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**INTERNATIONAL MANAGEMENT IN PRODUCTION OF CEREALS
AND PULSES CROP**

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ABSTRACT

Cereals and pulses are the most important food sources for supplying protein, calories, and energy especially for those who live in the developing countries. Therefore, in our study, population growth and production of cereals and pulses crops in the world, in a forty-year period were reviewed. In this assessment, World Bank reports and Food and Agricultural Organization Statistics (FAOSTAT) were used. The results shown that, from 1970 to 2009, population increase in Africa, America, Asia, Europe, and Oceania were equal to 174.32, 79.80, 93.02, 11.64, and 81.42 per cent, respectively. In the other side, cereals production had been increased from 1.19 billion tons in 1970 to 2.49 billion tons in 2009 in the world (109 %). Indeed, these statistics show that the world production of cereals has been increased 33 million tons per year. During 1970 to 2009, pulses production in Africa, America, Asia, and Oceania increased by 155.62%, 162.03%, 25.6% and 185.25%, respectively. While, at this time, Europe was decrease pulses production from 10.5 to 6.2 million tons. This decline occurred at a critical time when more food is needed.

Keywords: Cereals, Green Revolution, Population, Pulses

INTRODUCTION

Increasing world population and scarcity of water, land, energy and other factors limiter food production, will reduce food security. Today's more than one-seventh of world's population has not adequate access to their daily protein and energy requirements and suffers from food poverty [1]. The gap between food production and world population is ceaselessly widening and estimated that over the next fifty years this number will increase to 3.5 billion people [2, 3]. In the future, not only the human face hunger, but food insecurity can be devastating effects on physical, social, and psychological health. In the past, researchers have been trying to create harmony between the rate of population and food production. These efforts have been successful in many times [4]. Increasing in agricultural production was obtained by combination of many factors such as expanded irrigation, improved production practices [5], increased use of chemical fertilizer [6], and use of high yield cultivars (referred to as the "Green Revolution") [7, 8]. In the other side, crops production are affected significantly by climate change, including rising temperatures, changing precipitation regimes, and increased atmospheric carbon dioxide levels [9]. Therefore, population growth and food

production in future is the fundamental human challenges. Statistics and data analysis can help to plan better for the future [10]. Hence, in this article is to study population growth and the production of two major agricultural products cereals and pulses (that large share of food, protein and calories needed by human), across five continents and during a period of 40 years are reviewed and analyzed.

The main objective present work was simultaneous analysis of world population growth and production of two main agricultural products (cereals and pulses crops) during 1970 to 2009 in the world.

MATERIALS AND METHODS

In order to evaluation of world population growth and production of cereals and pulses crops in a forty-year period (1970-2009), World Bank reports and Food and Agricultural Organization Statistics (FAOSTAT) were used. The statistical data were analyzed and results obtained were depicted in several Tables and charts. Excel software was used for drawing graphs.

RESULTS AND DISCUSSION

Change in World Population During (1970-2009)

World population from 1970 to 2009 of 3.7 to 6.8 billion has increased [11] (Figure 1A).

Therefore, increasing in world population was equal to 84.77%. Averagely, over 80 million people added to world population per annum. At this time, share of Africa and Asia were increased 4.83 and 2.58 per cent, respectively. In contrast, America, Europe and Oceania share from the world population was decreased 0.38, 7.02, and 0.01 per cent, respectively (**Figure 1B**). Indeed, decline in population growth in these continents has been replaced by Africa and Asia. Statistics show that from 1970 to 2009, population increase in Africa, America, Asia, Europe, and Oceania were equal to 174.32, 79.80, 93.02, 11.64, and 81.42 per cent, respectively. If these trends continue, in 2050 will witness the 8.9 billion human beings [12].

Changes' Trend in Cereals Production in Five Continents From 1970 to 2009

Food and Agricultural Organization statistics show that within 1970 up to 2009, cereals production had been increased from 1.19 billion tons in 1970 to 2.49 billion tons in 2009 in the world (109 per cent increase) (**Figure 2A**). Indeed, this statistics show that the world production of cereals has been increased 33 million tons per year. While, at this period the cereals harvested area has been increased only 3.5 per cent. Therefore, increase of cereals production in the world has been done via increasing the yield per unit

area. This progress was possible with agricultural research and testing conducted in many years, resulted in new cultivars. These new cultivars produced more grain when fertilizer and irrigation water were applied [13]. For many years, supply growth was largely a consequence of increases in cultivated area [14]. Over time, the possibility of increasing the land productivity is reduced [15]. Over the past five decades, the amount of land devoted to arable agriculture globally has increased by only 9% [16]. **Figure 1C** shows that within 1970 up to 2009, Asia and Africa have just 49.98 per cent of produced cereals in the world (less than 50 per cent) with the approximate average of 71.91 per cent of the world population. Of course, comparing the years of 1970 and 2009 show that share of Asia and Africa in world cereals production has been increased respectively 7.75 and 1.28. But the fast trend of population growth in these continents cause per capita grain production does not a significant growth. Per capita cereals production in Asia is equal to 259.7 Kg per year that is less than world average (347.6 Kg /year) (**Table 1**). Meanwhile, Africa with the average of 12.13 per cent of the world population allocated only 5.26 per cent of the total cereals production to itself. Comparing to other continents and average of per capita cereals

production in the world, per capita cereals production in this continent is the lowest amount (151.3 Kg/year for each person). Survey of the cereals area harvested situation in five continents of the world within various years of 1970 up to 2009 show that except Europe, other continents have increased area harvested and production of cereals (**Figures 3A, and 3B**). Africa, America, Asia, and Oceania increase respectively 55.13, 2.86, 12.86, and 84.88 per cent of cereals cultivation. While, only Europe continent has reduced cereals area harvested by 33.93 per cent. Also, except Europe, other continents have a significant growth in cereals production as Africa 162.4%, America 121.13%, Asia 149.25%, and Oceania 167.16%. But Europe only has 32.81 per cent increases. Indeed, hereby Europe decreases its share from the world's cereals production by 29.41 per cent in 1970 to 18.68 per cent in 2009 (10.73% less) (**Figure 1C**). In 2009, the highest and lowest yield in unit area belonged to America and Africa with 5181.5 and 1524.9 kg/ha, respectively (**Figure 3C**). During 1970 to 2009 (a 40-year period) Africa, America, Asia, Europe and Oceania increased cereals yield in unit area 69.13, 115.56, 120.84, 101.00, 44.51 per cent, respectively.

-Changes' Trend in Pulses Production in Five Continents From 1970 to 2009

The trends of changes of pulses area harvested and production in various continents of the world have undergone many changes and to some extent differ with what we observed in cereals (**Figure 2B**). Comparing pulses area harvested in different continents within 1970 to 2009 is shown that the amount of pulses area harvested increased (**Figure 4A**). These increase calculated for Africa 76.98%, America 42.88%, and Oceania 1727.2%. In contrast, Asia and Europe decrease pulses area harvested respectively 5.54 and 69.75 per cent. On the other side, pulses production in 2009 has been increased comparing to 1970 in Africa 155.62%, America 162.03%, Asia 25.6% and Oceania 185.25%. Statistics show that within them just Europe continent in this 40-year period decrease the pulses production from 10.5 million tons in 1970 to 6.2 million tons in 2009 (**Figure 4B**). Moreover, per capita pulses production in the world in 2009 (9.4 Kg/year) is less than 1970 (11.9 Kg/year) (**Table.1**). Therefore, per capita pulses production decreases 21.18 per cent in the world. Europe continent decrease its share in pulses production of the world from 23.89% in 1970 to 9.72% in 2009 (14.17 less). Also Asia decreases its share in pulses production

from 51.67% to 44.45% (7.22 less) (**Figure 1C**). Decrease in per capita pulses production in Europe is because of decrease in area harvested and production, but decrease in per capita pulses production in Asia is because of population growth not decrease of area harvested or production. The share of America, Africa, and Oceania production from the whole pulses production in 1970 is respectively 12.47, 11.76 and 0.21 per cent and these amounts increase in 2009 by 22.37%, 20.59%, and 2.87%. It is important to note that, Africa and Oceania increase their share in the world's pulses production via increase of area harvested, while America increase it via growth in yield per unit area. As it was mentioned before, Europe decreases its pulses production too much. This decrease cause share of this continent decreases in the world's pulses production by 14.17%. Moreover, per capita pulses production decreases from 16 to 8.5 Kg/year per person. Per capita pulses production in Asia is also less than the world.

CONCLUSION

In average, in a 40-years period (1970-2009), Asia and Africa continents allocate 71.91% of whole population of the world to themselves, totally. But the share of cereals production in these two continents is less than 50% (49.98%) of total cereals production in the

world. While, three continents of America, Europe, and Oceania contain 28.09% of the world's population, totally; and allocates more than 50% (50.02%) of the whole cereals production. Studying the situation of pulses production in these continents show that Asia and Africa allocate 62.01% and America, Europe, and Oceania allocate 37.99% of the whole pulses production. Results show that strategy of Africa continent in increase of pulses production in an average of 40 years (1970-2009) is successful, that Due to increased area harvested reached this goal. Concerning production of cereals and pulses, Europe decreases its share in the world production of these two important agricultural products respectively by 10.73 and 14.17%; that can be a "Surreptitious Management Strategy" (SMS). This share decrease in the world agricultural production happens in a period that we see the increase require of demand for consumption of these two important agricultural products. Also, recent studies suggest that the world will need 70% more food by 2050 [17]. Although this Surreptitious Management Strategy in agricultural production is not clear to some extent since we do not know this decrease in cereals and pulses area harvested and production allocate to increase of area harvested and production of what agricultural

product. Is the decrease in producing some agricultural products and allocation of the resources to other products done in the way of a kind of dynamic agriculture production that Borlaug pointed to [2]? To what product is the production strategy in Europe focused? And several other questions that need more study. Surveys shows that increase of population in Asia neutralize the improved of cereals and pulses production in this continent. According to the increasing trend of population growth in Asia, it is expected that the difference of this continent with others increase from the view of food security of Asian people day by day. Therefore, it is not unexpected that we see food insecurity in Asia continent in the next decades. Meanwhile, "in many parts of Asia there is a huge gap between the average maximum climate-adjusted with actually achieved yields [18]. Interest of Africa continent towards more production of pulses makes its people being hopeful to having a bright future. If this trend towards more production of cereals and other agricultural production is considered in Africa, we can hope to increase of food security in Africa in the future. But studies indicated that, the total per capita food production in Africa was declined [1, 8]. Ultimately, according to the 40-year averages, the increasing production's strategy has more

sustainability in America. The programs of yield increase in unit area are more successful in the field of cereals in America and pulses in Europe. As during 1970 to 2009, the average of cereals yield increase to more than 5 metric tons per hectare in America and the average of pulses yield increase to more than 2 metric tons per hectare in Europe (**Figure 4C**). Asia continent does better in cereals than pulses production. Being low of per capita pulses production in Asia is one matter that should be considered more.

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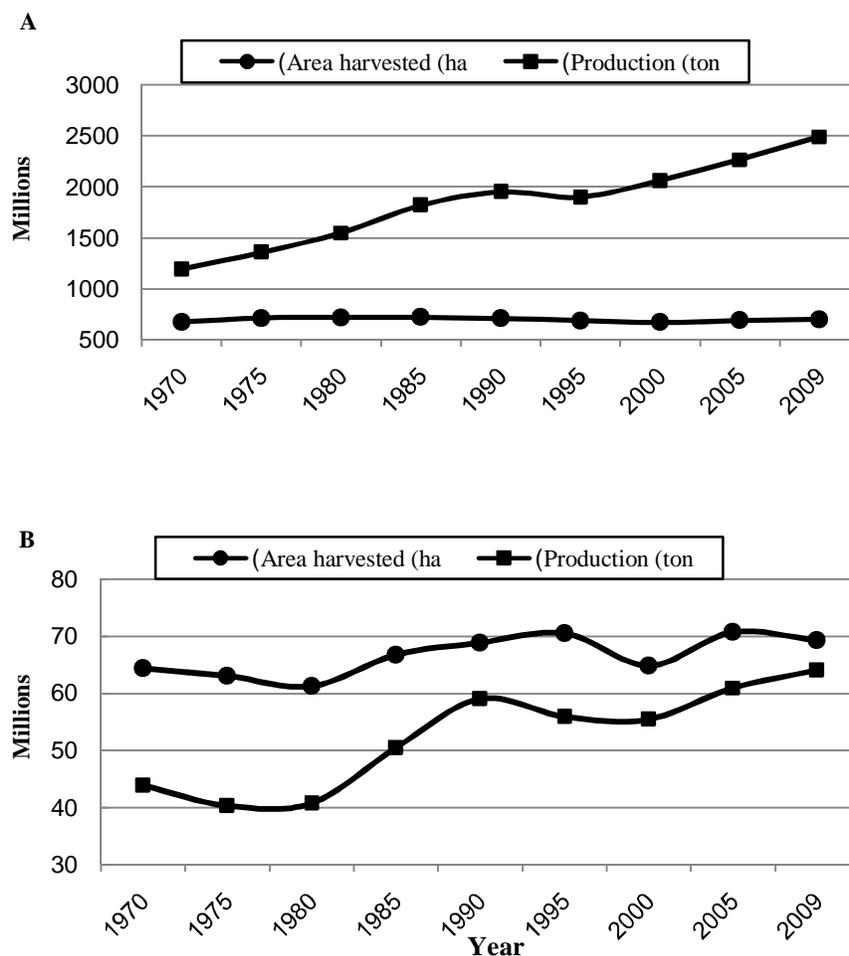


Figure 2: The Trend of Changes in Area Harvested and Production of Cereals (A) and Pulses (B) Crops in the World During 1970-2009. Data on Crop Production and Area Harvested are Taken From FAO, FAOSTAT Database, Revised 2011 (<http://faostat.fao.org>)

Table1: Per Capita Cereal and Pulse Production in the World and Continents (kg/year). Average Per Capita Cereal Production in Asia and Africa and Pulses in Asia is Less Than the World. Cereals Include Eight Species, which Collectively Supply 52% of the Total World Food Calories [19] and Seven Grain Legumes are Main Source of Plant Protein for Human. Author Calculations are Based on Data From (FAO, FAOSTAT Database; <http://faostat.fao.org>), Revised 2011

	Crops	Year									
		1970	1975	1980	1985	1990	1995	2000	2005	2009	Means
World	Cereals	322.6	333.6	348.1	374.5	367.9	331.4	336.5	348.6	365.1	347.6
	Pulses	11.9	9.9	9.2	10.4	11.1	9.8	9.1	9.4	9.4	10.0
Africa	Cereals	164.3	163.7	150.4	150.0	147.0	135.8	137.7	155.5	157.1	151.3
	Pulses	14.0	13.4	11.1	10.4	11.3	10.5	10.7	12.2	13.1	11.9
Americas	Cereals	554.0	649.0	648.0	754.9	646.6	579.6	637.4	643.8	681.3	643.8
	Pulses	10.6	10.4	10.0	9.9	10.5	12.6	14.4	14.2	15.4	12.0
Asia	Cereals	225.3	233.9	239.6	259.2	272.8	272.1	267.9	275.5	290.9	259.7
	Pulses	10.6	8.8	7.8	8.2	8.1	7.7	6.8	6.9	6.9	8.0
Europe	Cereals	534.8	511.4	618.3	640.8	685.4	517.1	529.5	585.8	636.2	584.4
	Pulses	16.0	11.3	12.3	19.0	23.4	12.5	9.8	10.3	8.5	13.7
Oceania	Cereals	692.8	859.6	748.8	1051.2	888.1	970.0	1135.1	1215.1	1020.3	953.4
	Pulses	4.8	8.6	10.7	37.6	52.7	91.2	72.1	78.7	52.0	45.4

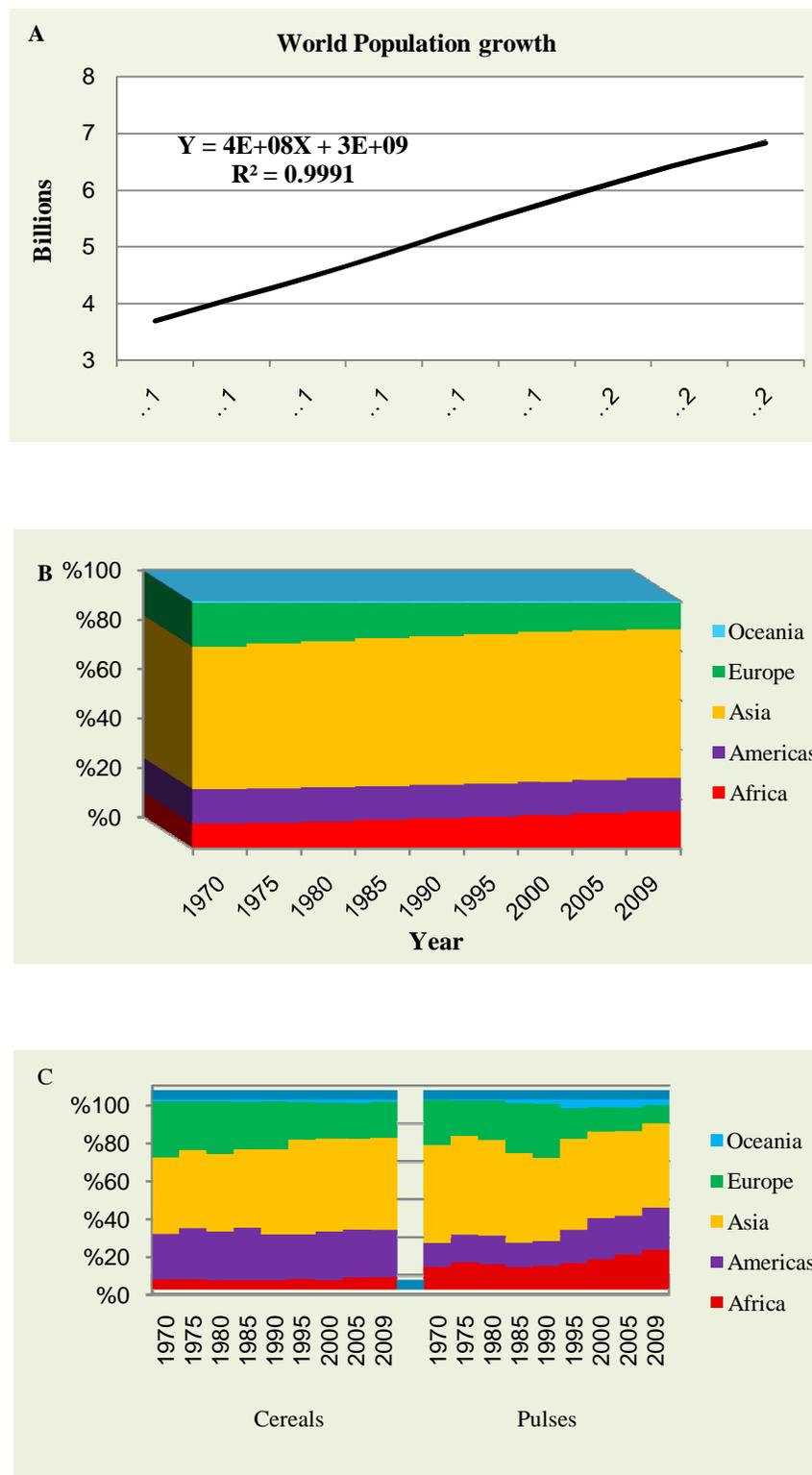


Figure1: World Population Growth (A), the Continent's Share of World Population (B), and the Continent's Share of World Cereals and Pulses Production (C) during 1970-2009. Data on Continents and World Population are Taken from United Nation, Department of Economic, and Social Affairs, Population Division, Population Estimates and Projections Section, Revised 2011 (<http://esa.un.org/unpd/wpp/unpp/p2k0data>)

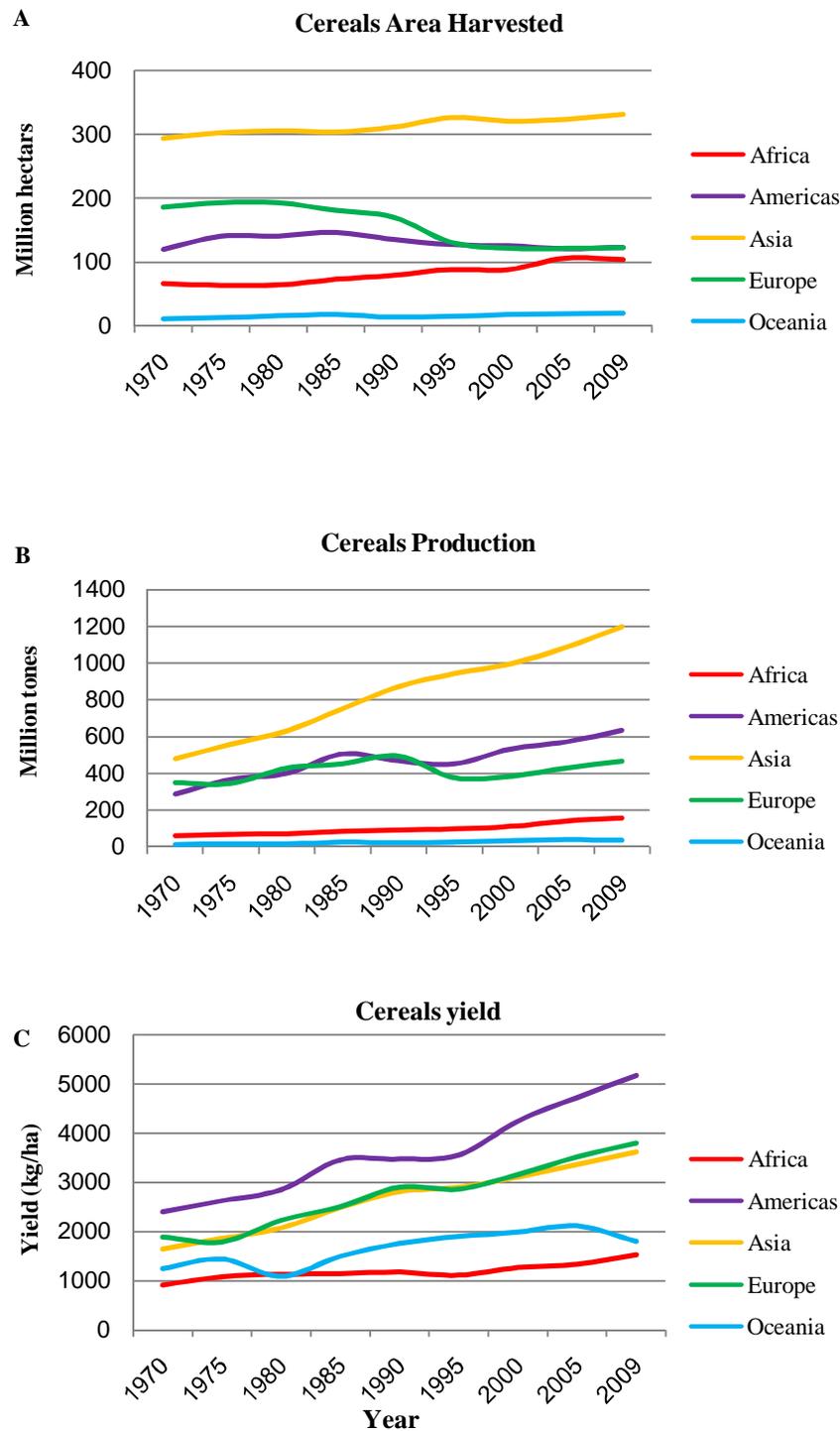


Figure 3: The Trend of Changes in Area Harvested (A), Production (B), and Yield (C) of Cereals in Five Continents (1970-2009). Data on Crop Production and Area Harvested are Taken From FAO, FAOSTAT Database, Revised 2011 (<http://faostat.fao.org>).

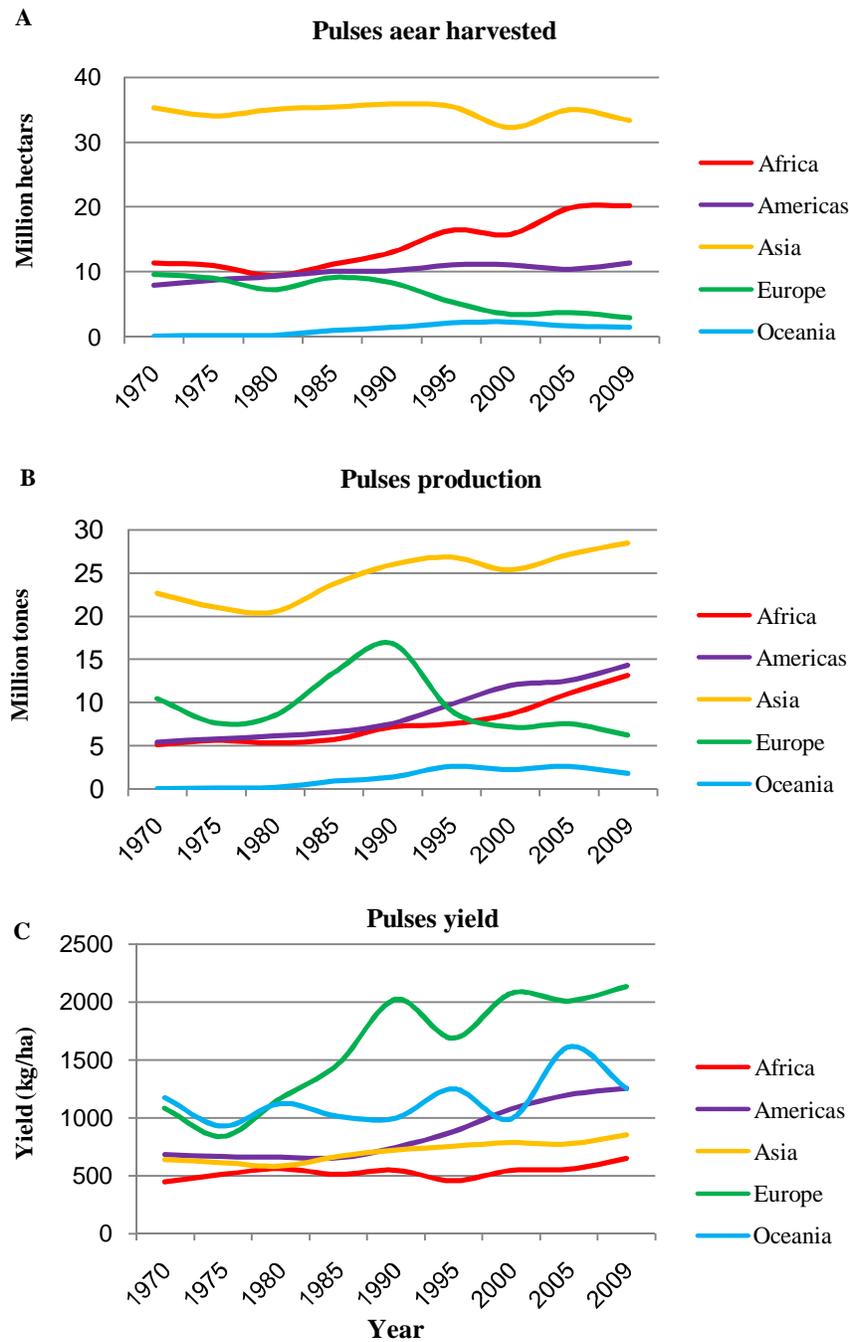


Figure 4: The Trend of Changes in Area Harvested (A), Production (B), and Yield (C) of Pulses in Five Continents (1970-2009). Data on Crop Production and Area Harvested are Taken From FAO, FAOSTAT Database, Revised 2011 (<http://faostat.fao.org>).