

GE 2211 Environmental Science and Engineering

Unit – V

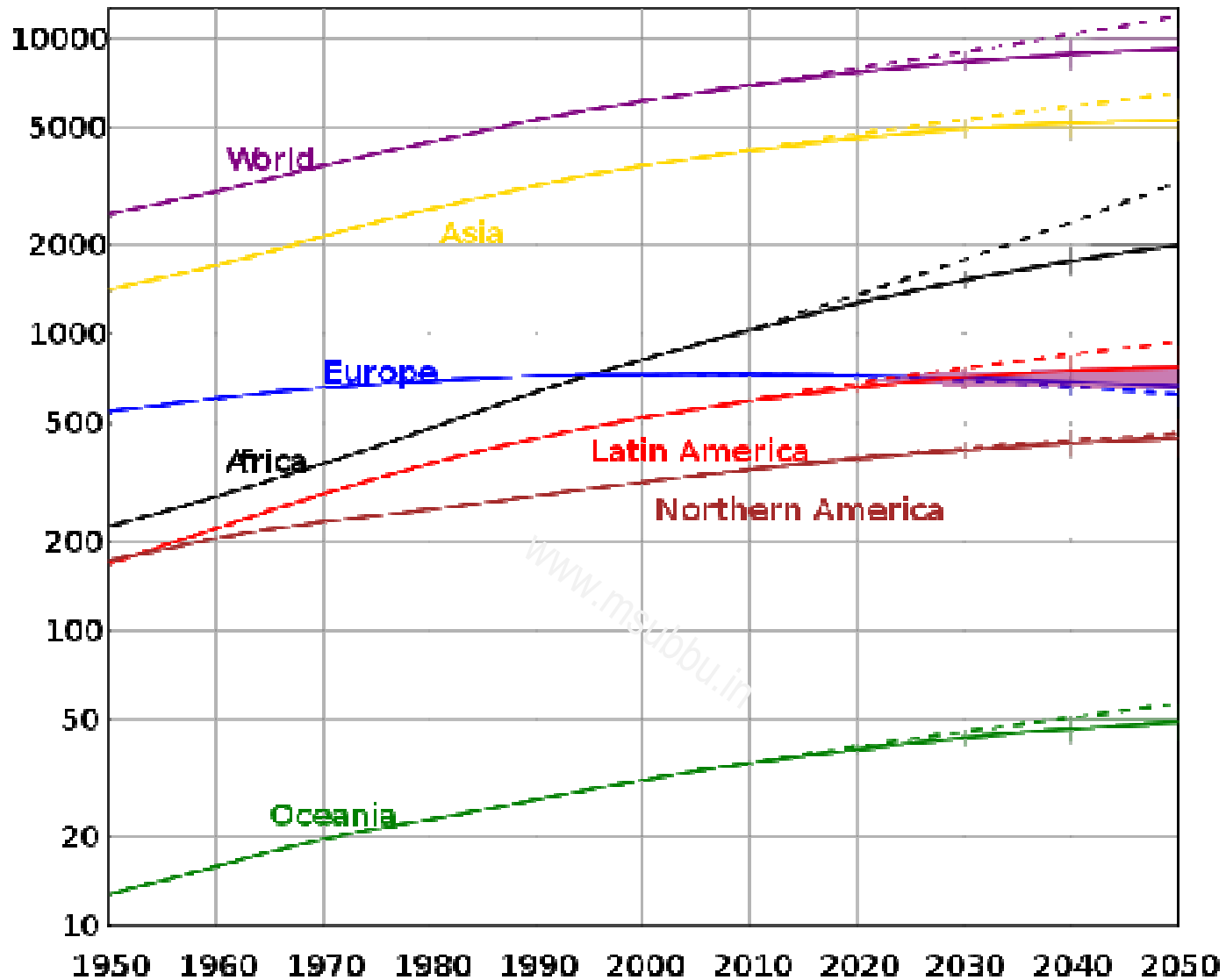
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Population Growth

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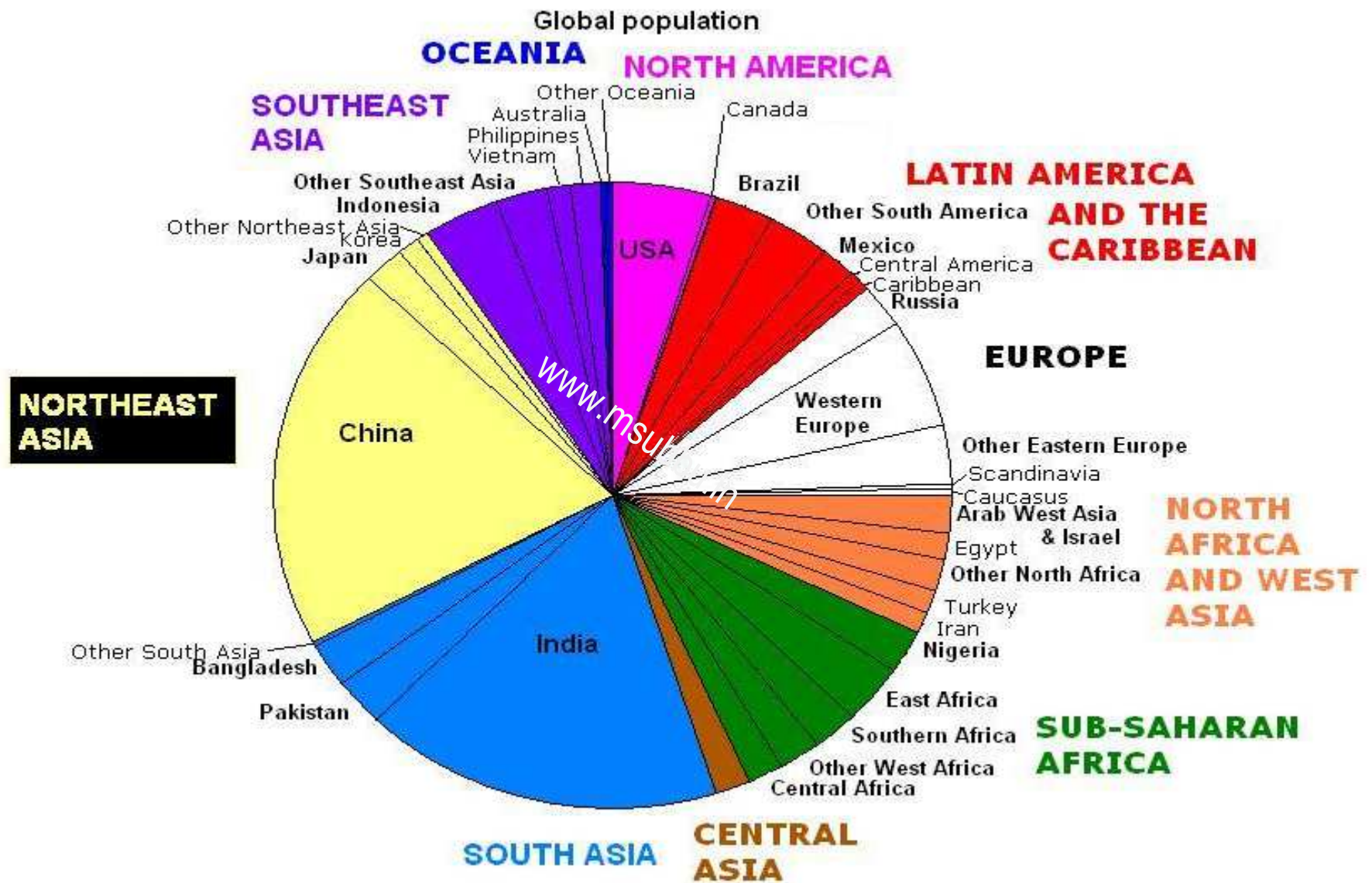
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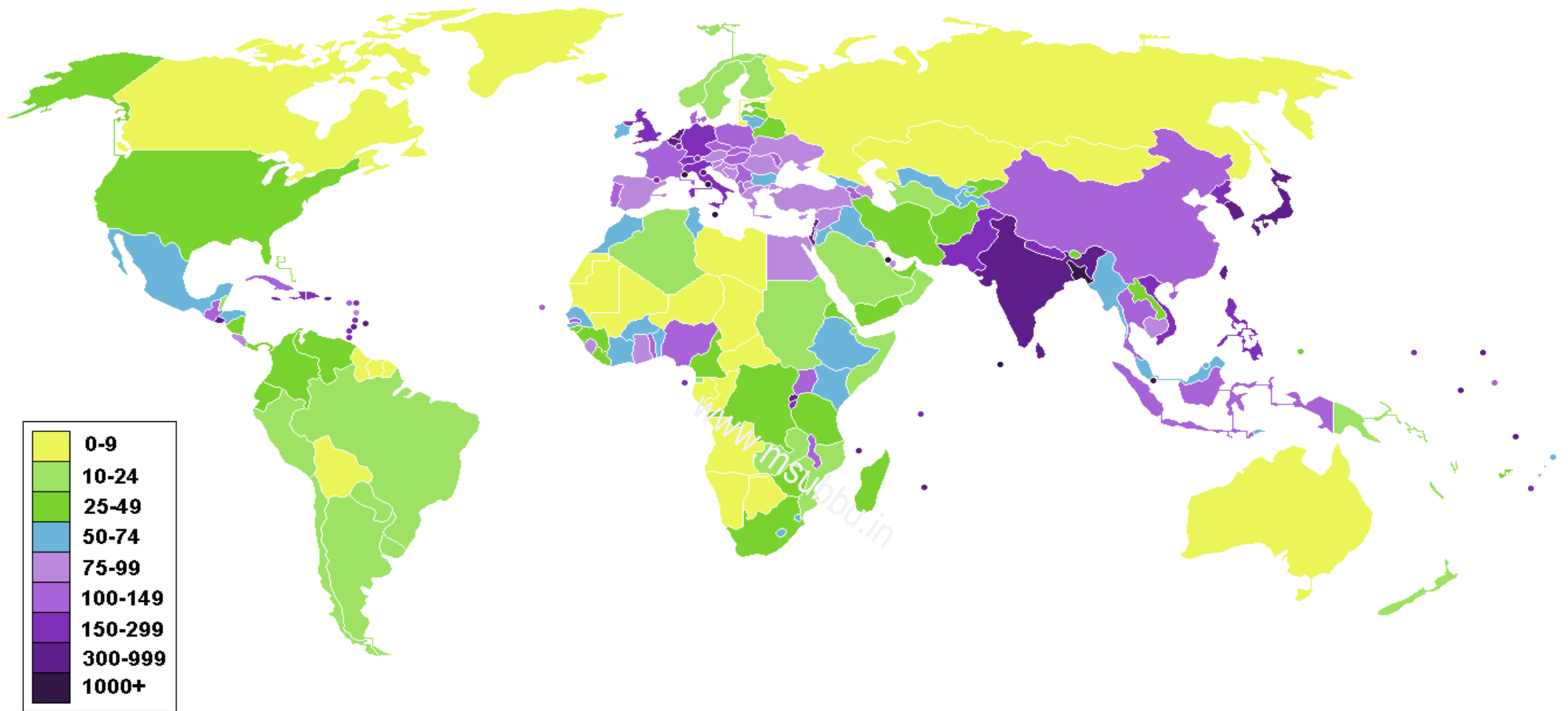




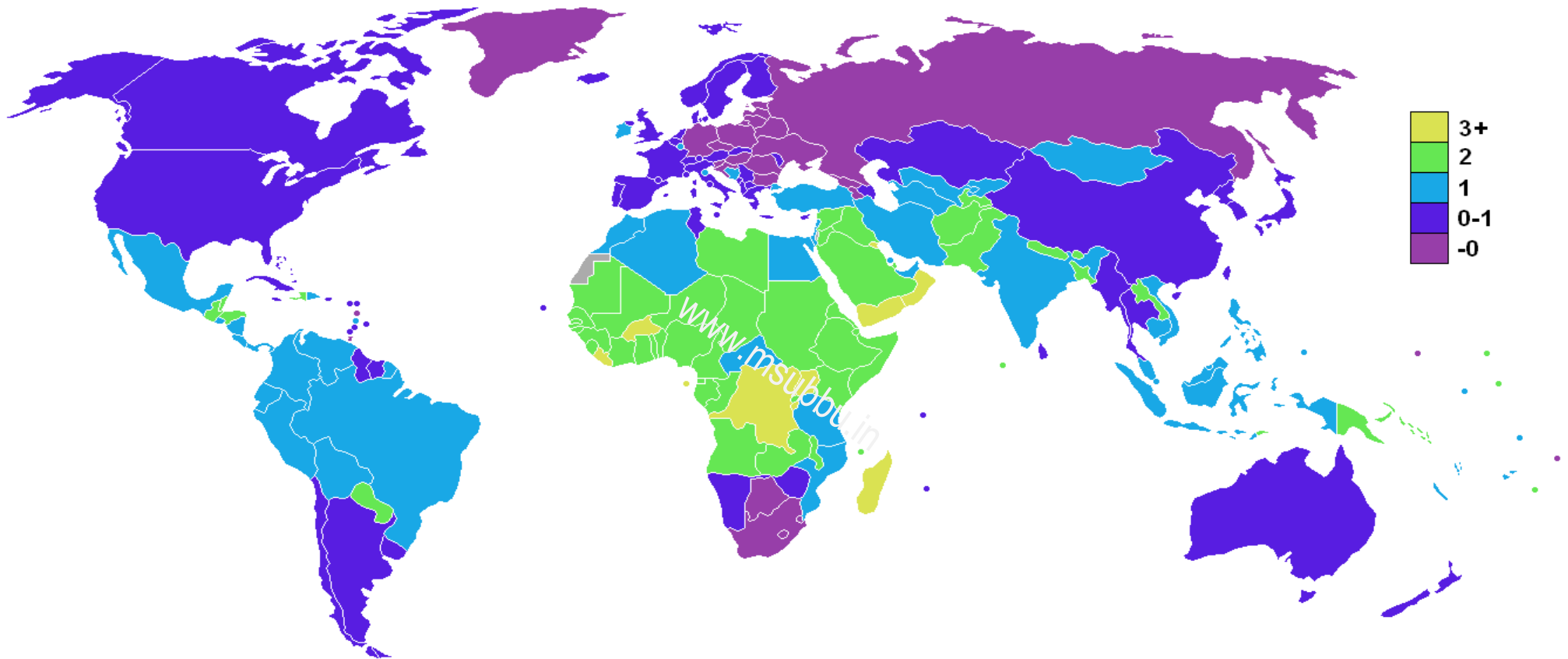
Past and projected population growth on different continents. The vertical axis is logarithmic and its scale is millions of people

(Source: http://en.wikipedia.org/wiki/Population_growth 17-Sep-09)





Population density (people per km²)



Population Growth Rate (% increase per year)

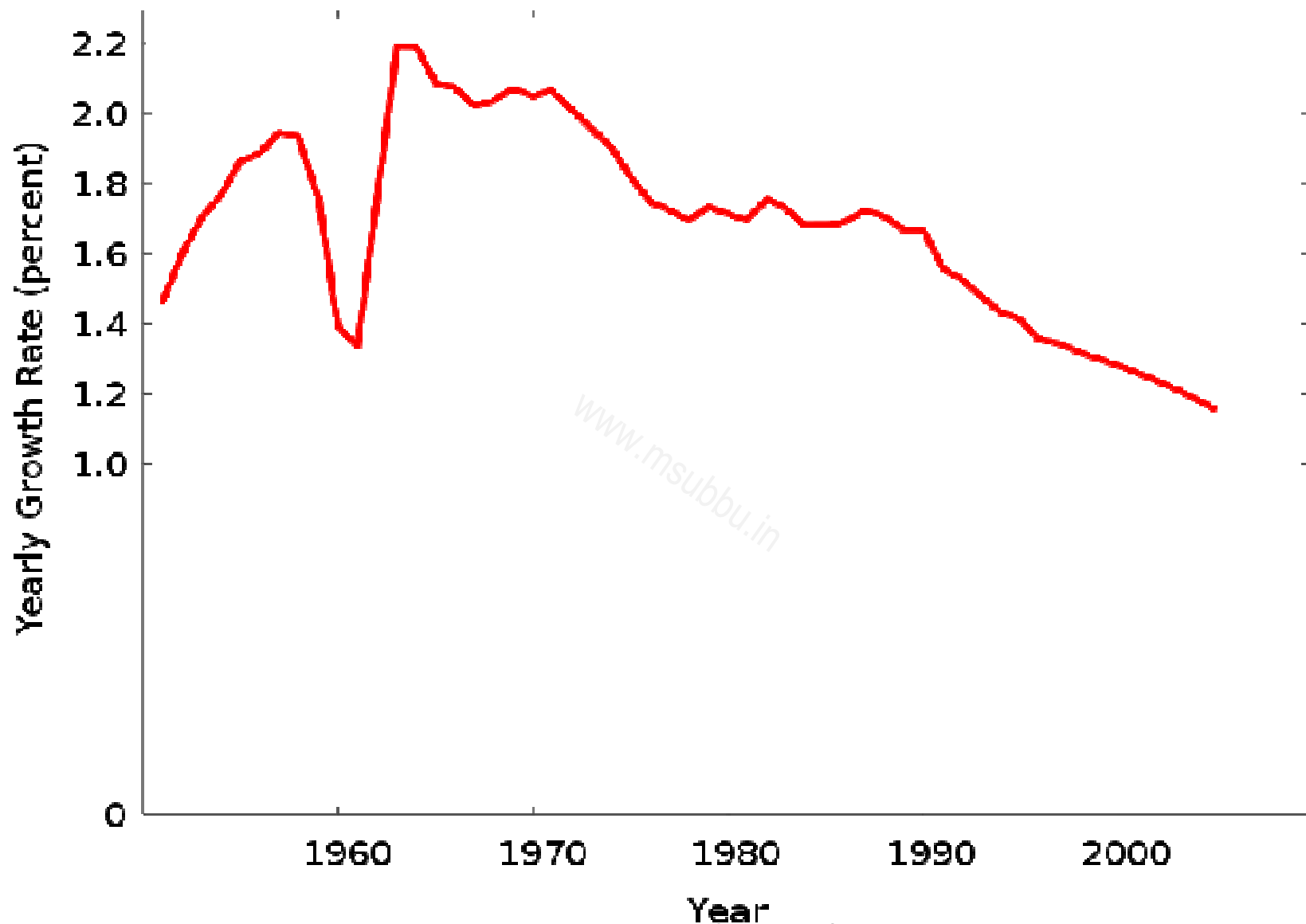
$$\text{Growth rate} = \frac{(\text{population at end of period} - \text{population at beginning of period})}{\text{population at beginning of period}}$$

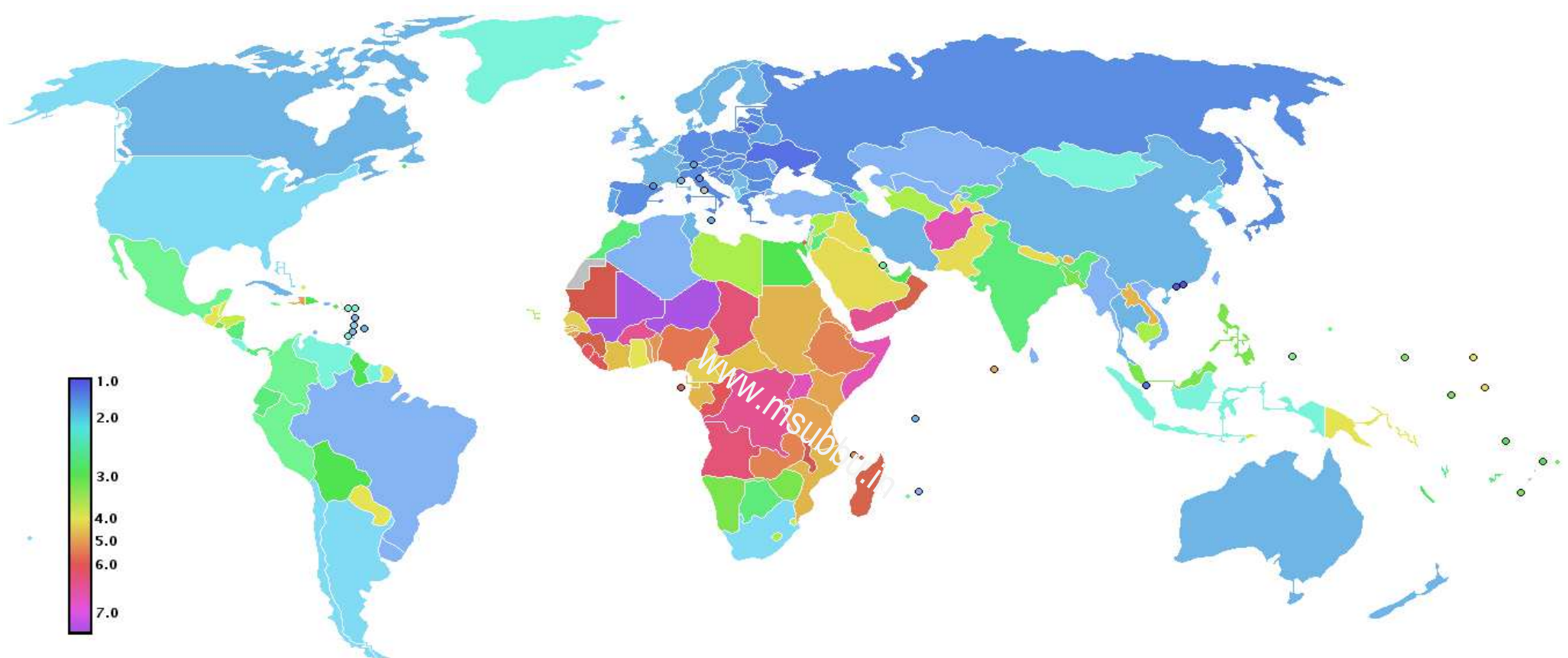
Population Growth

- In the 20th century, the world saw the biggest increase in its population in human history due to lessening of the mortality rate in many countries due to medical advances and massive increase in agricultural productivity attributed to the Green Revolution
- In 2000, the United Nations estimated that the world's population was growing at the rate of 1.14% (or about 75 million people) per year, down from a peak of 88 million per year in 1989.
- In the last few centuries, the number of people living on Earth has increased many times over. By the year 2000, there were 10 times as many people on Earth as there were 300 years ago.

Population Growth (contd.)

- Globally, the population growth rate has been steadily declining from its peak of 2.19% in 1963, but growth remains high in Latin America, the Middle East and Sub-Saharan Africa
- In some countries there is negative population growth (i.e. net decrease in population over time), especially in Central and Eastern Europe (mainly due to low fertility rates) and Southern Africa (due to the high number of HIV-related deaths).
- Within the next decade, Japan and some countries in Western Europe are also expected to encounter negative population growth due to sub-replacement fertility rates.





Fertility rate (average number of children that would be born to a woman over her lifetime)

Green Revolution

- **Green Revolution** usually refers to the transformation of agriculture that began in 1945. One significant factor in this revolution was the Mexican government's request to establish an agricultural research station to develop more varieties of wheat that could be used to feed the rapidly growing population of the country
- In 1943, Mexico imported half its wheat, but by 1956, the Green Revolution had made Mexico self-sufficient; by 1964, Mexico exported half a million tons of wheat. The associated transformation has continued as the result of programs of agricultural research, extension, and infrastructural development
- The Green Revolution allowed food production to keep pace with worldwide population growth, in turn causing human population to increase

Green Revolution (contd.)

- With the experience of agricultural development begun in Mexico by Norman Borlaug in 1943 judged as a success, the Rockefeller Foundation sought to spread it to other nations.
- The Office of Special Studies in Mexico became an informal international research institution in 1959, and in 1963 it formally became CIMMYT (The International Maize and Wheat Improvement Center).
- In the most basic sense, the Green Revolution was a product of globalization as evidenced in the creation of international agricultural research centers that shared information, and with transnational funding from groups like the Rockefeller Foundation, Ford Foundation, and United States Agency for International Development

The Father of Green Revolution

- **Norman Borlaug** (March 25, 1914 – September 12, 2009) was an American agronomist, humanitarian, and Nobel laureate who has been deemed the father of the Green Revolution
- He was also a recipient of the Padma Vibhushan, India's second-highest civilian honor (2006)
- Borlaug's discoveries have been estimated to have saved over 245 million lives worldwide



"Borlaug hypothesis", - *increasing the productivity of agriculture on the best farmland can help control deforestation by reducing the demand for new farmland.*

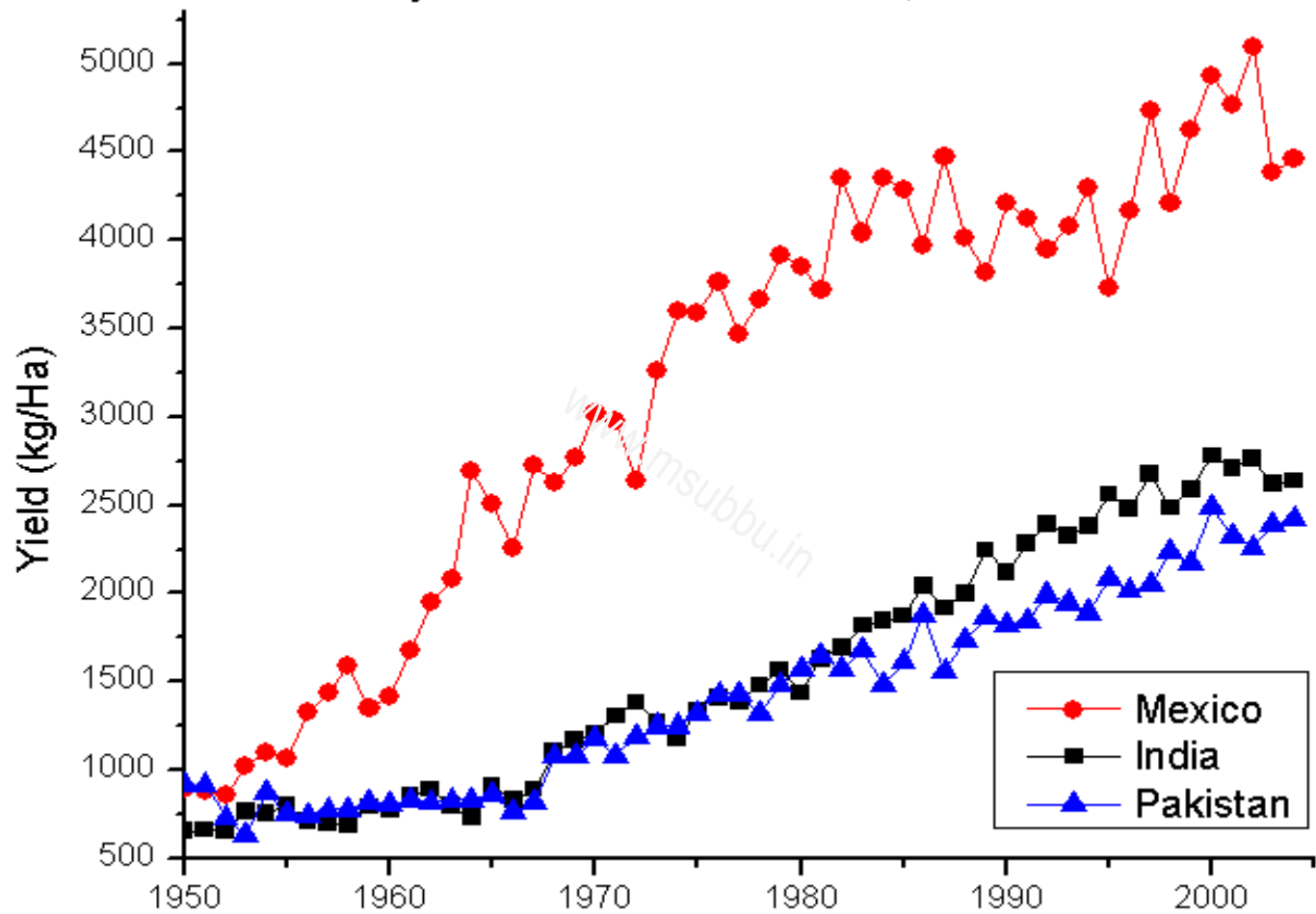
Green Revolution in India

- In 1961 India was on the brink of mass famine. Borlaug was invited to India by the adviser to the Indian minister of agriculture M. S. Swaminathan. Despite bureaucratic hurdles imposed by India's grain monopolies, the Ford Foundation and Indian government collaborated to import wheat seed from CIMMYT.
- Punjab was selected by the Indian government to be the first site to try the new crops because of its reliable water supply and a history of agricultural success. India began its own Green Revolution program of plant breeding, irrigation development, and financing of agrochemicals

Green Revolution in India (contd.)

- India soon adopted IR8 - a semi-dwarf rice variety developed by the International Rice Research Institute (IRRI) that could produce more grains of rice per plant when grown with certain fertilizers and irrigation.
- IR8 was a success throughout Asia, and dubbed the "Miracle Rice". IR8 was also developed into Semi-dwarf IR36
- In the 1960s, rice yields in India were about two tons per hectare; by the mid-1990s, they had risen to six tons per hectare. In the 1970s, rice cost about \$550 a ton; in 2001, it cost under \$200 a ton
- IR8 required the use of fertilizers and pesticides, but produced substantially higher yields than the traditional cultivars.

Wheat yields in selected countries, 1950-2004



Source: FAO

Effects of Green Revolution on Food Security

- Cereal production more than doubled in developing nations between the years 1961 – 1985. Yields of rice, maize, and wheat increased steadily during that period. The production increases can be attributed roughly equally to irrigation, fertilizer, and seed development, at least in the case of Asian rice
- The world population has grown by about four billion since the beginning of the Green Revolution and many believe that, without the Revolution, there would have been greater famine and malnutrition.
- India saw annual wheat production rise from 10 million tons in the 1960s to 73 million in 2006.
- The average person in the developing world consumes roughly 25% more calories per day now than before the Green Revolution

Environmental Impacts of Green Revolution

- While agricultural output increased as a result of the Green Revolution, the energy input to produce a crop has increased faster
- Green Revolution techniques also heavily rely on chemical fertilizers, pesticides and herbicides, some of which must be developed from fossil fuels, making agriculture increasingly reliant on petroleum products.
- Proponents of the Peak Oil theory fear that a future decline in oil and gas production would lead to a decline in food production.