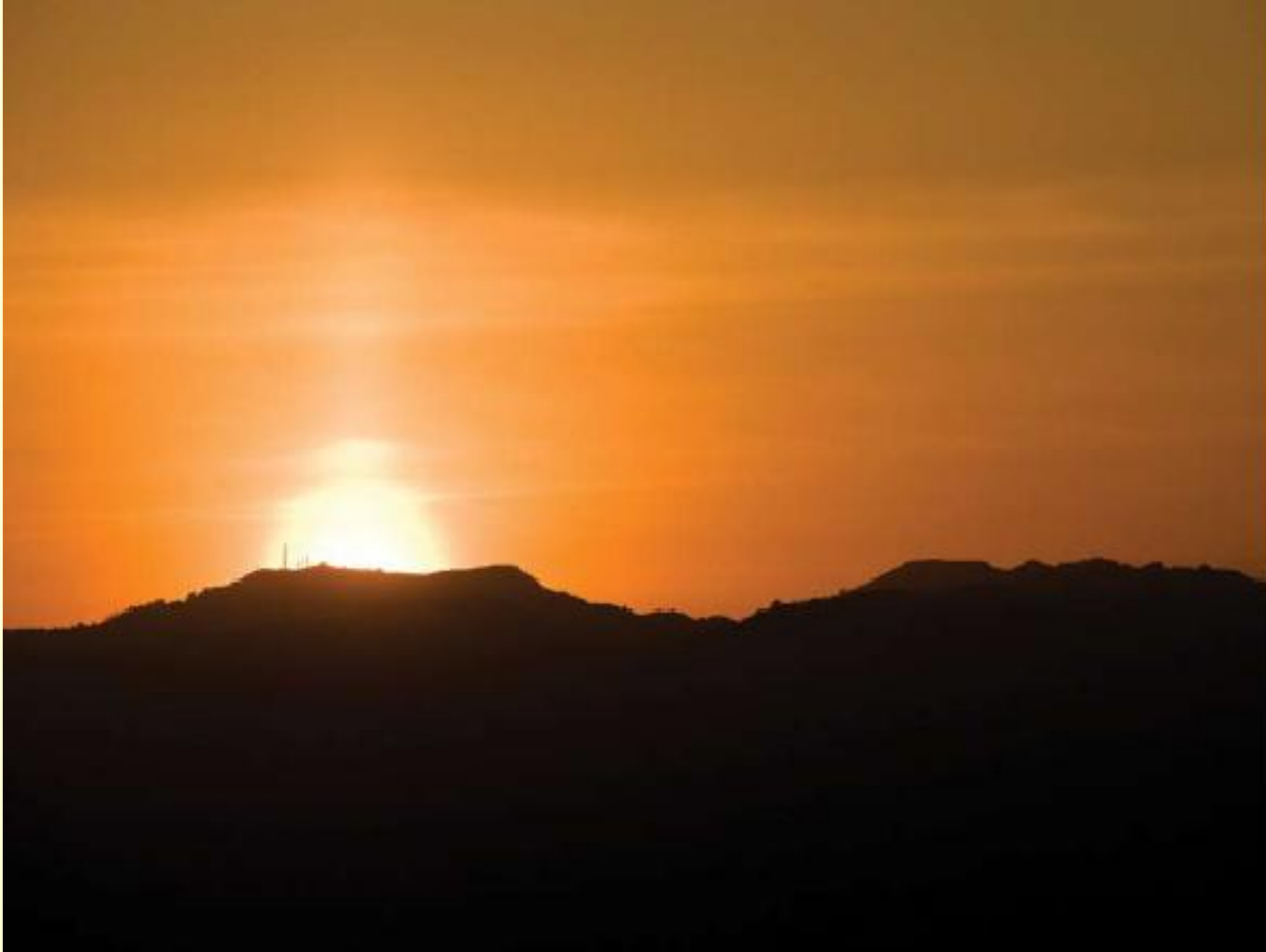
Agronomical Management Options for Adaptations and Mitigation to Climate Change

Dr.A.K.Gogoi
ADG(Agro)
ICAR, New Delhi



Warning ?

- Experts warned that India would have to import food grains in large quantities in future like China, if the present rate of growth of income continues.
- The real scope for exports lies, according to the experts, in the case of fruits, vegetables, livestock products and other processed foods.
  - On the food security front, there is a leveling off of the demand for cereals and further income increases will lead to higher intake of dairy, livestock and horticultural products
  - If the lower income group's income also increases, there is bound to be a higher need for cereals

Western Globalization

West needs its growth- better houses, bigger growth, longer holidays and so on, more of what is already has west wents luxuries.

India needs development

Basic amenities like running water, smokeless fuel, nutritious food, schools that reach children, dispensaries that attend patients, buses that connect to markets-goods and services which is never had India's need are basic

Changes in the atmosphere

- **The amount of carbon dioxide in the atmosphere in 2005 (379 ppm) exceeds by far the natural range of the last 650,000 years (180 to 300 ppm).**
- **The amount of methane in the atmosphere in 2005 (1774 ppb) exceeds by far the natural range of the last 650,000 years (320 to 790 ppb).**
- **Nitrous oxide concentrations have risen from a pre-industrial value of 270 ppb to a 2005 value of 319 ppb. More than a third of this rise is due to human activity, primarily agriculture**

Positive impacts

- Increased productivity from warmer temperatures
- Possibility of growing new crops
- Longer growing seasons
- Increased productivity from enhanced CO_2
- Accelerated maturation rates

Anticipated Impacts of Climate Change in Agriculture

- Increased production variability.
- Increasing glacier melt in Himalayas will affect availability of irrigation especially in the Indo-Gangetic plains, which, in turn, will have large consequences on our food production.
- Pathogens and insect populations are strongly dependent upon temperature and humidity. Increases in these parameters may result in change in their population dynamics resulting in yield loss.
- Climate change is likely to aggravate the heat stress in dairy animals, adversely affecting their productive and reproductive performance resulting in increased water, shelter, and energy requirement. Increasing sea and river water temperature is likely to affect fish breeding, migration, and harvests.
- Higher chemical fertilization for producing more food, would lead to more nitrous oxides (GHG) emission in the environment.

NE Region

- Population: >39 million (3.85%)
- Geographical area: 26.2 million ha (8%)
- Forest : 60%
- Rainfall : 2450 mm (11,500 mm)
- Temperature: 15° - 32°C Summer
  0 - 26°C Winter
- Flowering species : 5000 species (total 17,000 species)

Agriculture

- Operations carried upto : 3600 m altitude
- Slope : upto 60%
- Food grain : >80% area of gross crop area
- Rice alone occupies: 89.8% of the total food grain
  Production : 93.2% of the total food grain
- Regional deficit : 1.6 mt
- Cropping intensity :120 %

Resources

- **Soil – Research in OM, acidic in nature, low to medium in P, medium to high in K**
- **Water- 510 Km^3 of water annually, surface water resources 1487.65 Km^3, ground water potential of 25.31 km^3.**

Food Scenario by 2050

- Both internal consumption and exports : 550 Million tonnes
- Ultimate irrigation potential (assessed) : 140 million hectare
- Surface water : 76 mha
- Ground water : 64 mha
- Additional irrigation by interbasin water transfer : 35 mha
- Total ultimate irrigation to 175 mha

Land mass : 143 mha

(available net cultivable area)

Expected to go only to : 145 mha

Year 2010 – Rainfed food crop yield 1.1 t/ha

2050 – Rainfed food crop yield 1.5 t/ha

In case of irrigated 3.0 t/ha to 4 t/ha

Green Revolution Technologies

- Higher Harvesting Index (HI)
- Green revolution varieties
- Higher response to external inputs
- Addition to nutrients (nitrogen)
- Expansion of irrigation

Reasons for slowed down for Green Revolution

- Water table lowering
- Micronutrients depletion
- Monoculture
- Reducing bio-diversity
- Build-up of insects, disease and weeds
- Development of resistance against pesticides
- High concentration of pesticides or fertilzers-derived nitrates and nitrites in water courses

Strategy

- **Strategic research, including application of biotechnology tools for increasing productivity and reducing climate vulnerability due to climatic aberrations.**
- **Sustained increase in food grain production to counter likely reduced productivity due to temperature increase and extreme events.**
- **Reorientation of Agricultural Extension to promote sustainable Agriculture**
- **Institutional arrangement and financial support**

Development of stress tolerant crops, livestock and fish culture

- **Biotechnology is a viable option for developing genotypes which can perform better under harsh environmental conditions. Since there is no barrier to transferring useful genes across different species in animal or plant kingdom, this new technology offers novel strategies for producing suitable genotypes that are able to resist drought, high temperature, submergence and salinity stresses, and are also resistant to diseases and insect/pests in crops, livestock, fish and microbes.**

Development of crops with efficient atmospheric carbon dioxide capturing capacity

- Different ways and means can be devised using the latest tools of biotechnology for increasing the efficiency of crops to capture atmospheric carbon dioxide. This will significantly contribute to increased crop productivity and at the same time reduce the greenhouse effect and further rise of atmospheric temperature.

Development of crops with enhanced water & nutrient use efficiency

- **Water & nutrient use efficiency can be enhanced to a far greater extent than the present level through the use of biotechnologies.**

Conservation Agriculture

- Soil cover, retention of crop residues
- Sensible, profitable rotations
- A minimal level of soil movement (reduced or zero tillage)

Reduced Tillage and Biotic Changes

- Survival habitat for insects
- Weeding on insect survival
- Planting time shift and insect survival
- Decomposition of residues and insect survival

Cattle and Global Warming

- **Who is contributing most to global warming ?**
  - **Dumb cattle**
  - **Factories or**
  - **Power plants**
- **Increased world population would further increase in the number of livestock as demand for meat and milk increases and that would mean emission of more greenhouse gases.**
- **Improved animal diets to reduce enteric fermentation and consequent methane emissions.**
- **Sitting up biogas plant initiatives to recycle manure.**

Crop-Weed Interaction

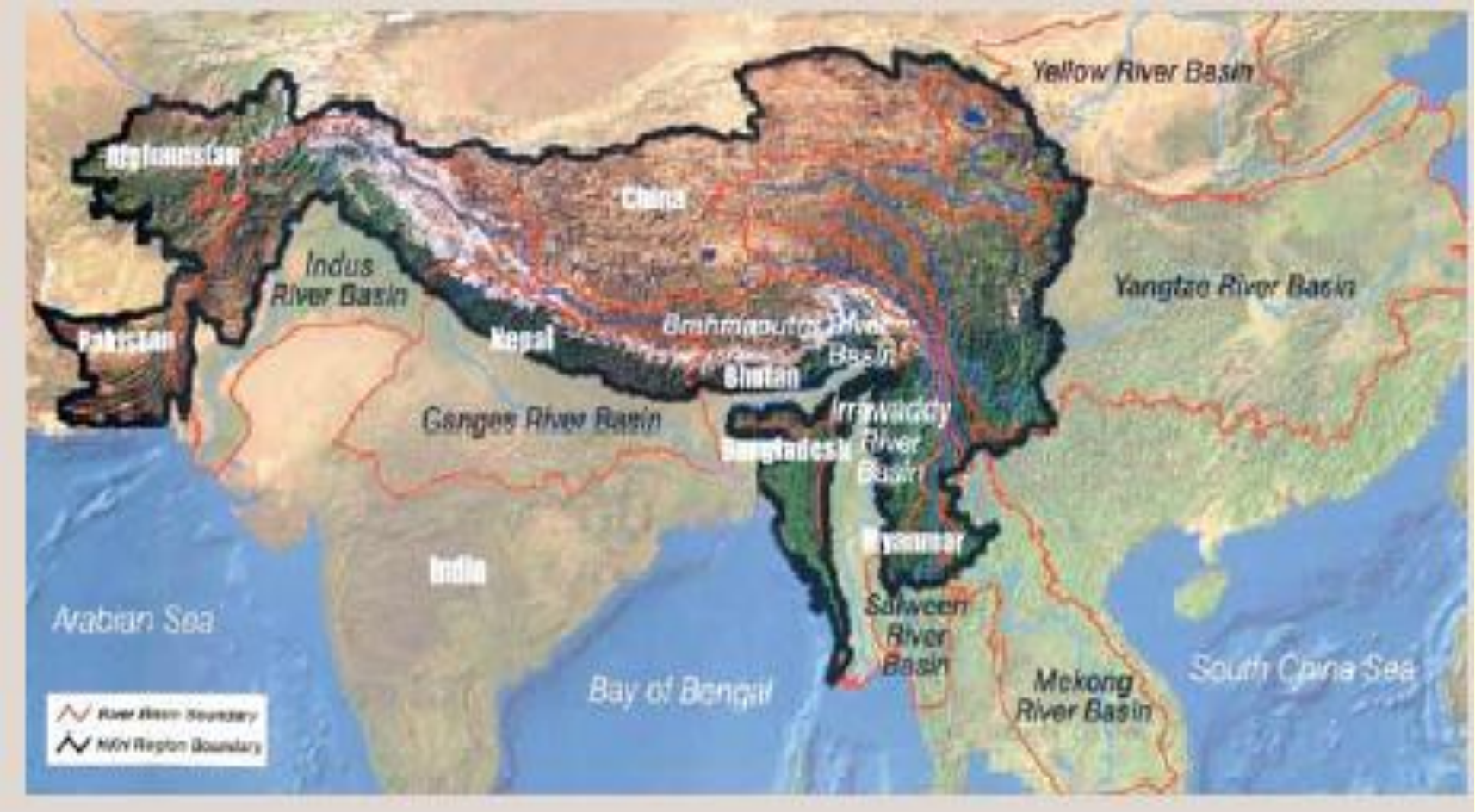
- Differential responses of C_3 and C_4 plants to elevated CO_2 and temperature may cause shifts in their competitive interactions.
- For the most important species on a worldwide basis, crops have predominantly C_3 photosynthetic metabolism and weeds disproportionally have C_4 metabolism.
- Among the 18 most troublesome weeds in the world, 14 are C_4, whereas of the 86 plant species that supply most of the world's food, only 5 are C_4 species.

Mechanical control

- **Roots and rhizomes in many perennial weeds are organs of vegetative propagation.**
- **Elevated CO_2 commonly stimulates the growth of roots and rhizomes more than that of shoots (Rogers et al., 1994).**
- **Increased root and rhizome growth in such species may make mechanical control of such weeds more difficult as CO_2 rises.**

Biological control

- Direct effect of CO2 on increasing starch concentration in leaves and lowering nitrogen contents could also affect biocontrol by altering the behaviour and growth rate of herbivores.
- Global warming could result in increased over wintering of insect populations, which could increase biological control of weeds in some cases.
- However, increasing insect populations could also include specific crop pests, which could increase the susceptibility of a given crop to weed competition (Patterson, 1995a).



Geography of Asia, the Hindu Kush-Himalayan – Tibetan glaciers and their river basin

Exporting of fruits and vegetables

Despite the lack of adequate infrastructure like cold storage and road connectivity, big corporate are buying :

- Apples in Himachal Pradesh
- Grapes in Nasik
- Oranges in Nagpur
- Mangoes in Ratnagiri

Aqua farming

- **Permanent waterlogged areas**
- **Green vegetables – *Ipomea aquatica, Arabica***
- **Green cosmetics – *Scirpus sp*.**
- **Green nutrients – *Azolla, Pistia, Salvania***
- **Water flowers- Water lily, lotus**

Herbal Farming

- Underuilized species with medicinal values to be grown in marginal areas
- Partially raw green vegetables
- Bulk quantity as powder (processed) formulation

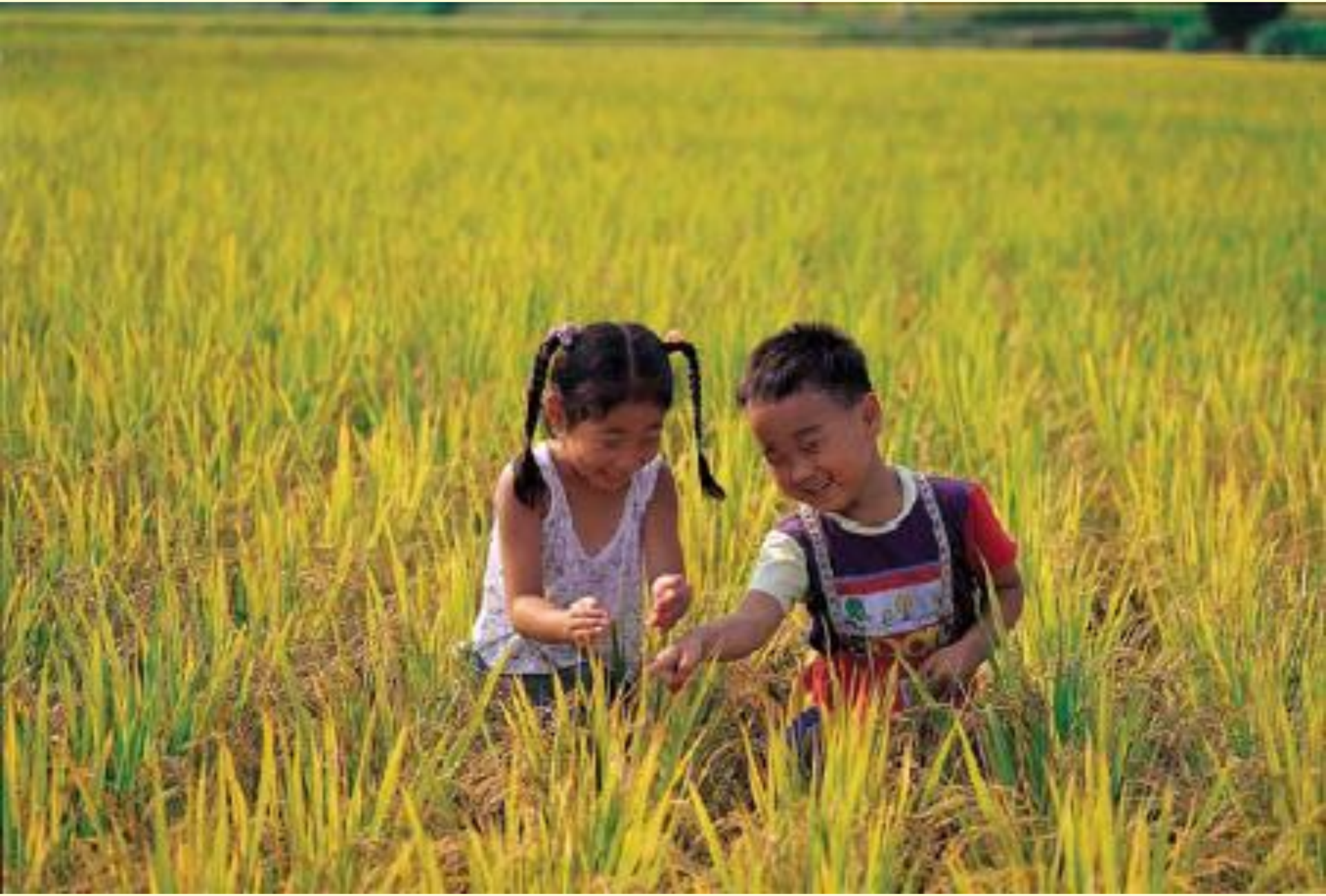
Bio-chem invaders in major reservoirs /water sources

- Microbes of highly infectious plant /animal diseases
- Heavy poisonous metals contamination
- Radio active ions etc.
- Consequences (Health hazards)
  (Crop failures / losses)
  (Poor productivity)
  (man,animal & other bioties)
  (Prolonged problems)
  (Socio – economic impact)

Impact of rainfall on inflation

Year	Rainfall *	GDP	Inflation
1971-72	-24	0.9	5.6
1979-80	-19	-5.2	17.1
1987-88	-19	3.8	8.1
2002-03	-19	4.0	3.4

* June- Sept.



Thanks