Long-term Projections of China's Ability to Feed Itself: Implications for Japan

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The Problem

- **There has been worldwide concern about China's ability to feed itself, and the impact it will have on world food supplies**
- **That concern continues, particularly driven by the dramatic increase in food prices in 2007 and 2008**
- **This presentation deals with the extent to which there is cause for concern, and if so how much and what can be done**

The Model

- **Especially developed for long-term projections of animal inventories, feedstuffs requirements and feedstuffs availabilities.**

- **The program is very large and complicated, with more than 5,000 lines of spreadsheet program, 800 variables and more than 2,200 parameters.**

- **The method used is to calculate all requirements and availabilities on the basis of metabolizable energy (ME) and crude protein (CP).**

This very detailed modeling is necessary because “back of the envelope” (meaning simplistic) analyses are usually wrong.....

- **Basing them on what you want to happen usually leads to erroneous findings.**
- **Research is all about going beyond what seems to be the obvious, searching for details and....**
- **“thinking outside the box”**

A nutritional based model is the appropriate one because:

- **Models based on commodity prices, ones favored by economists, lose their validity and predictive power after a few years of iterations and**
- **Long-term projections of China's ability to feed itself focuses on the question: Technically, and taking into account macroeconomic and microeconomic variables, to what extent could it feed itself?**
- **In fact, the modeling is all about development and adoption of technologies on both the animal (feed consumption) and crop (feed provision) sides**

Demand Side Variables

- Human population growth
- Changes in human diets
- Associated macro variables that impact such as growth in income per capita

China Population and Per Capita Income

Item	2007	2020	2030
Population (millions)	1,320	1,430	1,461
Additional pop from 2007		110	141
GDP Per Capita (PPP US dollars)	*7,700*	*14,644*	*23,854*
Growth rate percent (2007-2020 and 2020-2030)		8	7	5

23 years from now

- Japan PPP GDP Per Capita 2007 $33,100

“Back-of-the-Envelope” Prognostications

- For years many people have argued, and continue to argue, that China will significantly disrupt world food supplies.
- Their reasoning generally is simplistic, essentially calculations that can be done on the back of an envelope.
- To them, since China’s population is large and growing, and per capita income is increasing rapidly, total meat, fish and seafood per capita consumption will increase so much that vast feedstuffs and food imports will be required.
- Is this simplistic thinking credible?

PER CAPITA CONSUMPTION ANIMAL AND AQUA PRODUCTS, CHINA AND JAPAN

CHINA--BLACK JAPAN--RED	CHINA 2007		CHINA 2030	JAPAN 2007
		23 YEARS →		
BEEF AND VEAL	5		8	8
PORK	33		38	18
OTHER MEAT	3		2	0
POULTRY	11		21	15
AQUA PRODUCTS	27		34	66
TOTAL MEAT AND AQUA PRODUC	79	→	103	107
COW MILK	26		40	65
EGGS, HEN	17		18	19

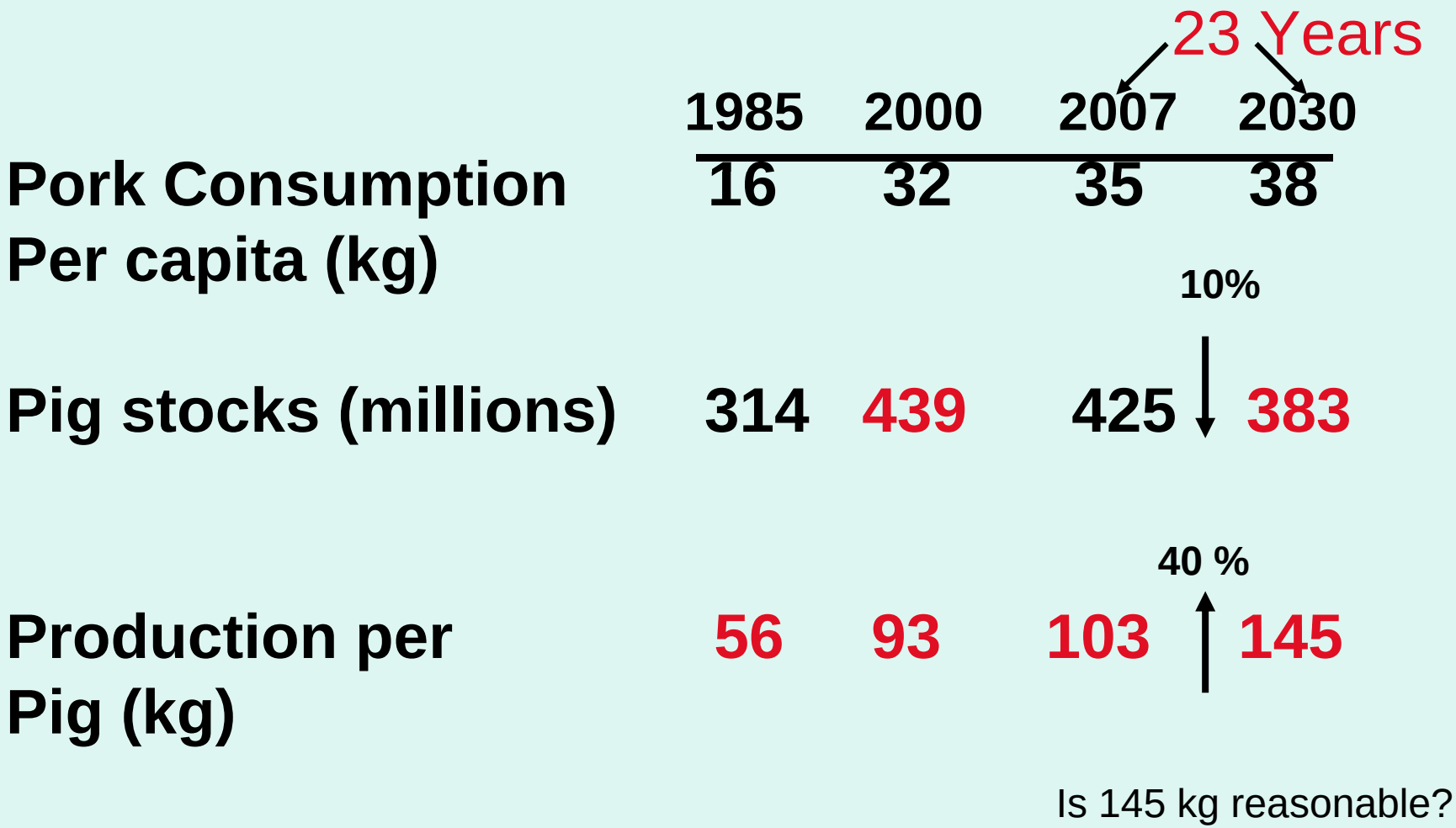
CONCLUSIONS

- **TECHNICALLY, CHINA CAN CONTINUE TO ESSENTIALLY MAINTAIN NET FOOD SELF-SUFICIENCY FOR THE NEXT QUARTER CENTURY.**
- **LITTLE OR NO ADDITIONAL ENERGY BASED FEEDSTUFFS WILL BE REQUIRED, BUT….**
- **UNDER MY BASIC VERY CONSERVATIVE PROJECTIONS SUBSTANTIAL ADDITIONAL PROTEIN BASED FEEDSTUFFS IMPORTS WILL BE REQUIRED TO MEET SHORTFALLS**
- **HOWEVER, THERE ARE AFFORDABLE, PRACTICAL MEANS BY WHICH IMPORTS NEED NOT EXCEED CURRENT LEVELS BY 2030 IF GOVERNMENT DECIDES TO ADOPT THE NECESSARY POLICIES.**

THE ANIMAL SIDE

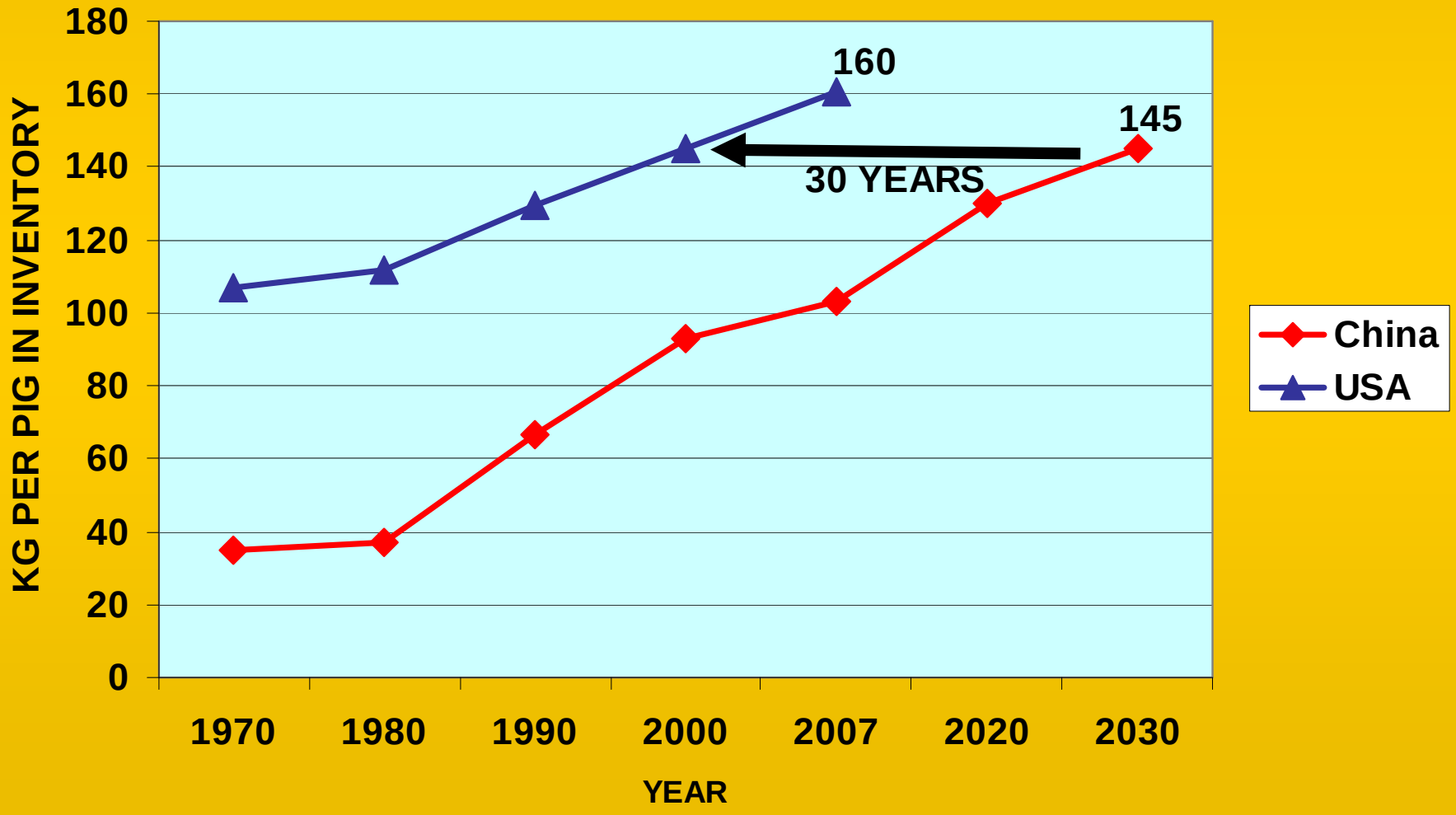
- **How many livestock will be required to meet demand assuming that China continues to be basically self-sufficient in livestock products?**
- **That depends on productivity, in other words the amount of product produced per animal per year.**
- **Productivity and detailed analysis of livestock inventories then form the basis to determine the total amount of energy and protein required annually to feed them.**

Pigs and Pork Production



Is 145 kg reasonable?

PORK PRODUCTION PER PIG IN INVENTORY (KG) IN CHINA AND USA, 1970-2007 AND PROJECTIONS FOR CHINA 2020 AND 2030



Poultry and Meat Production

	1985	2000	2007	2030
Meat Consumption Per capita (kg)	2	10	11	21
Poultry stocks (Millions)	1,549	4,423	5,557	4,199 (24 % ↓)
Production per Bird (kg)	1.2	2.5	2.5	7.0 (2.8 times larger ↑)

Reason: Decline of backyard production and increase in large farms

Cow milk Consumption and Production

	1985	2000	2007	2030
Milk Consumption per capita (kg)	2	7	26	40
Dairy Cattle stocks (millions)	1.7	4.7	12.4 ↓	9.0
Milk yield per head (kg)	1,541	1,807	2,000 ↑	6,500

Reason: China's dairy subsector is still very rudimentary. 6,500 kg in another two decades is very conservative. Consider that currently milk yield in Japan is about 7,300 Kg, and it is about 9,000 kg in the USA.

Egg Consumption and Production

	1985	2000	2007	2030
Egg Consumption per capita (kg)	4	15	17	18
Laying hens (millions)	658	1,931	2,387	1,303
Egg yield per layer (kg)	6.8	9.8	9.2	18.2

HALF AS MANY

DOUBLE

Reason: China's egg subsector is still very rudimentary. A large portion of eggs are still produced on back yard farms.

Cattle and Beef Production

	1985	2007	2030
Beef Consumption per capita (kg)	<1	5	8
		46 % ↑	
Cattle stocks (millions)	62	82	120
		18 % ↑	
Production per head (kg)	6	71	84

Reasons: Cattle stocks must grow because there is little potential to increase productivity since, among other reasons (1) cows average less than one calf per year (2) production is, and will continue to be on grassland and small farms, and (3) feeding methods are not oriented to rapid weight gain

j1

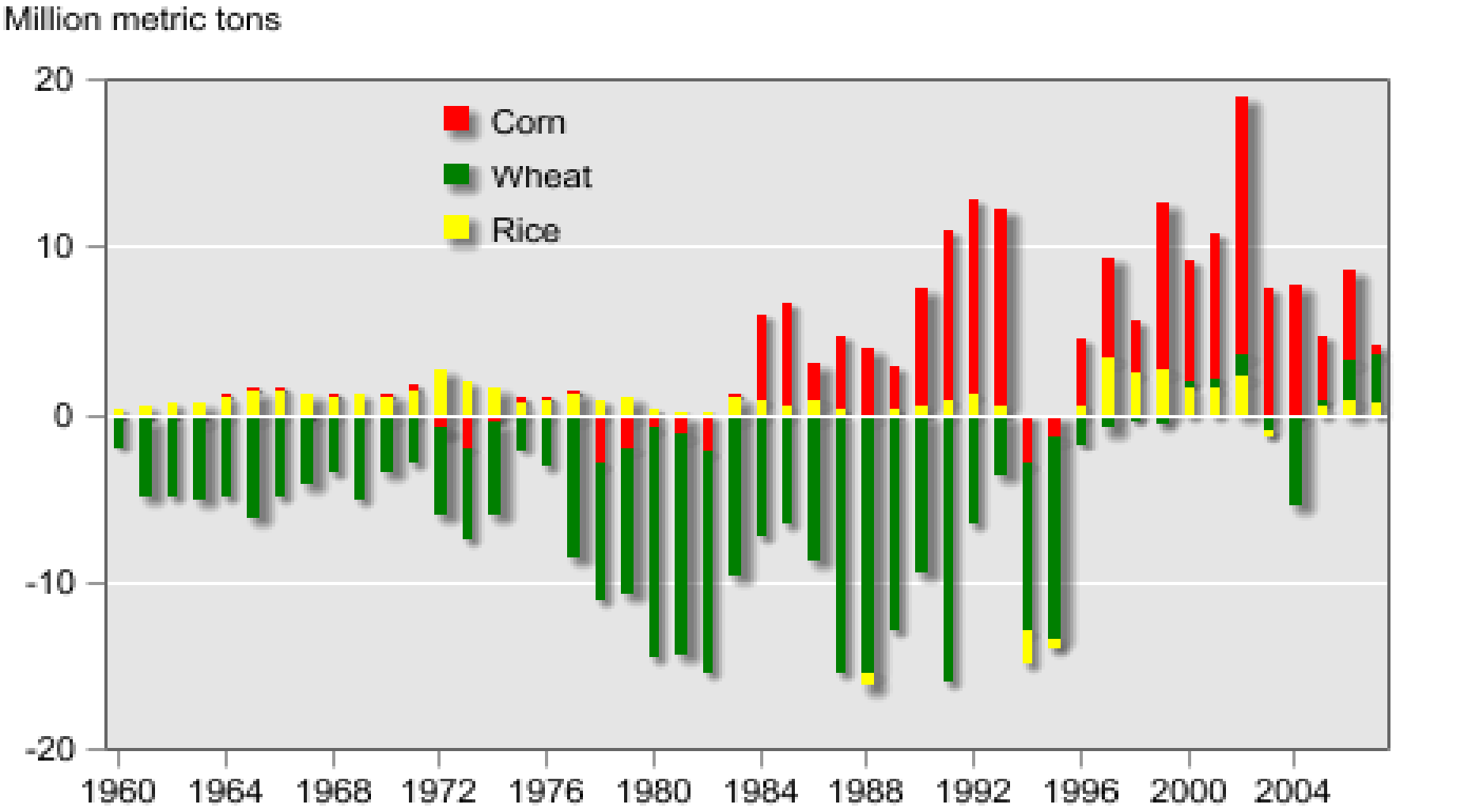
j1 cattle stocks in the year 2000 were 123 million according to revised 2008 China statistics from fred gale. the data not shown on this slide because too difficult to explain why there is such a huge decrease to 2007--even I do not fully understand. just restructuring i guess.
james, 2009/09/01

METABOLIZABLE ENERGY

- **MODELING RESULTS SINCE MY FIRST PROJECTIONS NEARLY 20 YEARS AGO HAVE CONSISTANTLY SHOWN THAT CHINA WILL HAVE AN EXCESS OF METABOLIZABLE ENERGY.**

- **THAT IS A REASON CHINA HAS BEEN A NET CORN AND RICE EXPORTER MOST YEARS, AND RECENTLY HAS SHIFTED FROM BEING A LARGE NET WHEAT IMPORTER TO A NET EXPORTER.**

China net trade of rice, wheat, and corn, 1961-2008



Note: net trade = exports - imports. Data are for market years.
Source: USDA, Economic Research Service using data from USDA, Foreign Agricultural Service, Production, Supply, and Distribution (PS&D) database.

ERS

SOURCES OF FEEDSTUFFS AVAILABILITIES

	NOW		2030
	METABOLIZABLE ENERGY		
PRINCIPAL CROP	45	↑	55
NONCONVENTIONAL	35	↓	26
BYPRODUCTS	9	→	10
GRASSLAND	11	↘	9
	CRUDE PROTEIN		
PRINCIPAL CROP	39	↗	42
NONCONVENTIONAL	27	↘	22
BYPRODUCTS	25	↗	28
GRASSLAND	9	↘	8

PROTEIN IS THE BIG PROBLEM

- MY MODELING RESULTS HAVE REVEALED CONTINUOUSLY GROWING PROTEIN DEFICITS, AND IMPORTS INCREASING AT A SIGNIFICANT RATE. CURRENT USDA PROJECTIONS ARE THE SAME.

- THE BIG QUESTION IS: HOW FAST IMPORTS CAN--AND WILL--GROW, REASONS FOR THEM, AND OPTIONS FOR CHANGING WHAT POTENTIALLY CAN BE A SERIOUS WORLDWIDE PROBLEM.

THE SITUATION

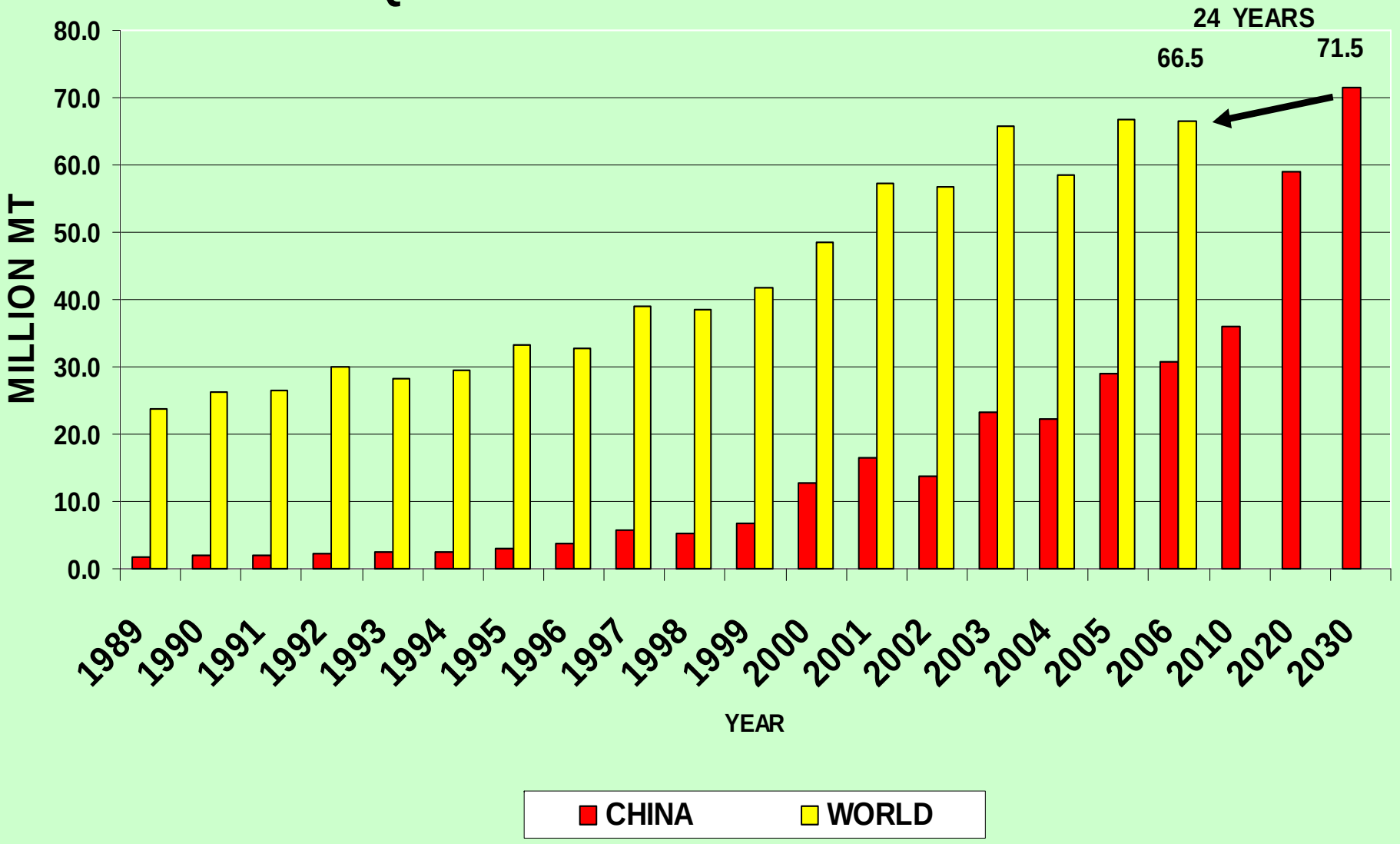
- ON THE NEGATIVE SIDE CHINA'S SOYBEAN IMPORTS ARE NOW NEARLY HALF OF ALL WORLD IMPORTS.

- ON THE POSITIVE SIDE SOYBEAN AND OTHER OILSEED YIELDS AS WELL AS OTHER MAJOR CROPS WILL GROW DRAMATICALLY DUE TO BIOTECHNOLOGY.

- CHINA IS A NET EXPORTER OF ENERGY FOCUSED CROPS SUCH AS CORN SO, LAND USE CAN SHIFT TO SOYBEANS AS APPROPRIATE VARIETIES ARE DEVELOPED

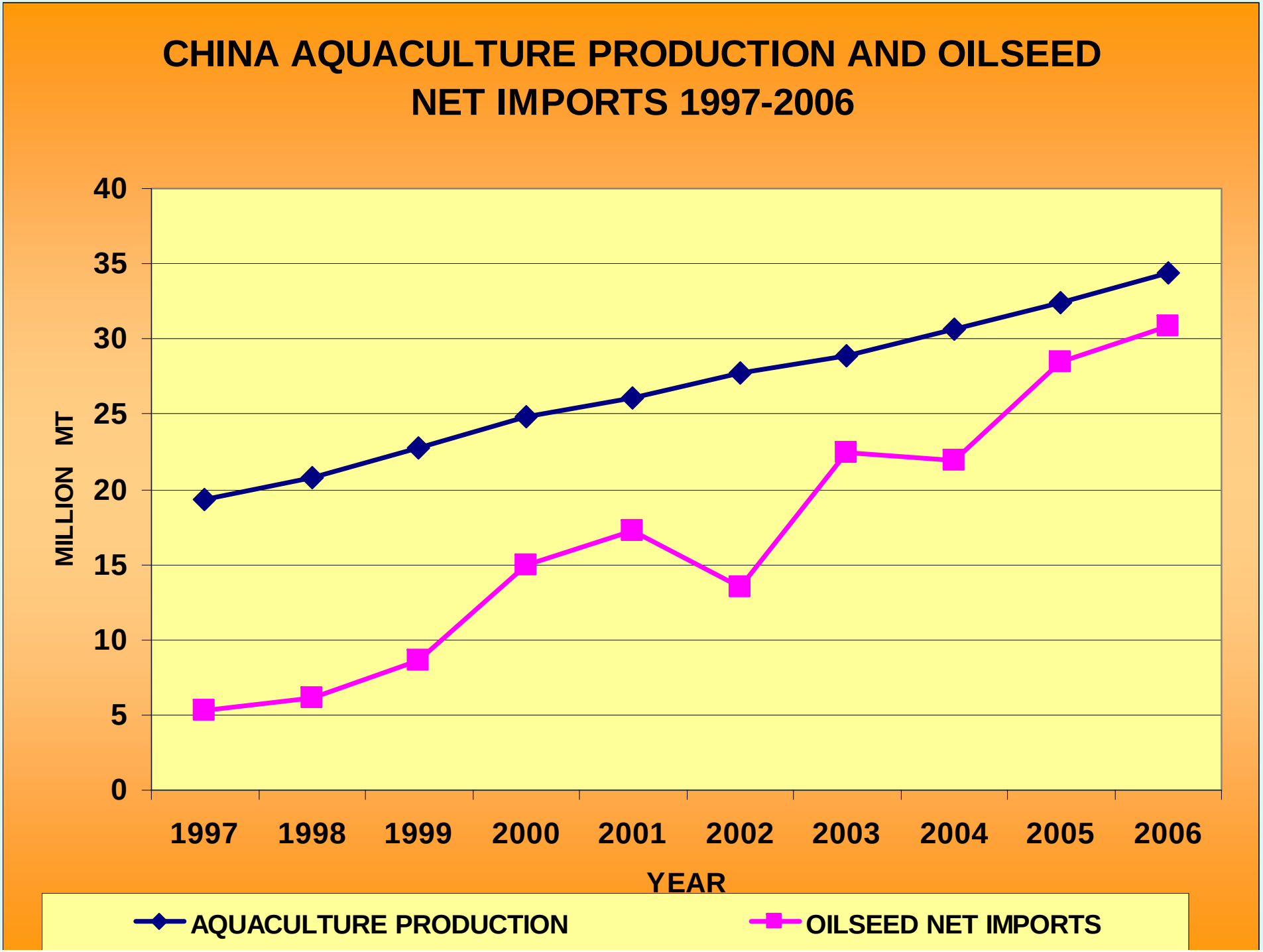
- THE USE OF NONCONVENTIONAL FEED RESOURCES SUCH AS CORN STOVER HAS HAD, AND CAN CONTINUE TO HAVE, A GREAT IMPACT ON BOTH ENERGY AND PROTEIN SUPPLIES

CHINA AND WORLD IMPORTS OF SOYBEANS 1989-2006, AND CHINA BASE PROJECTIONS OF SOYBEAN EQUIVALENT IMPORTS TO 2030



ONE OF THE MAJOR REASONS FOR CHINA'S RAPID INCREASE IN SOYBEAN IMPORTS IS ITS DRAMATIC GROWTH IN AQUACULTURE.
CHINA, ON A VALUE BASIS, ACCOUNTS FOR HALF OF WORLD OUTPUT

CHINA AQUACULTURE PRODUCTION AND OILSEED NET IMPORTS 1997-2006



SO, WHAT CAN BE DONE TO INCREASE PROTEIN?

- **ONE POSSIBILITY IS RESIDUES FROM OLD STOCK CORN AND WHEAT BEING MADE INTO BIO-ETHANOL. THAT IS BEING DONE, BUT THE TOTAL AMOUNT IS TRIVIAL.**

- **ANOTHER OPTION, AND ONE THAT CHINA HAS CAREFULLY RESEARCHED, IS PRODUCTION OF SWEET SORGHUM ON THE NATION'S EXTENSIVE MARGINAL (NON-ARABLE) LAND AS THE FEED STOCK FOR BIO-ETHANOL. THE RESIDUES CAN THEN BE USED FOR LIVESTOCK FEED.**

- **CHINA HAS COMMERCIAL SITES IN ALL CLIMATIC ZONES AND A PLAN TO INCREASE FROM 10,000 HA IN 2010, TO 1.62 MILLION HA IN 2030**

PRODUCTION OF SWEET SORGHUM IS 75-100 MT PER HA AND 2-3 CROPS ARE POSSIBLE IN WARM CLIMATES. THE GENOME IS MAPPED AND THE CROP GROWN WORLD-WIDE.

RESIDUE PRODUCTS FOR LIVESTOCK FEED INCLUDE DRIED DISTILLERS GRAINS SOLUABLES (DDGS) FROM THE GRAIN, AND CRUSHED STOVER (BAGASSE) FROM THE STALKS.

CHINA'S POTENTIAL BIO-ETHANOL ANIMAL FEEDSTUFFS RESULTS

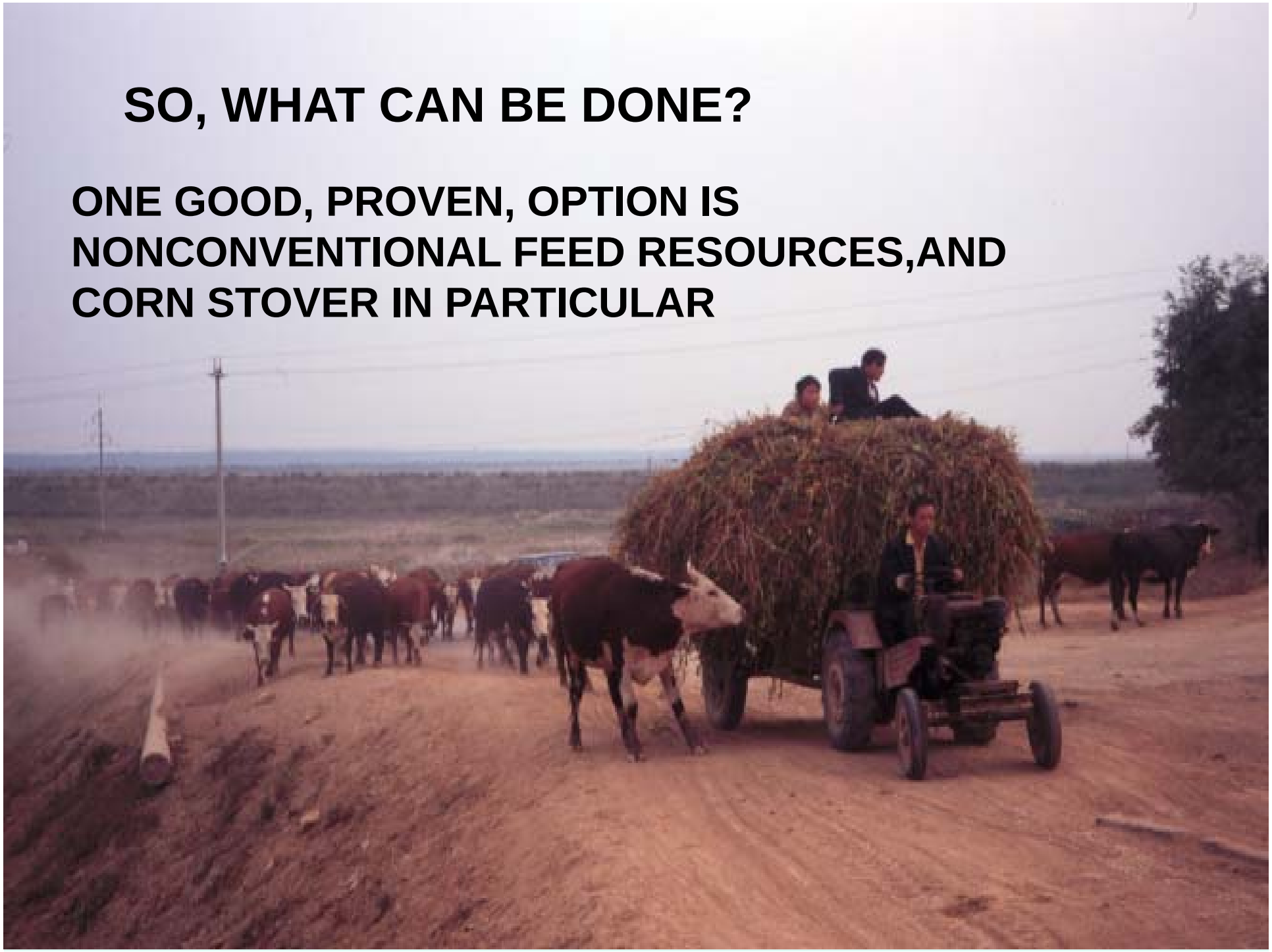
- IF 85 % OF STOVER RESIDUE WERE FED TO CATTLE, AND 10 PERCENT WAS TREATED TO IMPROVE QUALITY THEN--

- BY 2030 CRUDE PROTEIN AVAILABILITIES FOR LIVESTOCK WOULD INCREASE 1.2 %, BY 1.3 MILLION TONS

- THAT IS HELPFUL, BUT STILL IT ONLY AMOUNTS TO 3.8 MILLION MT OF SOYBEAN EQUIVALENTS OUT OF A DEFICIT OF 71.5 MILLION MT UNDER THE PROJECTIONS.

SO, WHAT CAN BE DONE?

ONE GOOD, PROVEN, OPTION IS NONCONVENTIONAL FEED RESOURCES,AND CORN STOVER IN PARTICULAR



FEEDING VALUES

RICE STRAW, WHILE USED EXTENSIVELY IN JAPAN, HAS LOW FEEDING VALUES

	CORN GRAIN	CORN STOVER	RICE STRAW
METABOLIZABLE ENERGY (Mcal			
UNTREATED PER KG)	3.4	1.9	1.4
TREATED	--	2.5	1.7
PERCENT GREATER	--	32	21
CRUDE PROTEIN (%)			
UNTREATED	8.6	5.4	2.9
TREATED	--	8.0	4.3
PERCENT GREATER	--	48	48

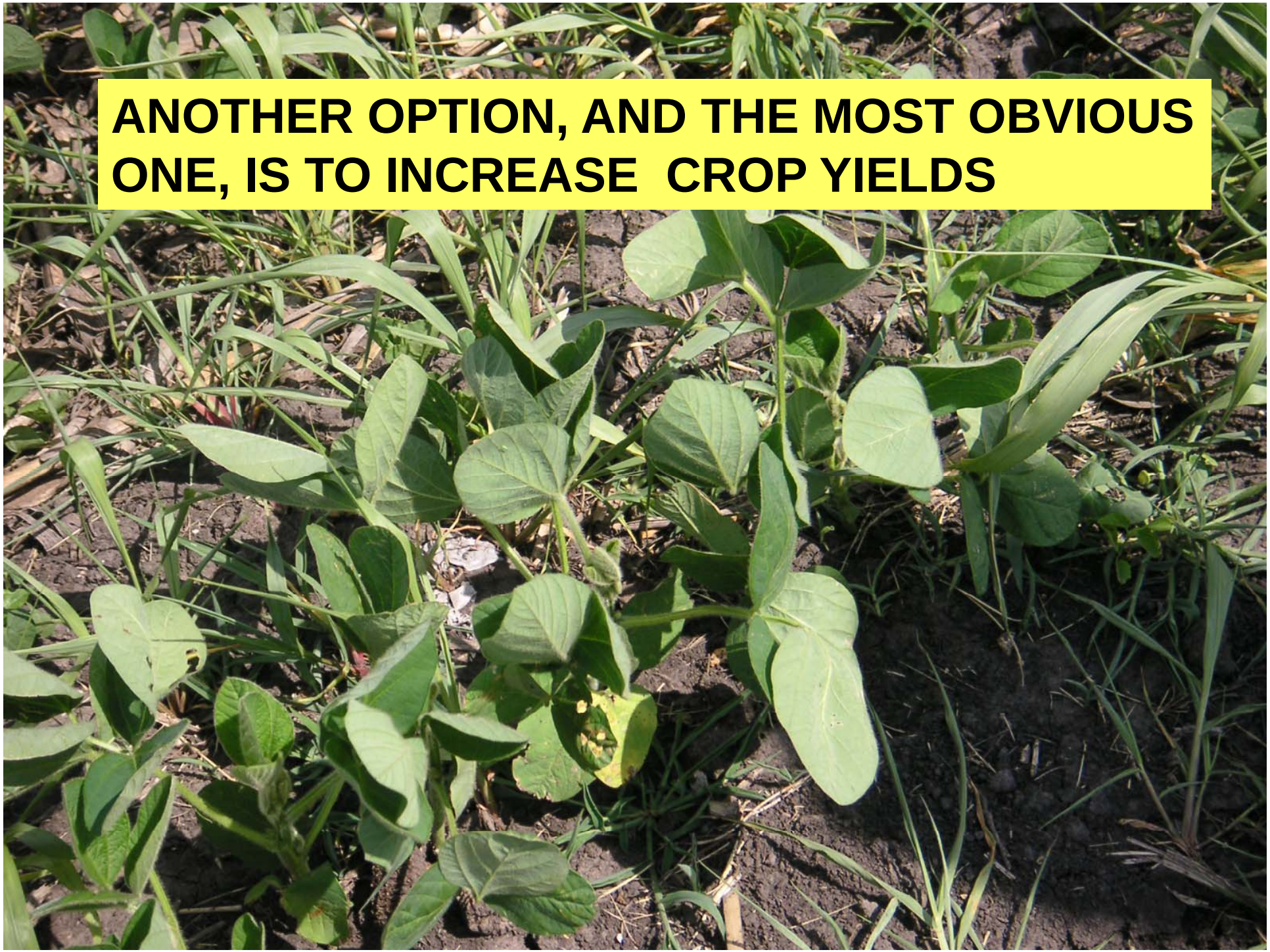
GREATER TREATMENT OF CORN FODDER HAS A LARGE IMPACT ON SOYBEAN EQUIVALENT (SBE) IMPORTS

- **FOR EXAMPLE, IN MY CONSERVATIVE 2030 PROJECTIONS 35 PERCENT OF ALL CORN FODDER IS TREATED AND FED TO RUMINANTS (AN ADDITIONAL 5 PERCENT IS NOT TREATED MAKING 40 PERCENT FED, LESS THAN THE CURRENT 45%)**

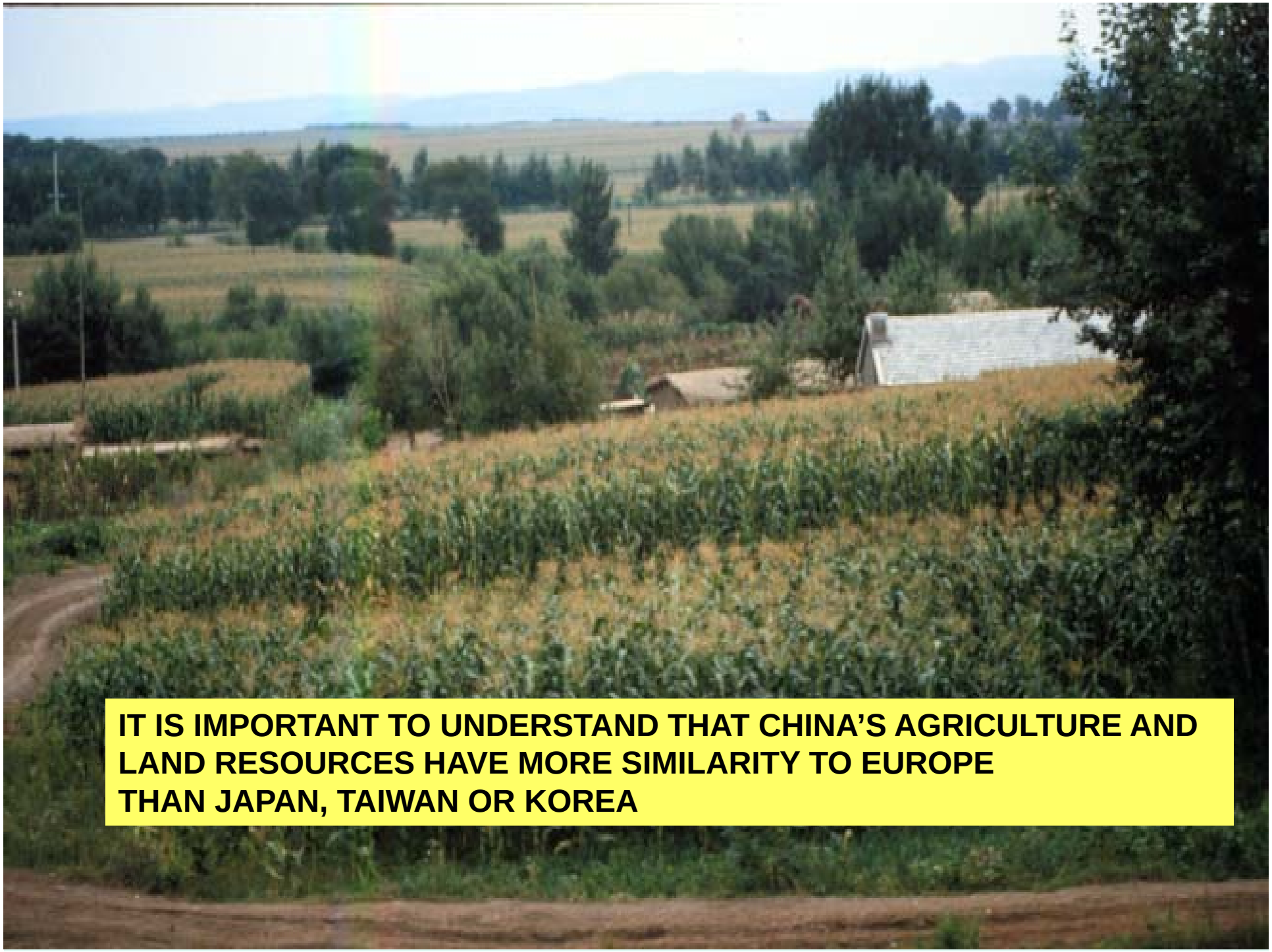
- **IF THE TREATED AND FED INCREASED TO 60 % — PROBABLY UNREALISTIC, BUT USED TO MAKE A POINT—THEN**

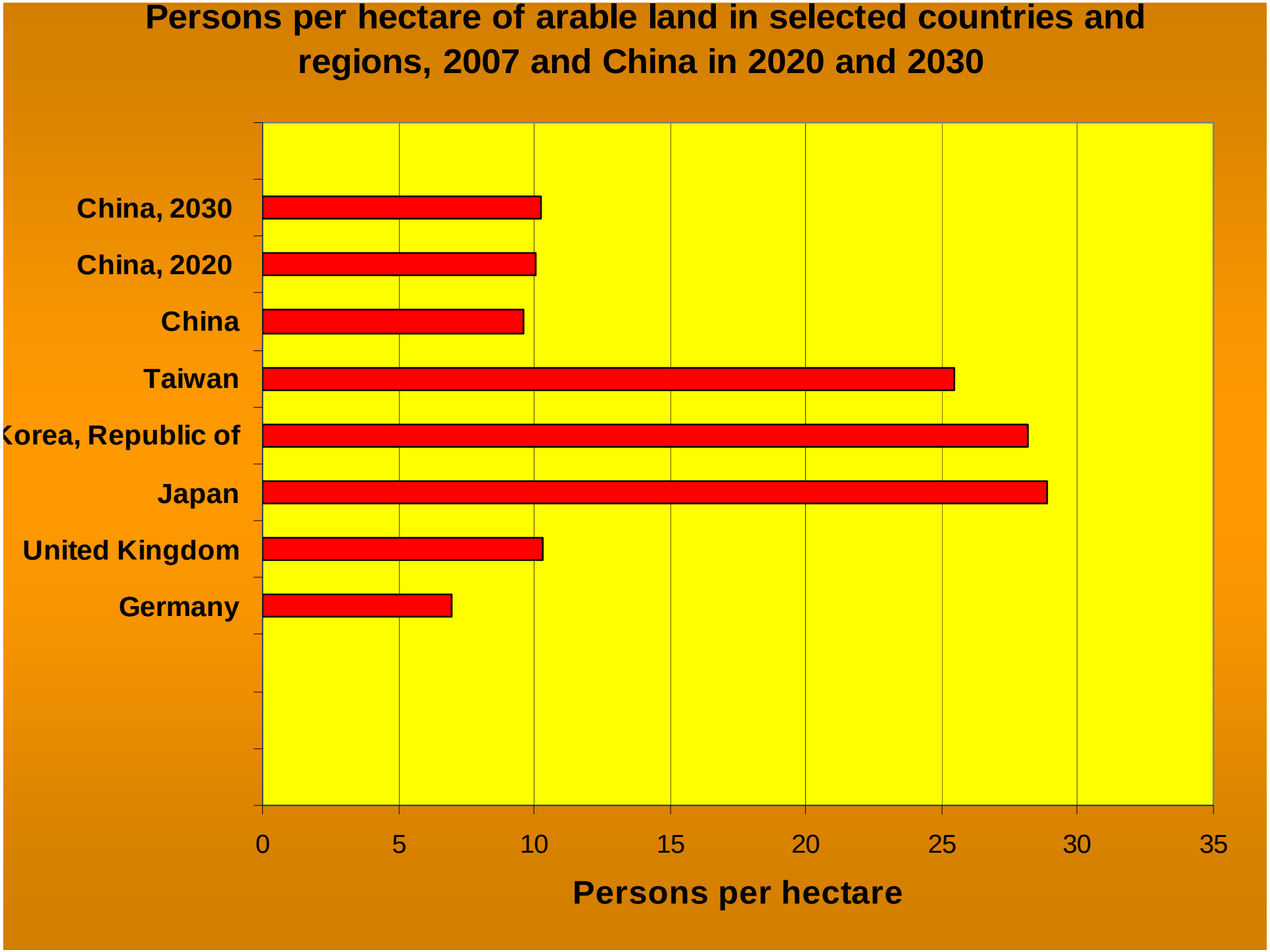
- **THE SBE SHORTFALL WOULD DROP 16 PERCENT, FROM 71.5 MILLION MT TO 60.4 MILLION MT.**
  IN VALUE TERMS THAT IS $3.3 BILLION (¥33 億).

- **THAT'S VERY IMPRESSIVE AND SHOWS THE VALUE OF TREATING—ANY OTHER OPTIONS?**

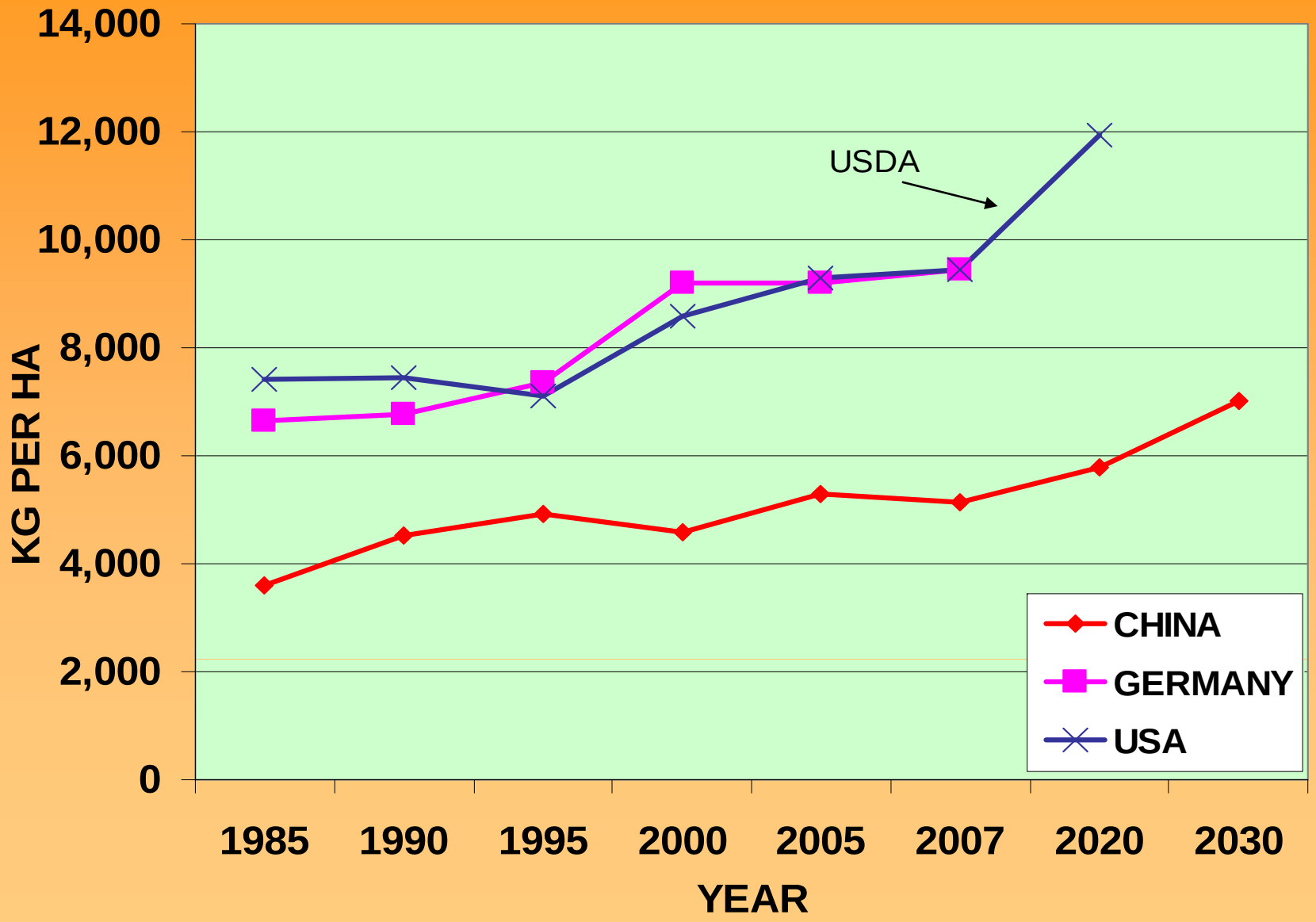

ANOTHER OPTION, AND THE MOST OBVIOUS ONE, IS TO INCREASE CROP YIELDS

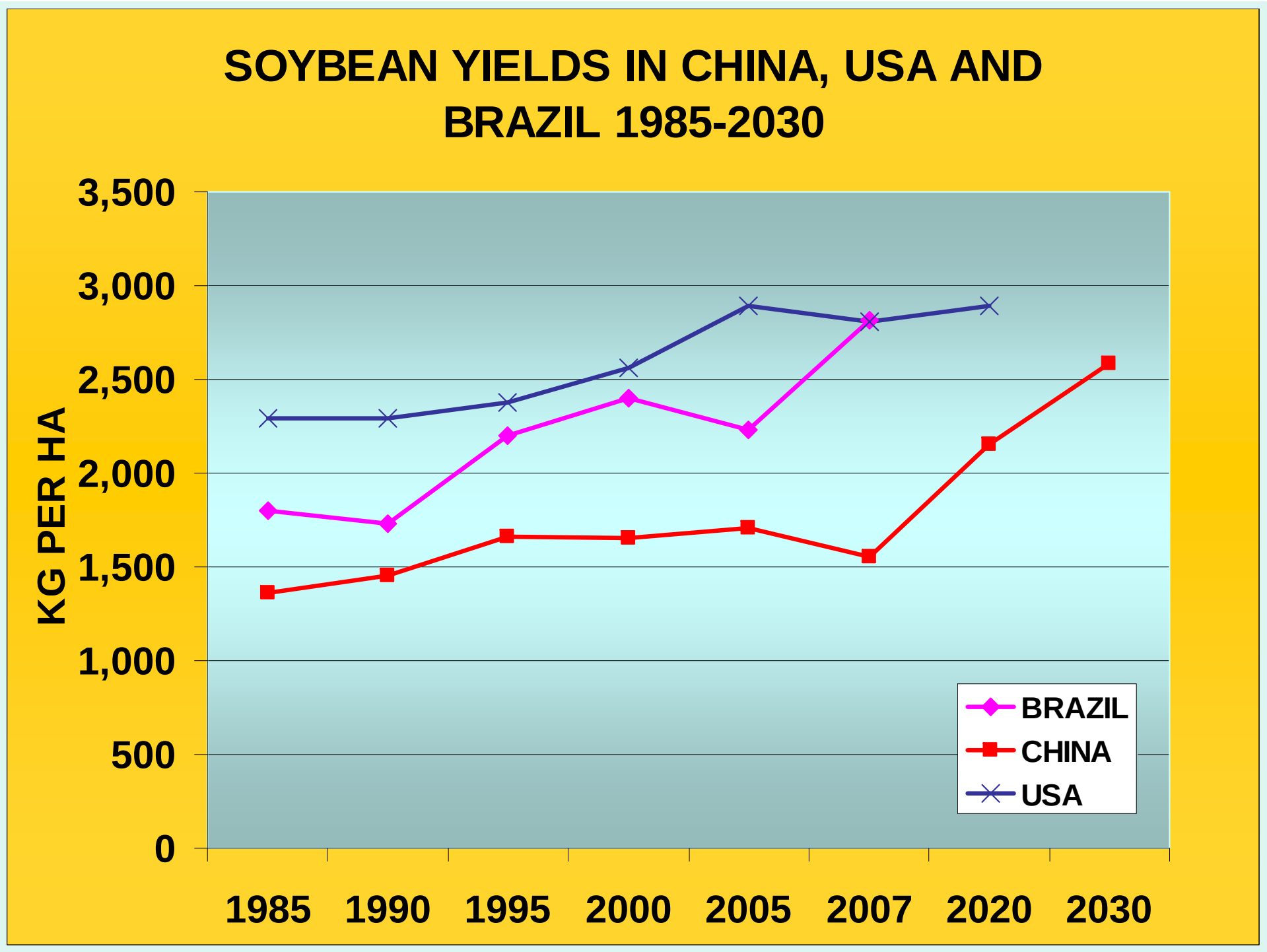

STATISTICALLY, CHINA'S FARM SIZE IS VERY SMALL.
BUT, MOST CROPS ARE ON QUITE LARGE FIELDS
WITHOUT DISCERNABLE BOUNDRIES
AND WORKED COMMUNALLY
ALSO, CHINA HAS A LARGE PART-TIME FARMER SYSTEM LIKE JAPAN.
THE ECONOMIES OF SCALE FROM LARGE FIELDS ARE LEADING TO AN INCREASING AMOUNT OF CONTRACTING FOR MAJOR TASKS.
AS RESTRUCTURING TAKES PLACE, TECHNOLOGY ADOPTION TO ENHANCE YIELDS AND CONSERVE RESOURCES LIKE WATER WILL INCREASINGLY BE EASIER


IT IS IMPORTANT TO UNDERSTAND THAT CHINA'S AGRICULTURE AND
LAND RESOURCES HAVE MORE SIMILARITY TO EUROPE
THAN JAPAN, TAIWAN OR KOREA


Persons per hectare of arable land in selected countries and regions, 2007 and China in 2020 and 2030
China, 2030
China, 2020
China
Taiwan
Korea, Republic of
Japan
United Kingdom
Germany
0
5
10
15
20
25
30
35
Persons per hectare

CORN YIELDS IN CHINA, GERMANY AND THE USA 1985-2030




SOYBEAN YIELDS IN CHINA, USA AND BRAZIL 1985-2030
KG PER HA
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1985
1990
1995
2000
2005
2007
2020
2030
BRAZIL
CHINA
USA

IMPROVEMENTS FROM THE BASE VERY CONSERVATIVE PROJECTIONS

- **IF, FOR EXAMPLE, CHINA'S SOYBEAN YIELDS INCREASED 40 PERCENT FROM CURRENT LEVELS OF ABOUT 1,600 KG TO 2,200 KG (STILL LESS THAN CURRENT BRAZIL AND USA YIELDS OF ABOUT 2,600 KG) AND**

- **LAND SOWN TO SOYBEANS INCREASED 20 PERCENT WHILE LAND AREA OF ENERGY SURPLUS CROPS (LIKE CORN) DECREASED AN EQUIVALENT AMOUNT, THEN**

- **CHINA'S SOYBEAN EQUIVALENT IMPORTS WOULD THEN BE ABOUT THE SAME AS CURRENT SOYBEAN IMPORT LEVELS**

RECENT NEWS RELEASES ON BIOTECHNOLOGY ADVANCES SHOW GREAT PROMISE TO DRAMATICALLY INCREASE SOYBEAN YIELDS

- **PIONEER HI-BRED EXPECTS TO DOUBLE THE RATE OF GENETIC GAIN—TARGETING A 40 PERCENT YIELD INCREASE IN CORN AND SOYBEANS OVER THE NEXT 10 YEARS.**

- **MONSANTO PROJECTS DOUBLING OF YIELDS (FROM 2000 BASE) OF CORN, SOYBEANS AND COTTON BY 2030.**

- **MONSANTO IS TAKING STEPS TO LAUNCH THE WORLD'S FIRST DROUGHT-RESISTANT CORN—AND INCREASE YIELDS OF IT.**

- **AND MONSANTO IS WORKING ON DROUGHT-RESISTANT AND YIELD ENHANCING WHEAT**

THE BIG FOUR MESSAGES

- **TECHNICALLY (MEANING NOT TAKING ECONOMICS INTO ACCOUNT), CHINA CAN CONTINUE TO ESSENTIALLY MAINTAIN A NET FOOD SELF-SUFICIENCY RATE UNTIL AT LEAST 2030**

- **LITTLE OR NO ADDITIONAL ENERGY BASED FEEDSTUFFS WILL BE REQUIRED, BUT….**

- **UNDER MY BASIC VERY CONSRVATIVE PROJECTIONS SUBSTANTIAL ADDITIONAL PROTEIN BASED FEEDSTUFFS IMPORTS WILL BE REQUIRED TO MEET SHORTFALLS**

- **HOWEVER, AS SHOWN, THERE ARE AFFORDABLE, PRACTICAL, MEANS BY WHICH PROTEIN IMPORTS NEED NOT EXCEED CURRRENT LEVELS BY 2030 ---IF GOVERNMENT DECIDES TO ADOPT THE NECESSARY POLICIES**

SOME IMPLICATIONS FOR JAPAN

- **THE PROJECTIONS HAVE CONSIDERABLE SIGNIFICANCE FOR THE PRIVATE SECTOR, ESPECIALLY THOSE INVOLVED IN TRADE.**

- **THE IMMENSE SIZE OF AGRICULTURAL RESEARCH BEING CARRIED OUT IN CHINA BOTH BY NATIONAL INSTITUTIONS, AND BY NATIONAL AND INTERNATIONAL COMPANIES, BEHOVES JAPAN TO BE INVOLVED IN PROJECTS WITH CHINA.**

- **MOST OF YOU CAN THINK OF IMPLICATIONS RELATED TO YOUR PROFESSIONAL AREA OF EXPERTIESE, AND TIME IS SHORT, SO I WILL FOCUS ON TWO ITEMS OF NATIONAL IMPORTANCE. WE CAN COVER OTHERS DURING THE DISCUSSION PERIOD.**

A VERY SIGNIFICANT IMPLICATION FOR JAPAN STEMS FROM CHINA BEING--AND GROWING-- AS A WORLD'S AGRICULTURAL POWERHOUSE

- THIS IS BECAUSE CHINA WILL INCREASINGLY HAVE THE ABILITY TO ADJUST ITS PRODUCTION TO MEET EXPORT OPPORTUNITIES FOR COMMODITIES SUCH AS RICE AND SPECIALIZED CROPS THROUGH THE ADVENT OF BIOTECHNOLOGY AND RURAL RESTRUCTURING.

- CHINA'S GIGANTIC PROCESSED FOOD SECTOR WILL ADOPT COST REDUCING MECHANISMS—AND WILL BOLDLY BE SEEKING FOREIGN MARKETS, ESPECIALLY NEARBY ONES….

A LIKELY SCENARIO IS THAT--

- **IF JAPAN IS FORCED TO REDUCE ITS IMPORT TARIFFS TO ANY SIGNIFICANT DEGREE IN THE CURRENT DOHA ROUND OF WTO TRADE NEGOTIATIONS, OR IN FUTURE ROUNDS, OR IN BILATERAL TREATIES, THEN….**

- **CHINA WILL LIKELY EXPAND ITS SHARE OF JAPAN'S—INEVITABLE—EXPANDED FOOD IMPORTS**

- **THAT WOULD CAUSE CONSIDERABLE CONSTERNATION CONSIDERING THAT JAPAN'S FOOD SELF-SUFFICIENCY RATE IS JUST 40 PERCENT….**

ON A MORE POSITIVE NOTE

- **LET'S CONSIDER SOMETHING THAT MIGHT BE LEARNED FROM CHINA'S AGRICULTURAL EXPERIENCE.**

- **FOR EXAMPLE, THEIR SWEET SORGHUM PROGRAM IS PARTICULARLY IMPRESSIVE,**

  ESPECIALLY CONSIDERING THE 2006 CHINESE GOVERNMENT MANDATE THAT NO ARABLE LAND BE USED TO PRODUCE SWEET SORGHUM FOR BIO-ETHANOL

  AND THAT ONLY NON-GRAIN RAW MATERIAL (APART FROM OLD STOCKS) BE USED

AND LETS TRY “THINKING OUTSIDE THE BOX” BY CONSIDERING HOW IT MIGHT BE USED IN JAPAN

WHERE 10 % OF ALL ARABLE LAND IS ABANDONED. HOW ABOUT ON JUST PART OF IT?

IT COULD, OF
OF COURSE,
BE USED TO
PRODUCE ETHANOL,
WITH BY-PRODUCTS
FOR LIVESTOCK

BETTER PERHAPS, HOW ABOUT JUST AS AN ANIMAL ROUGHAGE FEEDSTUFF? IT IS GROWN ALL OVER THE WORLD

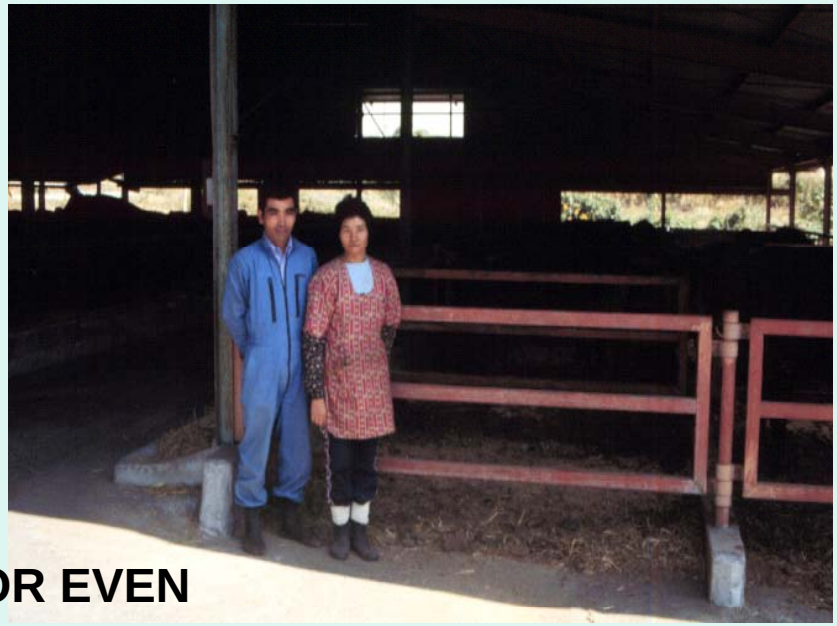
AND TEST PLOTS HAVE BEEN CARRIED OUT IN JAPAN

PRELIMINARY ANALYSIS INDICATES IT IS A PRACTICAL AND POTENTIALLY FEASIBLE CROP FOR JAPAN. WHAT IS NEEDED IS AN ON-FARM RESEARCH/EXTENSION PROJECT TO DETERMINE IF FARMERS WOULD ACCEPT IT.

SWEET SORGHUM IS WIDELY RESEARCHED IN MANY COUNTRIES SUCH AS INDIA.
IN THE UNITED STATES EXPERIENCES FROM ON-FARM TRIALS ON SMALL, MEDIUM AND LARGE PLOTS ARE POSITIVE. AND MECHANICAL HARVESTING AND PROCESSING MACHINERY IS AVAILABLE.

FEEDSTUFFS IMPORTS COULD BE REDUCED

SIGNIFICANT INCREASED INCOME FOR CROP AND LIVESTOCK PRODUCERS COULD BE OBTAINED



IS SOME KIND OF SWEET SORGHUM PROGRAM OF SOME SIZE FEASIBLE OR EVEN DESIREABLE?

THIS CONFERENCE IS ABOUT FOOD SECURITY, HUMAN RESOURCE AND ECONOMICALLY SUSTAINABLE DEVELOPMENT, INTEGRATED SYSTEMS, MULTI-FUNCTIONALITY, VALUE ADDITION, AND SO FORTH.

IT SHOULD NOT BE TOO DIFFICULT TO COME UP WITH SOME BROAD ESTIMATES OF BENEFITS AND CONSTRAINTS.

THANK'S

- **FOR THE OPPORTUNITY TO SHARE WITH YOU THE INFORMATION ON CHINA'S ABILITY TO FEED ITSELF AND A FEW IMPLICATIONS FOR JAPAN**

FOR MORE INFORMATION SEE: JAMESRSIMPSON.COM