591611711	-53	18,45178	20,10993	453,97
2005	Zbw	56,170936	6	4,06443185	-57,04	16,27979	19,19832	447,56

Date	Country	api	rpdal	rd	rld	infr	rpl
1990	Brd	128,68	572,402	52,03018	0	52,03018	36,2
1991	Brd	129,36	583,898	52,03018	0	52,03018	60,22
1992	Brd	130,54	593,9454	52,03018	0	52,03018	84,24
1993	Brd	124,41	602,5088	52,03018	0	52,03018	84,06
1994	Brd	107,97	609,6024	52,03018	0	52,03018	83,89
1995	Brd	109,73	608,8256	52,03018	0	52,03018	83,72
1996	Brd	110,29	612,8069	52,03018	0	52,03018	83,54
1997	Brd	109,08	609,1973	52,03018	0	52,03018	83,37
1998	Brd	101,76	612,2	52,03018	0	52,03018	83,2
1999	Brd	103,92	610,5809	52,03018	0	52,03018	81,41
2000	Brd	98,07	618,2702	52,03018	0	52,03018	79,62
2001	Brd	103,8	619,4605	50,47934	0	50,47934	77,83
2002	Brd	105,86	626,01	48,92849	0	48,92849	76,04
2003	Brd	102,66	639,2236	47,37765	0	47,37765	74,25
2004	Brd	101,54	659,7842	45,8268	0	45,8268	72,46
2005	Brd	99,58	705,8358	44,27596	0	44,27596	70,68
1990	Ghn	55,15	352,568	15,99103	0,399514	16,39054	48
1991	Ghn	79,92	345,759	15,37268	0,399514	15,7722	46,9
1992	Ghn	76,87	351,7064	15,51103	0,399514	15,91054	45,8
1993	Ghn	81,03	357,6735	15,59487	0,399514	15,99438	44,7
1994	Ghn	74,44	363,4607	15,67871	0,399514	16,07823	43,6
1995	Ghn	82,93	344,3344	15,76256	0,399514	16,16207	42,5
1996	Ghn	87,94	327,0628	15,8464	0,399514	16,24591	41,4
1997	Ghn	84,39	294,2448	16,0724	0,399514	16,47191	40,3
1998	Ghn	89,69	281,895	16,29608	0,399514	16,69559	39,2
1999	Ghn	93,18	281,1952	16,52092	0,399514	16,92043	36,58
2000	Ghn	89,66	276,8712	16,52092	0,402868	16,92379	33,96
2001	Ghn	90,33	272,1073	17,69165	0,406221	18,09787	31,34
2002	Ghn	96,88	266,7959	18,86239	0,409575	19,27196	28,72
2003	Ghn	97,59	268,9794	20,03312	0,409575	20,44269	26,1
2004	Ghn	99,29	283,8028	22,76809	0,40706	23,17515	23,48
2005	Ghn	99,97	285,9929	24,15276	0,404545	24,55731	20,87
1990	Mlw	71,13	371,3386	8,612424	0,665935	9,278359	51,7
1991	Mlw	75,74	362,7538	11,66357	0,665935	12,32951	53,55
1992	Mlw	62,05	374,1155	11,94379	0,665935	12,60972	55,4
1993	Mlw	78,98	375,5648	11,94885	0,665935	12,61479	57,25
1994	Mlw	64,29	413,6545	11,98852	0,665935	12,65446	59,1

1995	Mlw	77,1	382,3859	12,31769	0,665935	12,98363	60,95
1996	Mlw	87,63	373,7942	12,31769	0,599257	12,91695	62,8
1997	Mlw	83,37	375,6819	13,88504	0,599257	14,4843	64,65
1998	Mlw	90,44	364,4794	13,88504	0,599257	14,4843	66,5
1999	Mlw	98,48	361,4642	13,88504	0,599257	14,4843	64,73
2000	Mlw	111,59	364,8383	13,88504	0,599257	14,4843	62,96
2001	Mlw	116,27	361,0156	13,88504	0,599257	14,4843	61,19
2002	Mlw	90,59	369,7955	13,88504	0,599257	14,4843	59,43
2003	Mlw	100,48	378,4738	13,88504	0,599257	14,4843	57,66
2004	Mlw	101,31	367,8751	13,88504	0,599257	14,4843	55,9
2005	Mlw	85,57	376,4084	13,88504	0,617615	14,50266	54,14
1990	Mzq	91,8	309,7276	3,368305	0	3,368305	83,9
1991	Mzq	80,38	308,5313	3,443157	0	3,443157	81,8
1992	Mzq	68,74	312,6513	3,518008	0	3,518008	79,7
1993	Mzq	74,72	320,1182	3,580384	0	3,580384	77,6
1994	Mzq	71,17	323,0951	3,642136	0	3,642136	75,5
1995	Mzq	93,5	322,4037	3,730086	0	3,730086	73,4
1996	Mzq	100,84	319,4238	3,792462	0	3,792462	71,3
1997	Mzq	104,89	311,7816	3,792462	0	3,792462	68,6
1998	Mzq	108,64	308,0276	3,792462	0	3,792462	65,9
1999	Mzq	106,76	315,9458	3,792462	0	3,792462	63,25
2000	Mzq	93,39	324,2781	3,792462	0	3,792462	60,6
2001	Mzq	100,34	321,2171	3,791386	0	3,791386	57,95
2002	Mzq	98,6	293,3498	3,79031	0	3,79031	55,3
2003	Mzq	99,78	294,6442	3,789234	0	3,789234	52,83
2004	Mzq	100,89	292,5611	3,788159	0	3,788159	50,36
2005	Mzq	94,6	303,256	3,787083	0,382989	4,170071	47,9
1990	Rwd	95,54	768,6569	49,84109	0	49,84109	51,7
1991	Rwd	111,45	735,7046	51,07832	0	51,07832	53,57
1992	Rwd	123,86	682,7617	52,21339	0	52,21339	55,45
1993	Rwd	96,66	646,7057	52,97011	0	52,97011	57,33
1994	Rwd	70,18	731,0726	54,10518	0	54,10518	59,21
1995	Rwd	88,14	712,6978	55,24026	0	55,24026	61,09
1996	Rwd	93,82	683,7439	56,37533	0	56,37533	62,97
1997	Rwd	88,28	688,1266	52,71787	0	52,71787	64,85
1998	Rwd	89,84	733,1438	49,06041	0	49,06041	66,73
1999	Rwd	89,33	750,3244	45,40295	0	45,40295	66,41
2000	Rwd	93,87	762,1801	45,40295	0	45,40295	66,1
2001	Rwd	88,48	710,177	47,30231	0	47,30231	65,72

2002	Rwd	104,8	648,2065	49,20167	0	49,20167	65,34
2003	Rwd	97,37	634,2649	51,10102	0	51,10102	64,96
2004	Rwd	95,77	638,392	53,00038	0	53,00038	64,58
2005	Rwd	100,7	645,0883	53,00038	0	53,00038	64,2
1990	Ugd	112,28	315,2549	7,774228	0,511118	8,285347	65
1991	Ugd	111,43	324,7105	7,340939	0,514852	7,855791	62,65
1992	Ugd	106,08	334,21	6,90765	0,514852	7,422502	60,3
1993	Ugd	109,32	345,0924	6,474361	0,514852	6,989213	57,98
1994	Ugd	105,66	354,648	6,041072	0,514852	6,555924	55,66
1995	Ugd	106,76	365,6526	5,607783	0,518586	6,126369	53,34
1996	Ugd	102,12	376,891	5,174494	0,518586	5,69308	51,02
1997	Ugd	99,50	388,2383	4,741205	0,518586	5,259791	48,7
1998	Ugd	104,11	399,8309	4,307916	0,381877	4,689793	44,93
1999	Ugd	106,97	411,851	3,874627	0,245049	4,119676	41,16
2000	Ugd	105,14	424,4361	3,441338	0,108281	3,549618	37,4
2001	Ugd	108,14	434,2079	12,07767	0,107451	12,18512	40,05
2002	Ugd	109,68	447,9097	20,71993	0,107451	20,82738	42,7
2003	Ugd	107,77	453,3102	29,35032	0,107451	29,45777	39,86
2004	Ugd	104,59	459,0334	29,35032	0,107451	29,45777	37,03
2005	Ugd	99,89	465,0342	29,35032	0,107451	29,45777	34,2
1990	Tzn	92,22	229,3745	8,987901	0,47022	9,458121	41,35
1991	Tzn	91,83	236,1125	9,095695	0,471913	9,567608	41,35
1992	Tzn	84,91	243,3789	9,203489	0,471913	9,675402	40,8
1993	Tzn	82,3	250,7176	9,311283	0,471913	9,783195	40,52
1994	Tzn	76,53	257,909	9,311283	0,471913	9,783195	40,25
1995	Tzn	81,79	264,7509	9,321864	0,472442	9,794305	39,97
1996	Tzn	80,92	271,0387	9,332445	0,275635	9,60808	39,7
1997	Tzn	74,69	278,4484	9,332445	0,288015	9,620459	39,42
1998	Tzn	79,05	285,9514	9,332445	0,288015	9,620459	39,15
1999	Tzn	80,65	293,4991	9,332445	0,484822	9,817266	38,87
2000	Tzn	76,8	301,364	9,332445	0,484822	9,817266	38,6
2001	Tzn	83,36	304,295	9,004116	0,484822	9,488938	38,42
2002	Tzn	97,23	304,0193	8,675788	0,484822	9,160609	38,25
2003	Tzn	84,67	298,5569	8,347459	0,484822	8,832281	38,08
2004	Tzn	94,89	304,2828	8,530151	0,484822	9,014972	37,91
2005	Tzn	100,34	311,2377	8,712842	0,275106	8,987948	37,74
1990	Zmb	98,88	209,1461	4,690344	0,169145	4,859489	83
1991	Zmb	101,25	230,797	4,796641	0,169145	4,965786	85,5
1992	Zmb	82,13	236,7637	4,876364	0,169145	5,045508	88

1993	Zmb	107,52	243,8121	4,963926	0,169145	5,13307	90,1
1994	Zmb	93,37	246,3832	5,07567	0,169145	5,244815	92,2
1995	Zmb	80,89	280,5506	8,873254	0,169145	9,042399	88,2
1996	Zmb	94,57	262,2949	8,873254	0,169145	9,042399	84,2
1997	Zmb	88,5	279,968	8,873254	0,169145	9,042399	85,6
1998	Zmb	83,2	305,9904	8,873254	0,169145	9,042399	87
1999	Zmb	96,09	288,8772	8,873254	0,169145	9,042399	83,82
2000	Zmb	89,29	306,7265	8,873254	0,169145	9,042399	80,65
2001	Zmb	87,26	326,2153	8,873254	0,169145	9,042399	77,47
2002	Zmb	87,22	358,5111	8,873254	0,169145	9,042399	74,3
2003	Zmb	97,08	318,9733	8,873254	0,169145	9,042399	75,8
2004	Zmb	98,2	327,1184	8,873254	0,169145	9,042399	77,3
2005	Zmb	100,14	354,2238	8,873254	0,169145	9,042399	76,8
1990	Zbw	120,59	257,0033	23,08322	0,70606	23,78928	20
1991	Zbw	117,77	258,4749	23,16	0,70606	23,86606	27
1992	Zbw	83,48	259,3645	23,30791	0,70606	24,01397	34
1993	Zbw	109	259,702	23,31329	0,70606	24,01935	41
1994	Zbw	114,16	259,5384	14,01896	0,70606	14,72502	48
1995	Zbw	91,41	258,9068	4,724639	0,70606	5,430699	46
1996	Zbw	120,35	254,6624	7,245528	0,70606	7,951588	44
1997	Zbw	123,53	250,1415	9,766417	0,70606	10,47248	44,5
1998	Zbw	119,38	254,2046	12,87307	0,701965	13,57503	45
1999	Zbw	117,01	255,1454	14,80819	0,697871	15,50607	48,71
2000	Zbw	132,88	255,2771	17,32908	0,693776	18,02286	52,42
2001	Zbw	125,06	254,6156	19,84997	0,689671	20,53964	56,14
2002	Zbw	102,25	249,4373	22,37086	0,685577	23,05644	59,85
2003	Zbw	103,15	247,6865	24,89175	0,681482	25,57323	63,57
2004	Zbw	109,04	238,4624	24,89175	0,677388	25,56914	67,28
2005	Zbw	93,11	229,7853	24,89175	0,673293	25,56504	71