

GLOBAL ECONOMIC FORCES AND THE OUTLOOK FOR AGRICULTURE

Presentation by

Alex F. McCalla, Professor Emeritus, UC –Davis to:

First Annual Canadian Agriculture Policy

Conference-

The Future of Farms & Food in Canada

Ottawa, Canada January 14, 2011

What Global Forces Matter to the Future of Agriculture Globally- A Preview

2

- Population Growth and Its Spatial Distribution;
- Economic Development, Income Growth and the Distribution of Poverty;
- R & D, Technology, and Productivity Growth;
- Globalization, Trade Liberalization and Monetary Stability;
- Resource Availability, Sustainability and Degradation;
- Shocks-e.g. Climate Change- Increases in Frequency and Amplitude of Weather Shocks;
- Policies- Domestic and International

1/19/2011

Outline-How am I Going to Look to the Future?- By Telling the “Feeding The World” Story-before & later

3

1. How did we feed the world until now;
2. Population growth continues at least until 2050;
3. Feeding 9 Billion in 2050 –a big Challenge;
4. Future Sources:
 1. Land expansion?
 2. Water – more irrigation?
 3. Biological productivity improvement?
 4. Policy Reform?

Global vs Indigenous Capacity

A Tough Row to Hoe.

Population Growth & Sources of Our Food Supply

4

- 50 Years Ago (1960) world population reached 3 billion increasing from 2 to 3 billion in just 33 years.
- The second billion had taken 102 years (1825-1927)
- And the first billion took from the origins of humans.
- Virtually all of the increased food production needed to feed the first 2 billion came from expanded area under production. Evans, *Feeding the Ten Billion* (1998),

Population Growth & Sources of Our Food Supply- 2

5

- Despite pockets of scientific agriculture in Western Europe and Japan in the 19th century, the third billion was primarily fed by:
 - a 40% increase in area; and
 - the mechanical revolution which freed up 130 million hectares, previously producing fuel for horses, for food grain production.
- ***It is only after 1960 that increasing yields per hectare became the major source of increases in food supply.***
- Adding the **fourth** billion took just **15** years (1960-1975),
- the **fifth** billion arrived in **11** years (1975-1986),
- And the **sixth** in **13** years (1986-1999).

Population Growth & Sources of Our Food Supply- 3

6

- The vast majority of the increase in food production needed to feed this doubling of world population in less than 40 years came from increased productivity.
- Modest increases in area since 1975 were more than offset by losses of productive land to other uses and soil degradation.
- Clearly the application of science to agriculture had research roots dating back at least to von Liebig in the mid 19th century,
- But it was increasing investments in applied research in developed countries in the first half of the 20th century that led to the genetic and chemical revolution that drove agriculture in the second half of the 20th century.

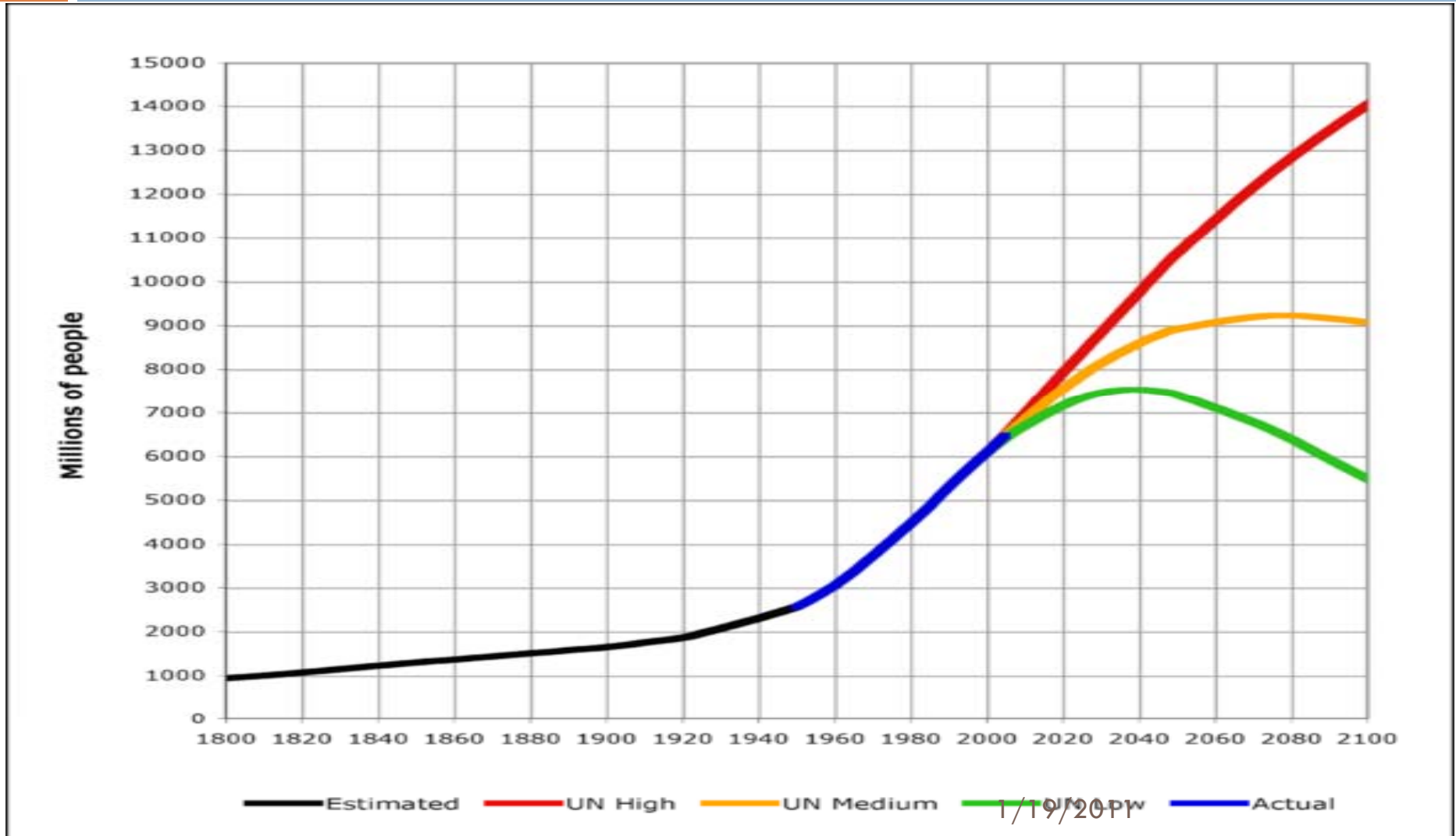
World Population To 2050

7

- World Population to day is over 6.9 Bil;
- Will Reach **7 Billion** in this year; just **12** yrs after 6 Bil;
- **8** Billion in 2025 – (in **14** years); and
- **9+** Billion by 2050 and then stabilize and begin to decline under UN Medium Variant Projections.
- 1/3 rd of the World's Pop will be in 2 Countries-
 - ▣ India 1.572 Billion
 - ▣ China 1.462 Billion
 - ▣ And only one currently developed country -the USA – will be in the top 10.

World Population Projections to 2100

8



	1950	2000	2001	2025	2050
World	2,519,495	6,056,715	7,207,361	7,936,741	9,322,251
India	357,561	1,008,937	1,230,484	1,351,801	1,572,055
China	554,760	1,275,133	1,410,217	1,470,787	1,462,058
United States of America	157,813	283,230	321,225	346,822	397,063
Pakistan	39,659	141,256	204,267	250,981	344,170
Indonesia	79,538	212,092	250,068	272,911	311,335
Nigeria	29,790	113,862	165,313	202,957	278,788
Bangladesh	41,783	137,439	183,159	210,823	265,432
Brazil	53,975	170,406	201,393	218,980	247,244
Dem. Rep. of the Congo	12,184	50,948	84,045	114,876	203,527
Ethiopia	18,434	62,908	89,765	113,418	186,452

FAO Report -How to Feed the World in 2050?

10

- ***“By 2050 the world’s population will reach 9.1 billion, 34 percent higher than today. Nearly all of this population increase will occur in developing countries.***
- ***Urbanization will continue at an accelerated pace, and about 70 percent of the world’s population will be urban (compared to 49 percent today).***
- ***Income levels will be many multiples of what they are now.***
- ***to feed this larger, more urban and richer population, food production (net of food used for biofuels) must increase by 70 percent.***
- ***Annual cereal production will need to rise to about 3 billion tonnes from 2.1 billion today;***
- ***Annual meat production will need to rise by over 200 million tonnes to reach 470 million tonnes.” Page 2***

FAO Report -How to Feed the World in 2050? - 2

11

- The report argues that >80% of the increase must come from improved yields as possible expansion of area is limited and potentially available land is found in only a few countries.
- This is a larger challenge in the face of recent declines in productivity growth rates.
- **It will have to be produced with less water;**
 - *“...An increasing number of countries are reaching alarming levels of water scarcity and 1.4 billion people live in areas with sinking ground water levels. Water scarcity is particularly pronounced in the Near East/North Africa and the South Asia regions and is likely to worsen as a result of climate change in many regions.” Ibid P. 9*

FAO Report -How to Feed the World in 2050? - 3

12

□ **Major threats identified are:**

- competing demands for land for energy production;
- climate change, which will most negatively impact those closest to the equator;
- the loss of biodiversity.

□ **What will be required are very large increases in investment in international agricultural development and agricultural R&D to develop new varieties/hybrids and crop and livestock production systems.**

□ **Even under optimistic assumptions about improved production in developing countries, their food imports will more than double.**

The Challenges in Summary

13

- To feed yet another 2 Billion people
- In a world that is richer and more urban;
- On basically the land area we now have, and with less water;
- Increase food production 70%;--grain production by 43%, and meat production by 75%;
- Made more difficult by:
 - ▣ With competing demands for bio energy;
 - ▣ The negative impacts of climate change;

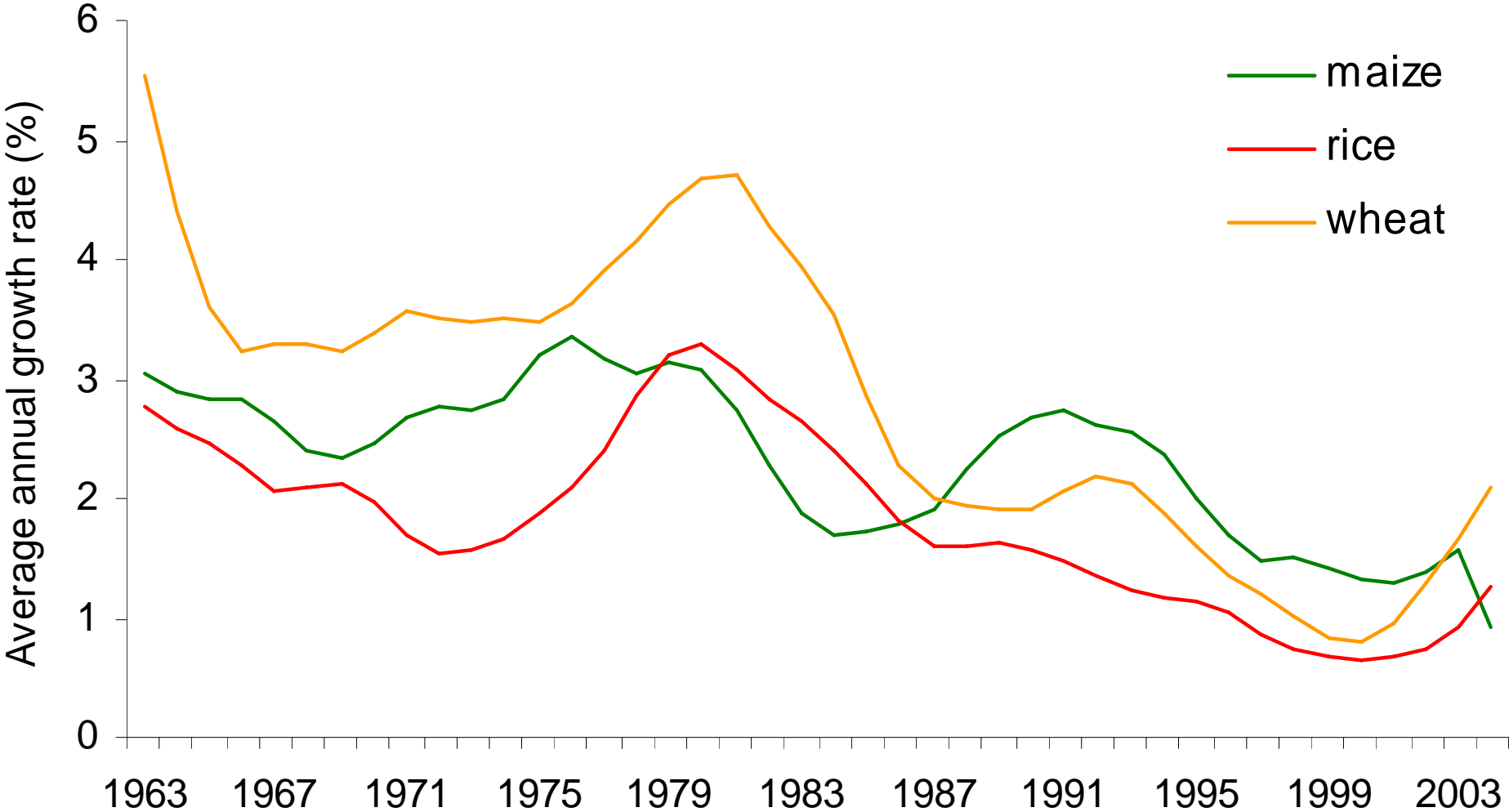
Immense Implications:

14

- The increases are all going to have to come from productivity improvement; *-not just in terms of land productivity but also water productivity*; But **productivity growth is slowing**
- And **input prices have risen** and there are **additional non-food demands** for Agricultural Production e.g. Biofuels
- The increases are going to have to **come from basically the current spatial distribution of production**;
- Which means **trade** in agricultural and food products **must expand more rapidly than demand**; *-trade liberalization becomes central*;
- And in **world markets likely to be more unstable.**

Lets look at a few slides that illustrate these implications

Productivity growth is declining



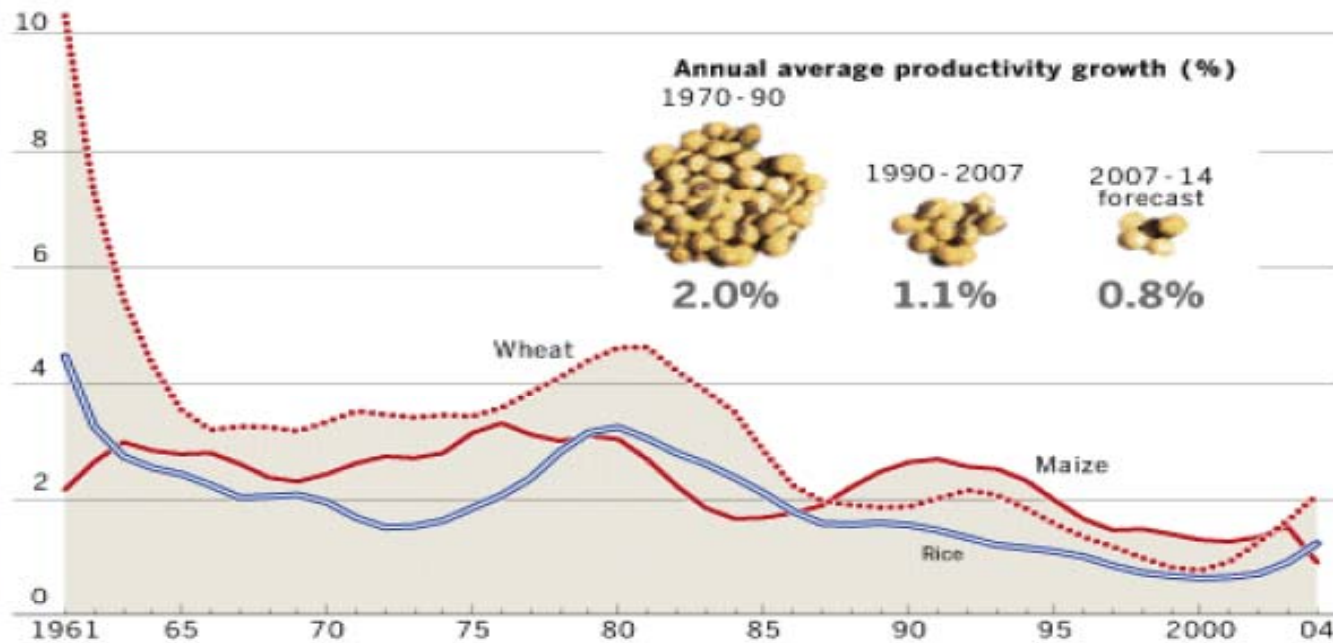
Productivity Decline- 2

16

Is the recent agricultural price rise because productivity growth has been slowing down?

The pace of improvement has slowed steadily...

Annual % change in crop yield

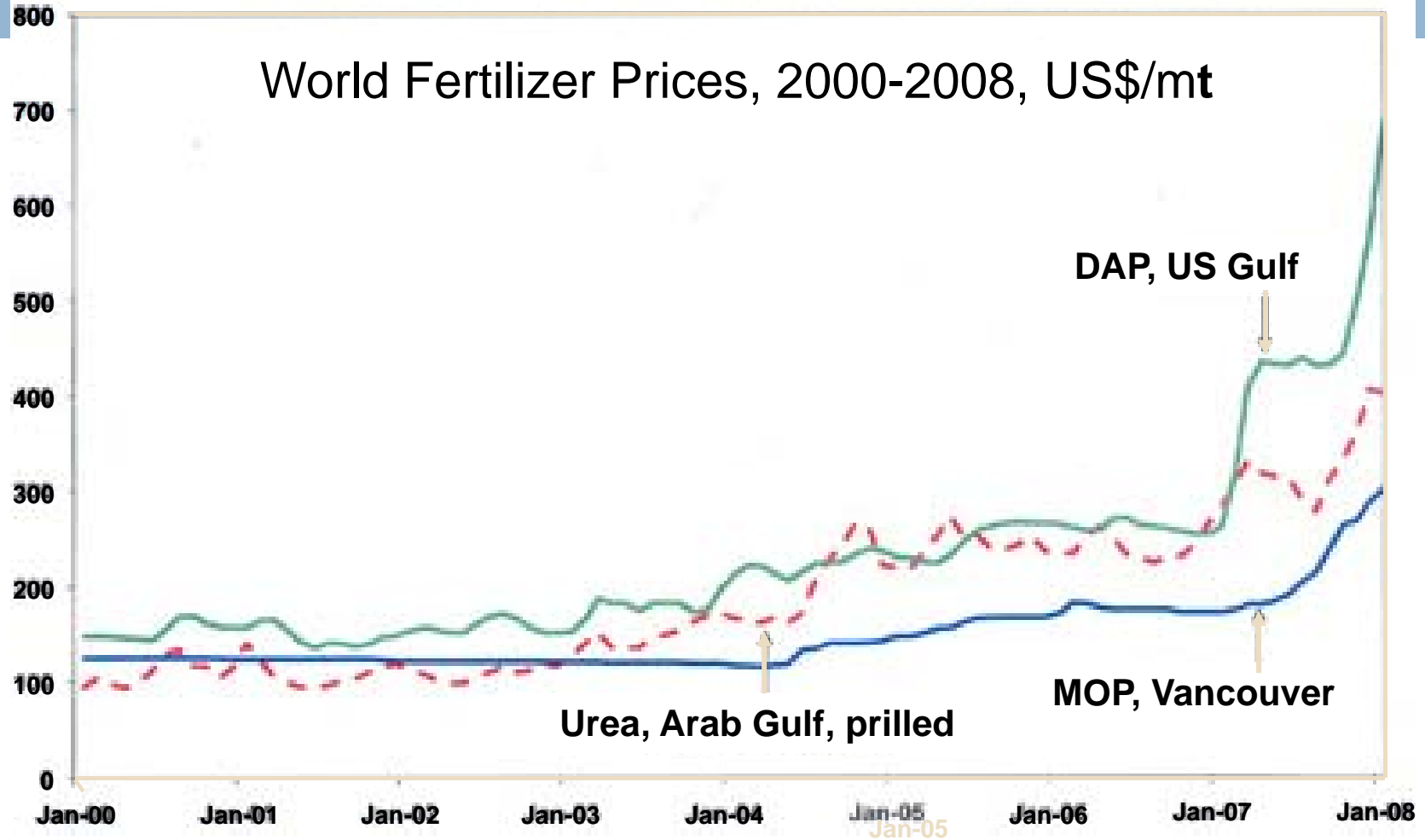


Source: World Bank Development Report 2008 (figure refers to developing countries only)



Higher input costs: Global fertilizer prices spiked in 2007-08

17



1/19/2011

Source: IFDC 2008.

Fertilizers Price Index Chart 2005-10: Fell After 2008 Peak, But Trending Up Again— Currently, 3X 2000 Prices

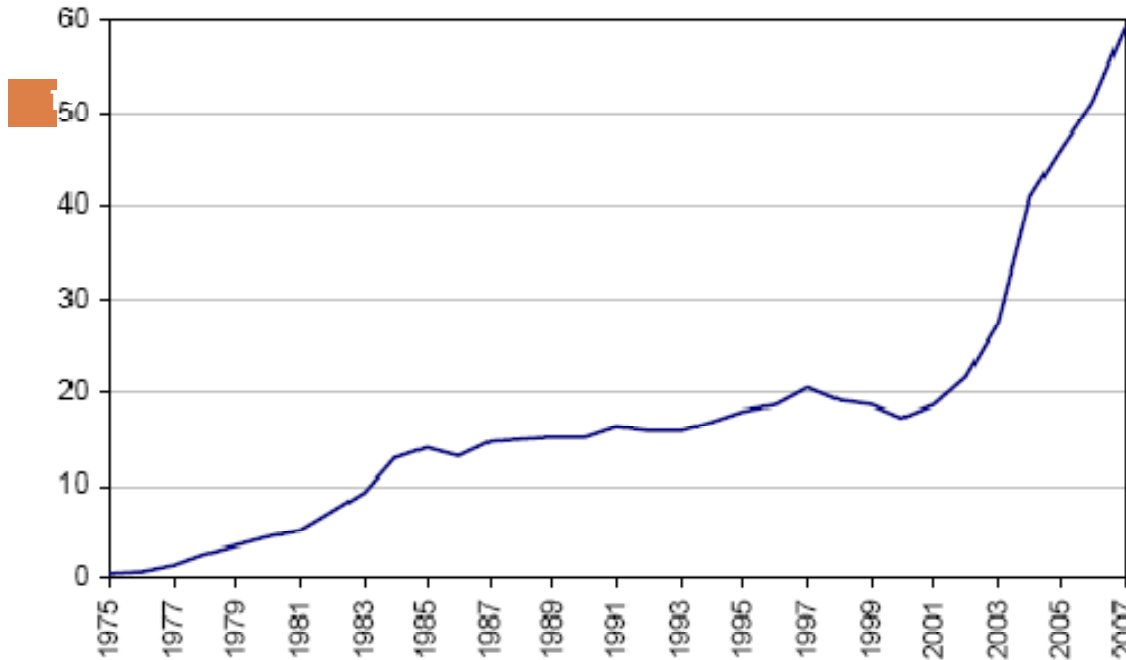
18



1/19/2011

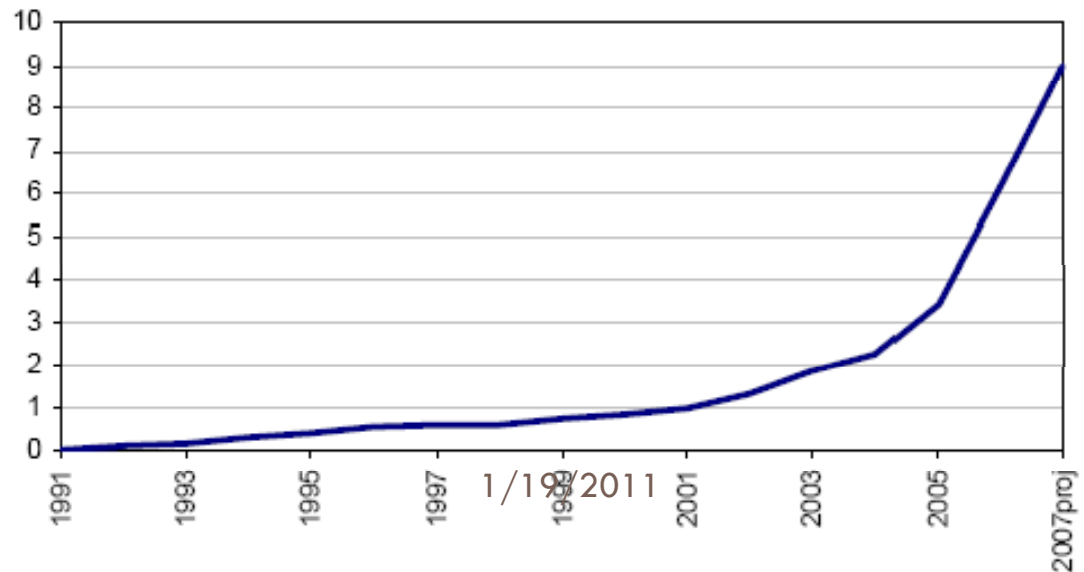
BioFuels Boom

Ethanol production 1975 - 2007 (billion liters)



Ethanol > 90% of biofuel production; Brazil and US dominate the market

Biodiesel production 1991 - 2007 (billion liters)

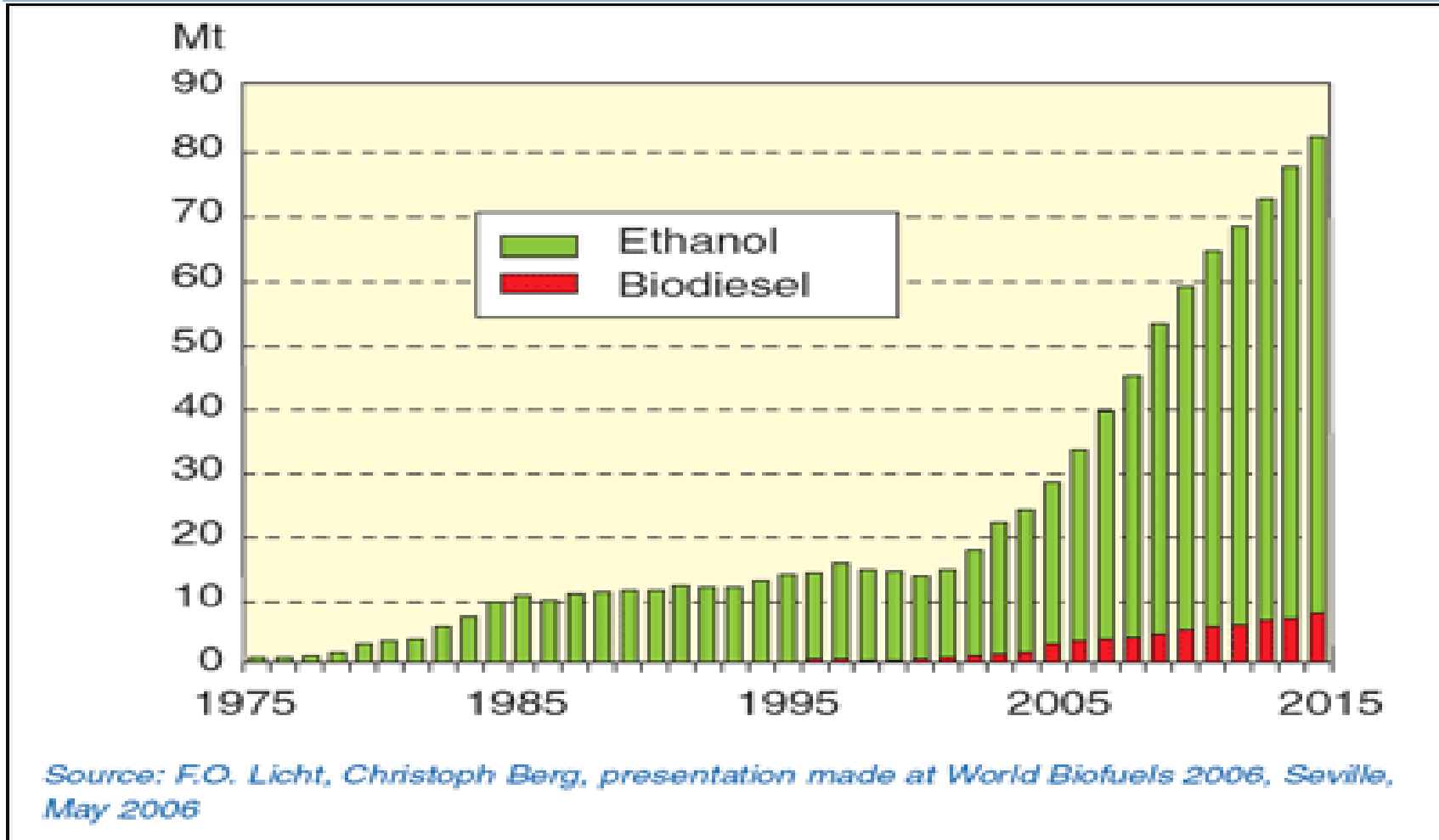


Biodiesel: EU is the largest producer and consumer

**Source: Global Subsidies Initiative
2007**

BioFuel Demand Expected to Double Again by 2015

20



1/19/2011

Agricultural Trade Issues:

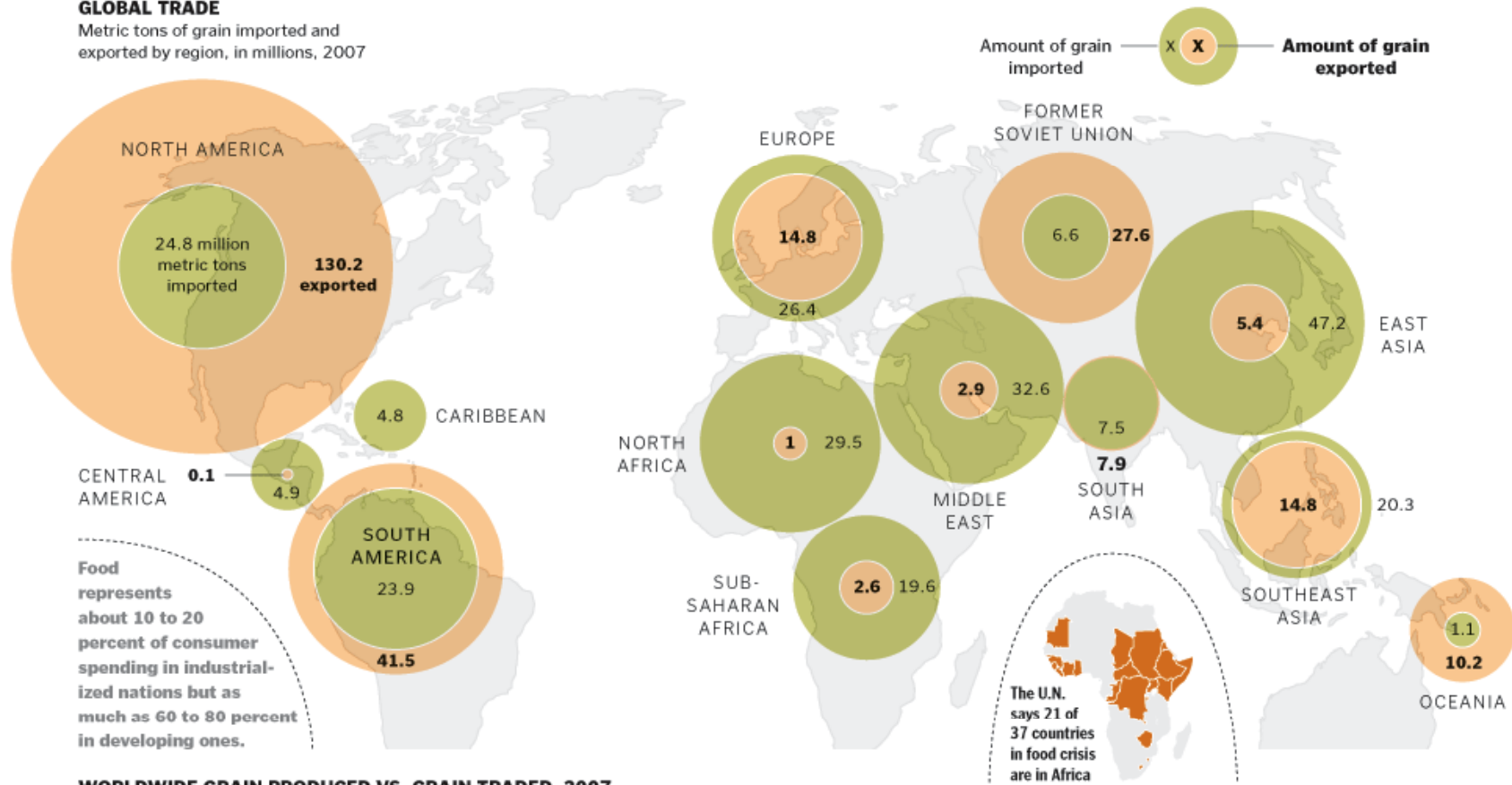
21

- Agricultural trade is important but growing less rapidly than total trade;
- Rich Countries are major exporters- developing countries major importers;
- Trade is a relatively small share of total food grain consumption;
 - ▣ Wheat < 18% of Consumption is imported;
 - ▣ Corn – 12.4 %
 - ▣ Rice – 6.5 %

To Meet Future Needs From Current Locations of Production Trade Will Have to Grow Rapidly.

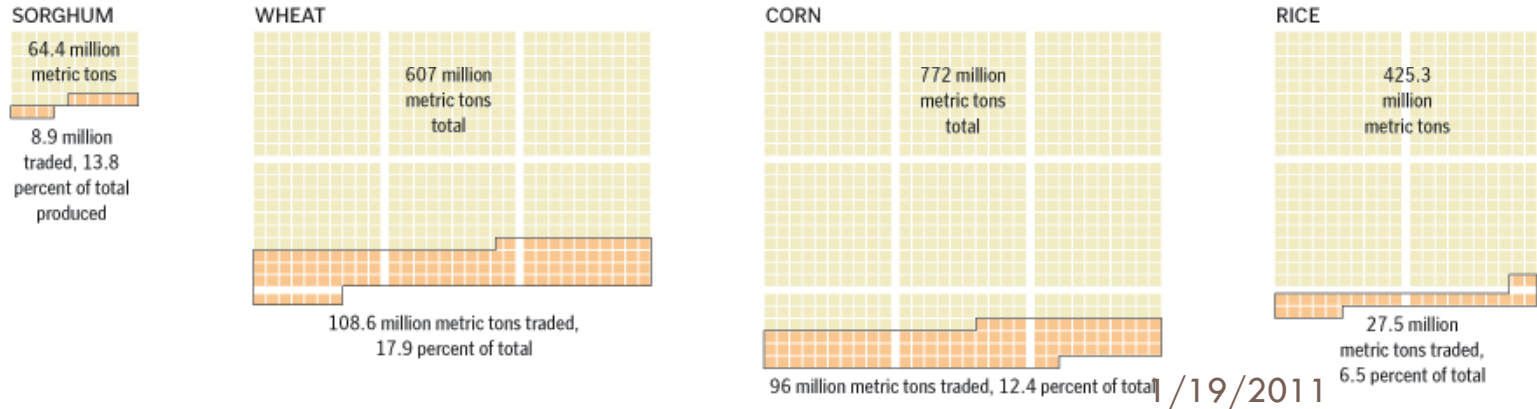
GLOBAL TRADE

Metric tons of grain imported and exported by region, in millions, 2007



WORLDWIDE GRAIN PRODUCED VS. GRAIN TRADED, 2007

The amount of grain traded on the global market is a small percentage of the total produced because countries keep most of their crop for domestic needs.



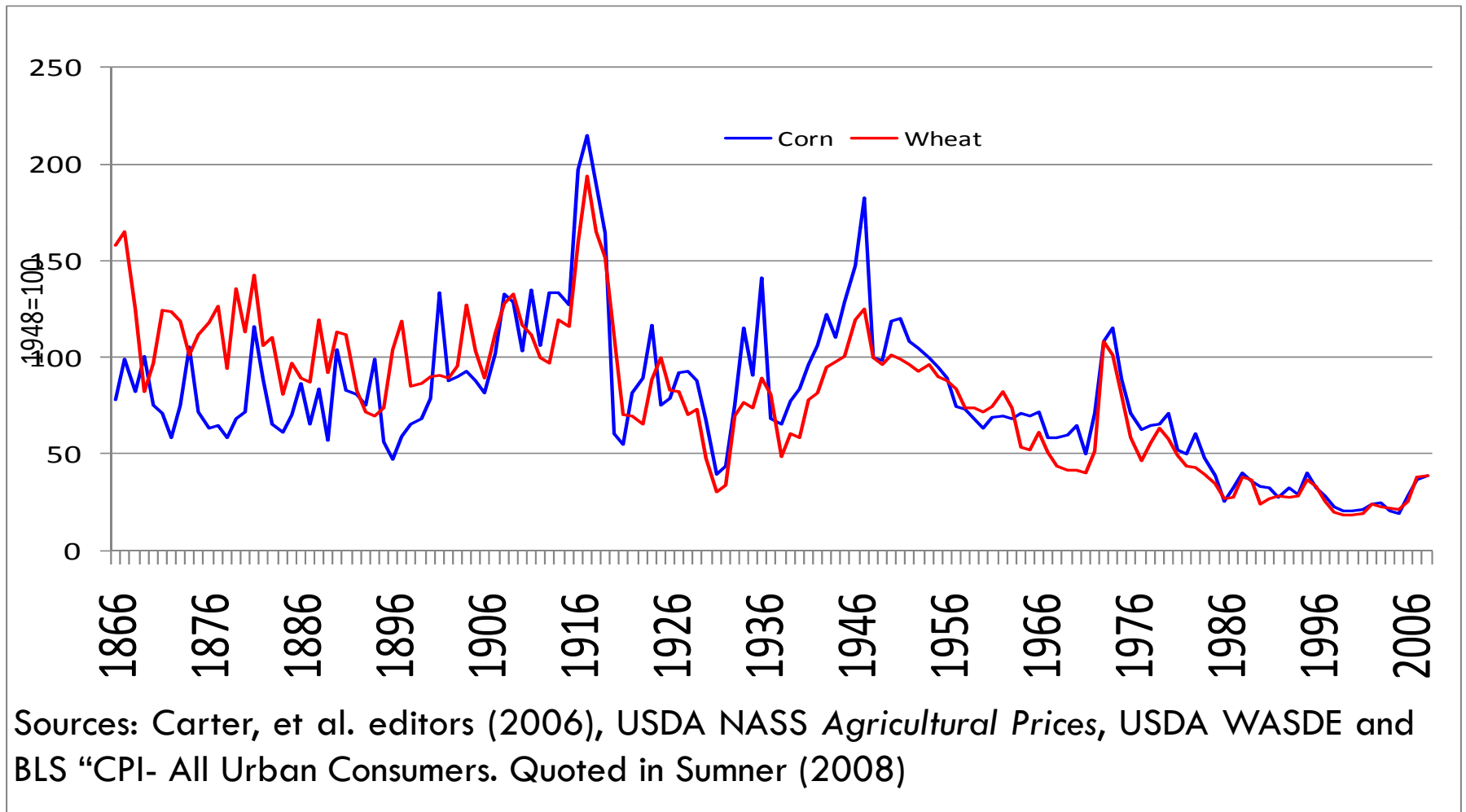
Grain Prices-LT Trends? & Stability?

23

- The Big Question after 2008 Price Spike Remains-
What Will Happen to LT Real Grain Prices?
 - ▣ Will they resume their 150 years decline?
 - ▣ Will they settle higher & remain relatively stable?
 - ▣ Or will LT real prices settle higher and begin to rise?
 - ▣ Two projections suggest the latter-OECD/FAO & FAPRI.

Index of real corn and wheat prices, 1866-2008

24



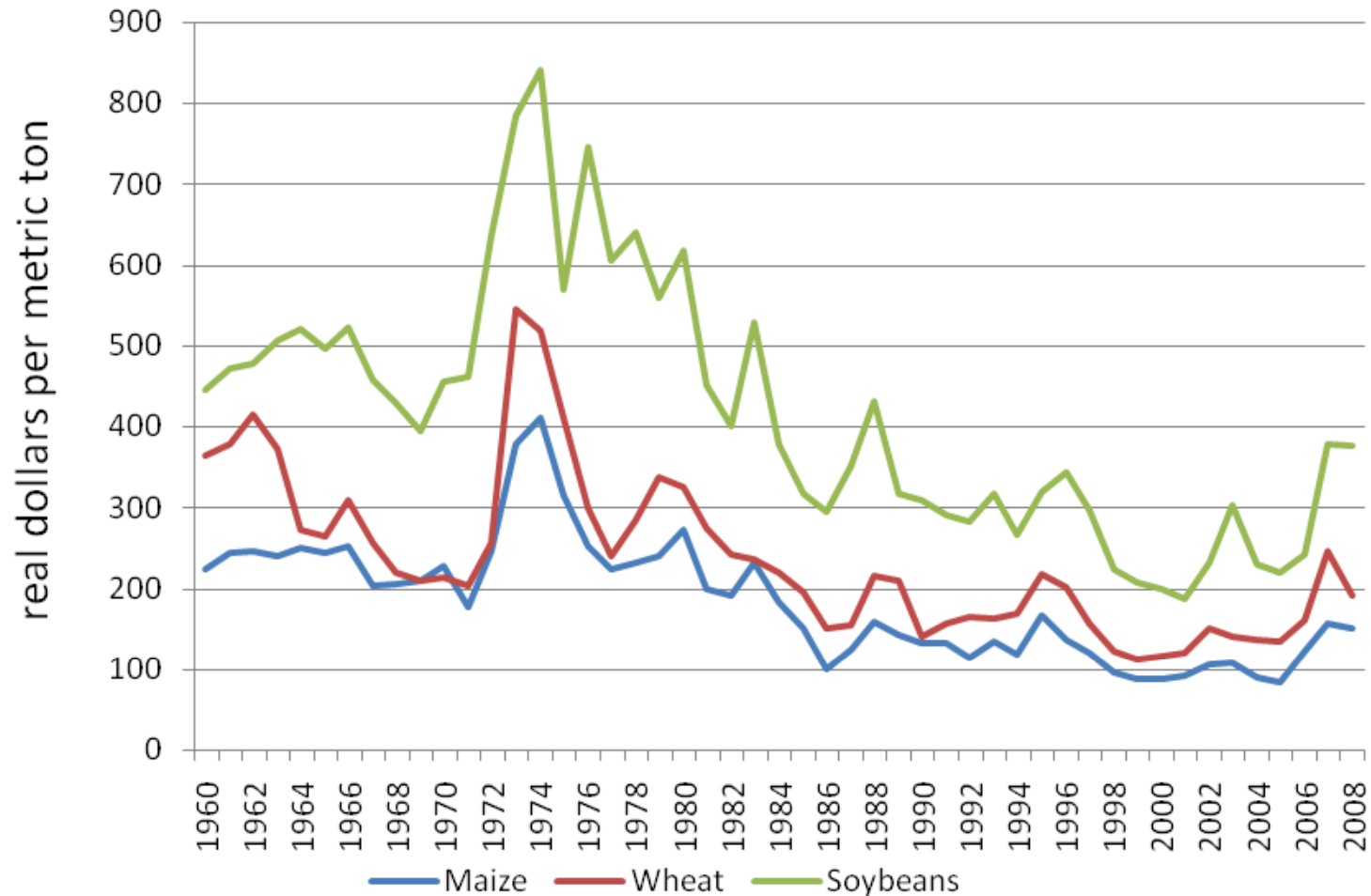
Sources: Carter, et al. editors (2006), USDA NASS *Agricultural Prices*, USDA WASDE and BLS "CPI- All Urban Consumers. Quoted in Sumner (2008)

1/19/2011

Declining Real Prices of Grains and Soybeans

(2000 US\$) 1960-2008 USDA deflated prices from Meyers & Meyer, Dec 2008

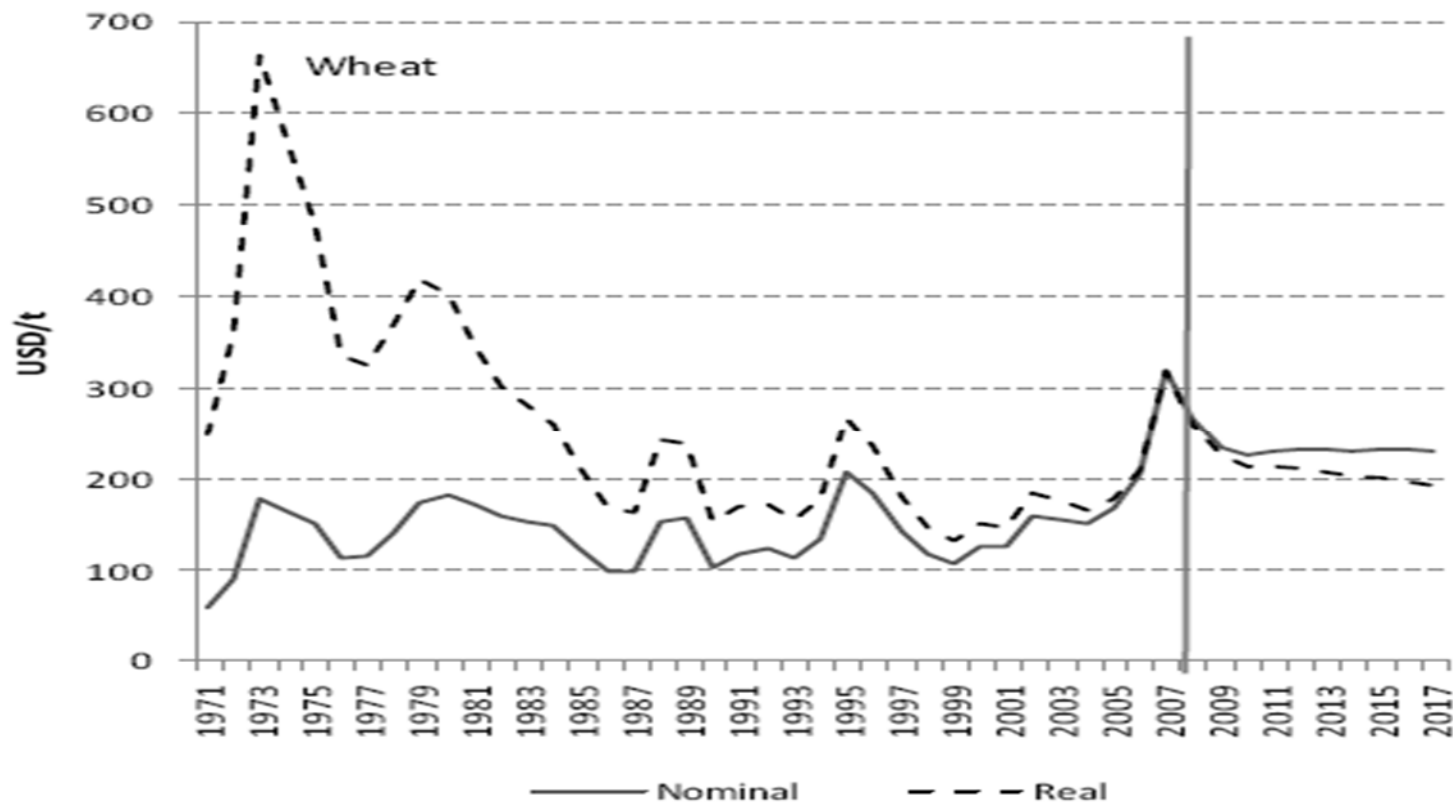
25



1/19/2011

OECD-FAO Projections: Wheat

26

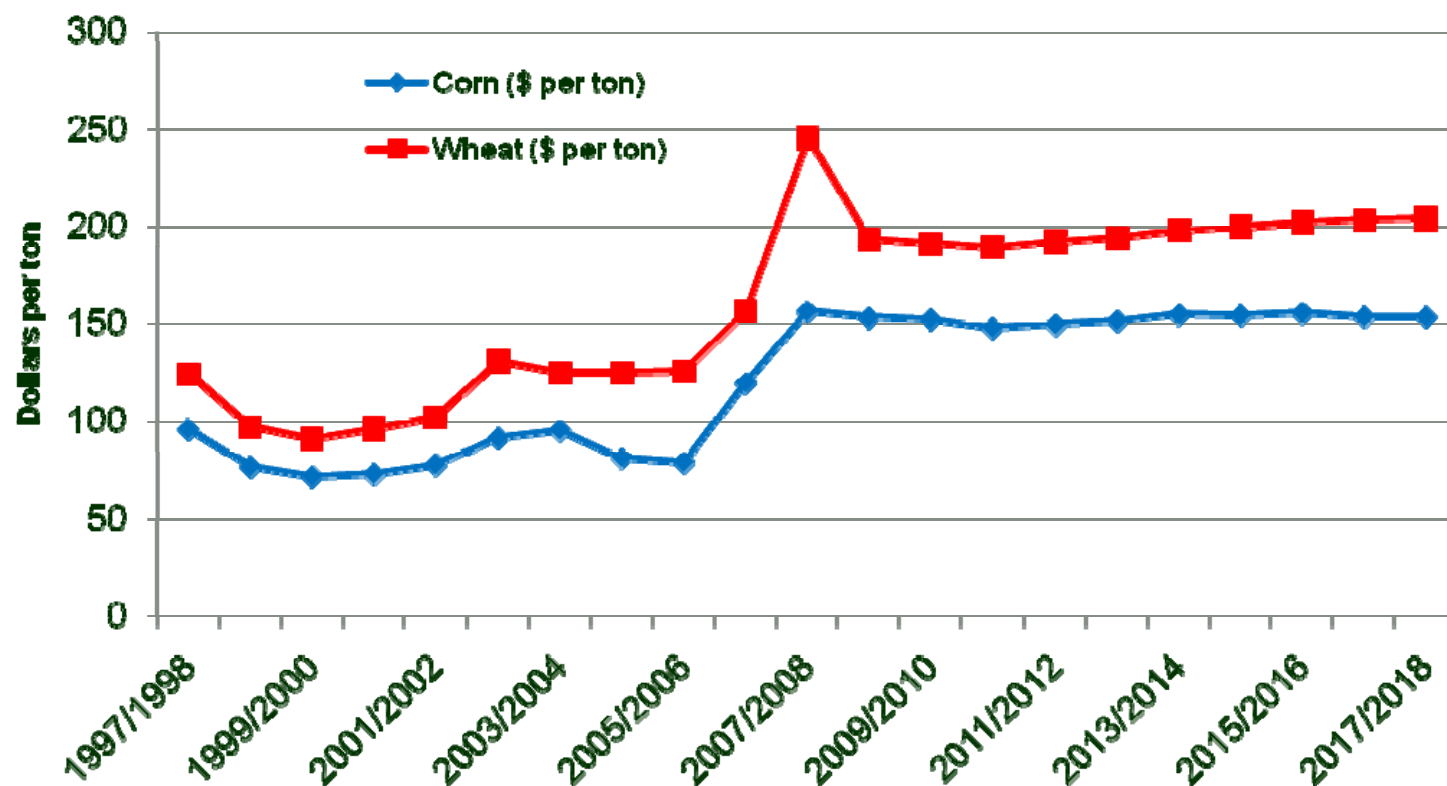


OECD-FAO Agricultural Outlook, 2008-2017

1/19/2011

FAPRI Projections of US Crop Prices from January 2008

27



Actual wheat prices were 2008 US\$ 12.4 per Bushel in March and less than US\$ 5 per Bushel in early Dec. 2008

1/19/2011

Recent Price Behavior

28

- Look at Some Markets –pre and post 2008 Spike-
- WHEAT prices tripled in the spike and then dropped sharply to about 30% above previous levels-BUT in last 8 months have gone up to more than double;
- Similar pattern with canola and soybeans;
- Corn Prices increased almost 3X, dropped sharply but now more than double pre spike levels;
- Current Rice Prices are double pre spike levels:
- **Both Wheat and Corn prices are well above OECD/FAO and FAPRI Projections; 1/11/11-Wheat \$US 284/mt, Corn \$US 239/mt.**

Wheat: Near Future- Sept 2005 – Jan, 2011 (CBOT) Cents/Bu

29



1/19/2011

Canola Near Future Sept 2005 – Jan 2011 (CBOT) \$/MT

30



1/19/2011

Soybeans: Near Future Sept 2005 – Jan 2011 (CBOT) Cents/Bu

31



1/19/2011

Corn- Near Future Sept 05 – Jan 11

CBOT Cents/bu

32



1/19/2011

SO What Can We Say?

33

- No evidence yet that Prices will return to pre spike levels- but no hard facts to prove they wont;
- It could all be Russian and Australian weather;
- Price Instability seems to have increased;
- Food Prices didn't triple with grain prices but they almost doubled in 2008, dropped back some in 2009;
- But rose again in 2010
- FAO index for Dec 2010(215) exceeded peak in 2008(213)

World Food Prices Close to Record High

FAO December 2010

34

ANNUAL FOOD PRICE INDICES (2002-2004=100)

Date	Food Price Index	Meat Price Index	Dairy Price Index	Cereals Price Index	Oils Price Index	Sugar Price Index
1990	107.9	131.3	74.8	97.6	74.0	178.1
1991	103.5	125.3	79.6	96.9	79.1	127.2
1992	106.7	120.3	95.4	102.3	84.3	128.5
1993	105.4	120.4	84.6	99.5	86.0	142.2
1994	111.7	118.5	82.3	104.5	113.4	171.8
1995	121.9	114.7	109.6	119.4	125.0	188.5
1996	124.1	114.1	109.4	140.7	111.2	169.7
1997	113.5	109.2	105.1	112.1	112.5	161.4
1998	103.7	93.5	99.1	99.8	129.9	126.6
1999	91.1	94.4	86.3	90.2	91.6	89.0
2000	89.5	93.9	95.4	84.5	67.8	116.1
2001	92.3	93.7	107.1	86.2	67.6	122.6
2002	90.2	90.3	82.2	94.6	87.0	97.8
2003	98.3	98.7	95.1	98.1	100.8	100.6
2004	111.5	111.0	122.6	107.4	112.2	101.7
2005	114.7	112.7	135.4	103.4	103.6	140.3
2006	122.4	106.7	128.0	121.5	112.0	209.6
2007	154.1	112.1	212.4	166.8	169.1	143.0
2008	190.9	128.3	219.6	237.9	225.4	181.6
2009	151.5	117.7	141.6	173.7	150.0	257.3
2010	179.1	134.9	200.4	182.6	193.0	302.0
					1/19/2011	

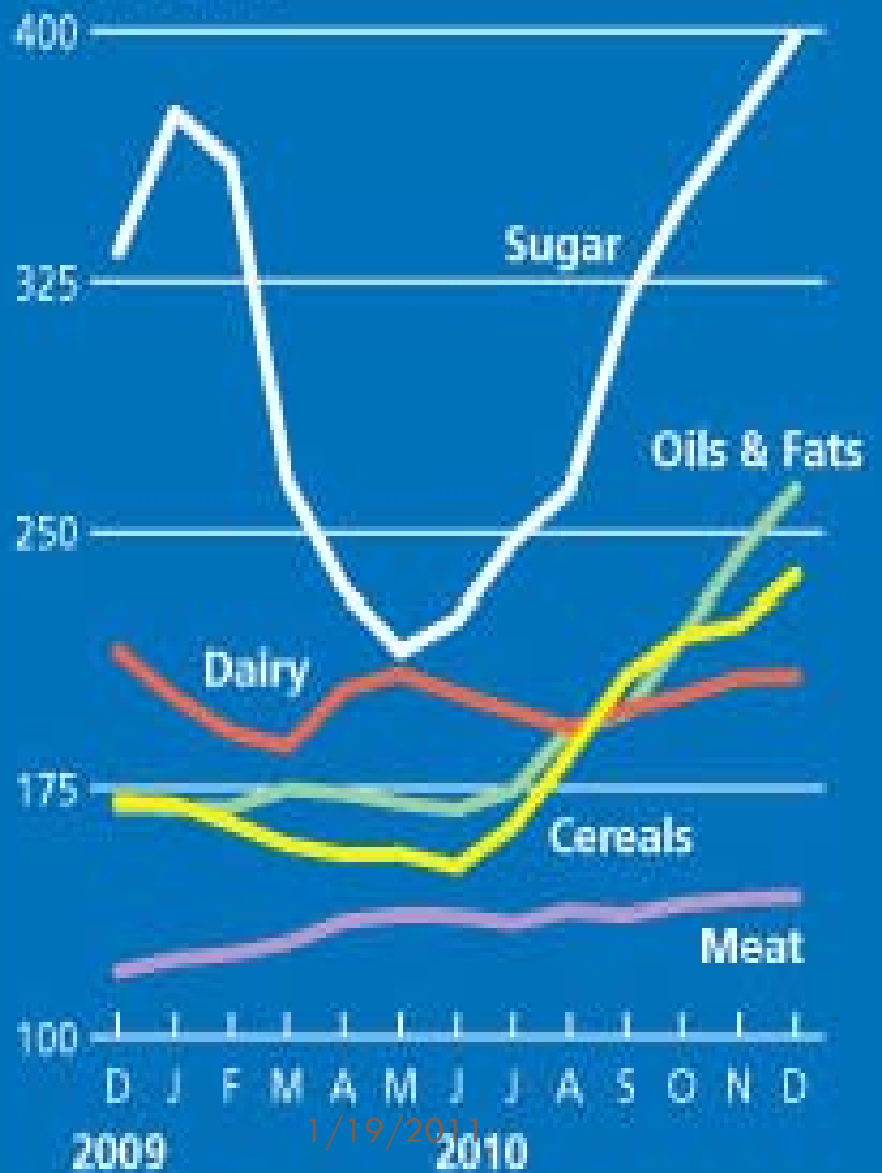
FAO Food Price Index

2002-2004=100



Food Commodity Price Indices

2002-2004=100



Future Sources: Land

36

- New Land into production? Limited potential in only a few countries – Brazil, Savannah Africa, Ukraine, Russia and not many more.
- Would in many cases require new technology e.g. cerrados in Brazil; or loss of forests.
- Offsetting challenge of land loss to urbanization, degradation, desertification, and salinization,
- In recent years loss has exceeded new land brought into production.
- **BOTTOM LINE-** new land not the answer -most must come from productivity improvement.

Future Sources: Water -1

37

- Except for old systems of irrigation in Egypt, the Middle East and East Asia, irrigated acreage doubled from a low level 1850 -1950;
- It took off in the 1960's peaking at growth of 2.7%/yr in the 1970's --declined to 0.4%/yr by the 1990's and has stayed low.
- Big Damns are out –WB focus now small scale catchment basins, system rehabilitation and improving efficiency of water use.
- Current focus more on hydro e.g Ethiopia on Nile.
- **BOTTOM LINE:** New expansion limited if at all.

Future Sources: Water -2

38

- Bigger Challenge is to maintain magnitude and efficiency of existing systems;
- Losses of productivity due to salinization, siltation, and water logging are mounting;
- Expanded use of ground water has seriously depleted aquifers e.g. Ogallala, Punjab and China;
- Increasing competition from urban and industrial users;
- Expanded concerns about safe drinking water puts pressure on agriculture to be less of a polluter
- **BOTTOM LINE:** bigger issue may be decline in available water for Ag.-must improve productivity.

Future Sources- Biological & Agronomic Productivity

39

- Therefore comes down basically can we double yields again in major crops?
- Commercial wheat and rice yields doubled, and corn yields quadrupled, in the 2nd half of 20th century, can we do it again? But productivity growth has slowed.
- Semi-dwarf wheat and rice, which allowed greatly increased fertilizer use without lodging, was combined with expanded irrigated area to, for example quadruple wheat production in India between 1960 & 2000- India became a an exporter in some years;
- How often and where can this be repeated??
- Critical then to use best of modern biological science

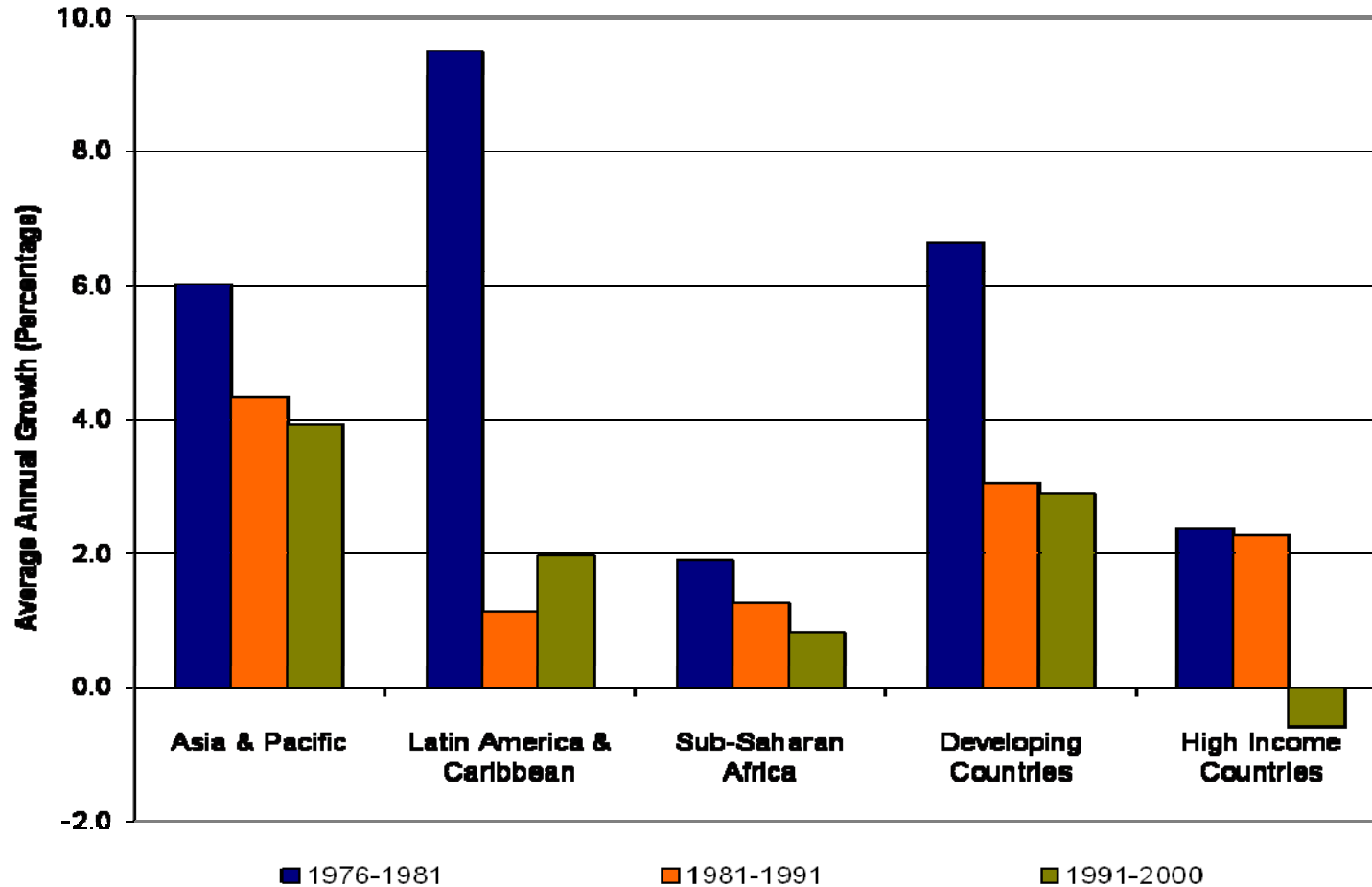
Future Sources-Biological & Agronomic Productivity- 2

40

- Biotechnology, in the minds of many, offers enormous potential for yield increases and managing biotic and abiotic stresses;
- To date they claim to have only scratched the surface, and yet has fostered improved yields by better management of pests and weeds; --Round-Up Ready, BT
- One result is no-till agriculture which has reduced erosion and pesticide use. e.g. BT cotton
- And yet is highly controversial especially trans-species genetic manipulation.
- Is further complicated by widespread use intellectual property protection by large private firms that dominate developed country ag research;
- Growth in public investment in Ag research and agricultural development plunged in the 1990's and 2000's

Slowdown in Public Ag R&D Spending Growth

41



Source: Pardey, Beintema Dehmer and Wood (2006)

1/19/2011

Future Sources- Biological & Agronomic Productivity- 3

42

- European resistance to biotech is spilling over to Africa via trade threats, see Paarlberg *Starved for Science*;
- Yet Africa has the lowest, and slowest growing, yields in the world and has the highest Population growth projections;
- So where will increased output come from?
- Until now the vast majority of food consumed has been indigenously produced, while trade has grown, but as we noted it still represents a small share of basic staples-rice 6%, corn 12% and wheat 18%;
- And these percentages have changed little over time.

Future Sources –Policy Reform?

43

- Many Policies Will Have Major Impacts:-Positive or Negative- the list seems endless.
 - R & D Investments –domestic and international- CGIAR;
 - Investments in agricultural development/poverty reduction;
 - A Substantive WTO agreement which liberalizes ag trade;
 - Elimination of export controls and taxes;
 - International/Regional policies for food security in poor countries- regional stocks? Collective use of futures markets?
 - Domestic policy reform, particularly in Developed Countries- get rid of amber box subsidies e.g. supply management;
 - Policies to manage climate change and its impacts on agriculture- mitigation and adaptation not vs

Future Sources –Policy Reform? -2

44

- ▣ Development of alternative energy sources;
- ▣ Better Management of natural resources; more efficient use of water especially in agriculture;
- ▣ Better management of wastes- agriculture is not immune here
- ▣ Effective policies for food security, nutrition and health security;
- ▣ Investments in Human Capital;
- ▣ Macro-Economic Stability and Growth;
- ▣ And on and on

Global Potential vs Indigenous Capacity-not either BUT BOTH

45

- Food Security is much broader than self-sufficiency- is issue of access and this means big impact of poverty reduction.
- Some see a world of rich countries –a smaller and smaller share of world's pop.- producing surplus food; and
- Many countries remaining poor with limited capacity to increase food production; haves vs have-nots?
- Therefore simply making world markets work better is not enough – need to address improving agricultural profitability in poor countries- win-win –poverty reduction and food security.
- **BOTTOM LINE:** Productivity driven agricultural development is an especially high priority.

A Tough Row to Hoe

46

- Feeding 2 Billion more in a world growing more urban and with an expanding middle class is a huge challenge, made more so by:
 - Potential negative impacts of climate change;
 - Resource degradation accelerated by a growing population and expanded urban foot print;
 - Loss of biodiversity, deforestation, declining per capita water availability and fisheries decline;
 - Where production could expand is not where expanded need will be.

Will Require Combination of Productivity Growth and Policy Improvements.

1/19/2011

Therefore:

47

- Policy Challenges Are Enormous-
- Both for Canada and the World.