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World Trend and Evolution of the Agricultural Machinery Manufacturing Sector

Stefan Böttinger, Reiner Doluschitz, Richard Volz,
University of Hohenheim, Stuttgart, Germany

&

Chakib Jenane, Sean Paterson
United Nations Industrial Development Organization, Vienna, Austria

Agrievolution
2010
Second World Summit
on Agricultural
Machinery

Presentation Outline

1. Major Challenges for Agriculture

2. Analytical Framework
   2.1 Main Geographical Regions
   2.2 Data Sources and their Limitations

3. General Overview of Agricultural Mechanization in Different Regions of the World

4. Future Trends and Evolution of Agricultural Mechanization
   4.1 Impact Factors
   4.2 Cross Regional Predictions
   4.3 Summary of Trends and Predictions

5. Conclusions

1. Major Challenges for Agriculture

Climate Change
- temperature increase
- rainfall changes
- weather uncertainties

Demographic Factors
- growing world population
- urbanization and industrialization
- changing diets

Political / Economical Conditions
- economic farm sizes
- subsidies and support policy
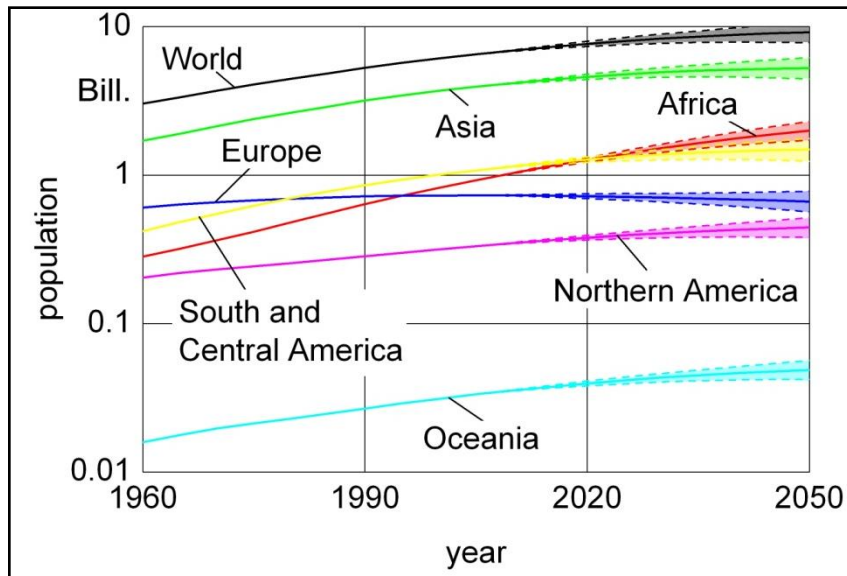- infrastructure and education

Bio-based Products and Bio-energy
- alternative sources for commodities
- competition food, feed, fibre and fuel
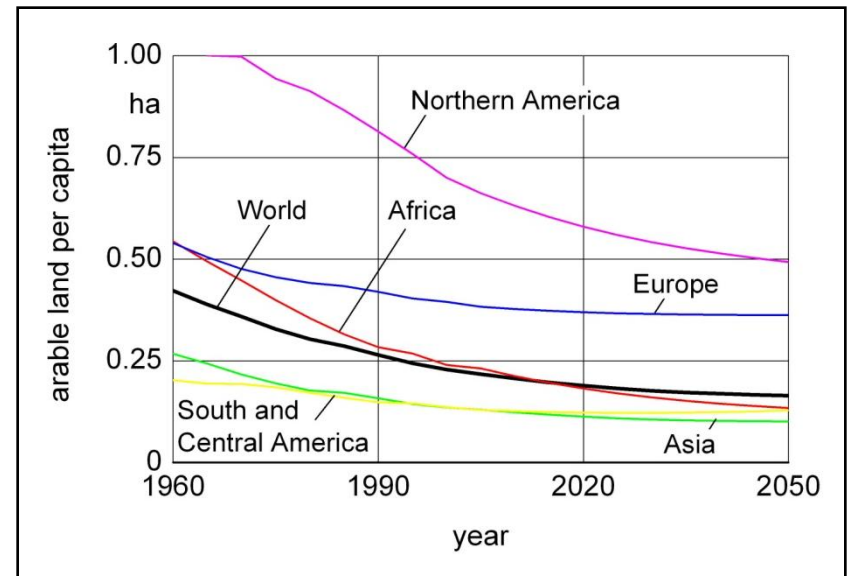- finite nature of crude oil and natural gas

Agriculture

1. Major Challenges for Agriculture

From 1960 to 2005 the world population has increased by almost **260 %**
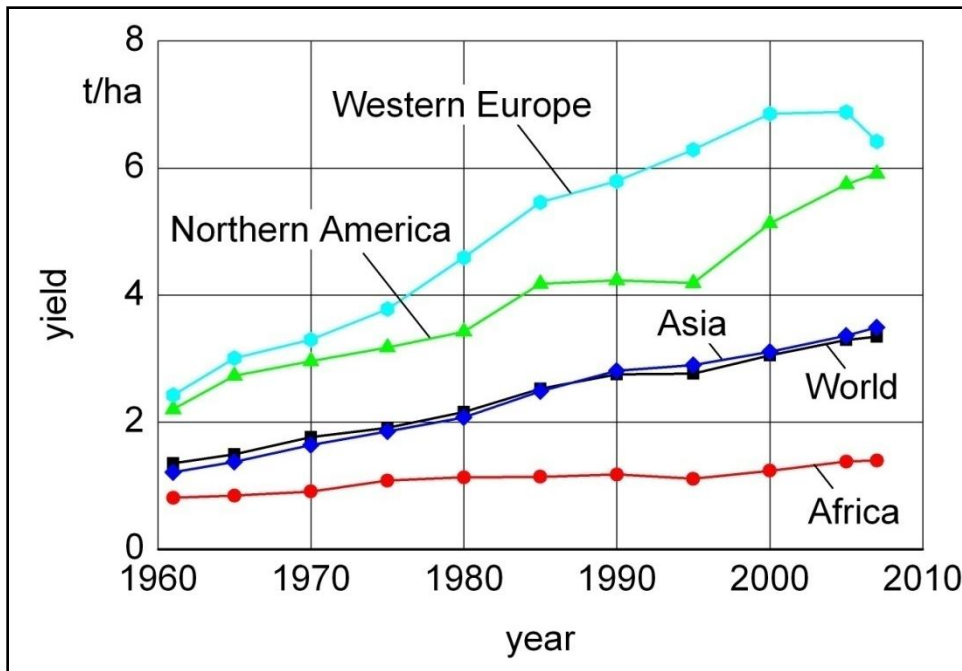

World population development (FAO)

From 1950 to 2005 the land per capita has decreased approximately by **50 %**

Development of the arable land per capita for different regions of the world (FAO)

1. Major Challenges for Agriculture

...but yields per ha have adapted over time to meet the challenge

Cereal yield development in different regions of the world (FAO).

• On specialized farms the labour productivity can reach nearly 1 000 t of cereals per worker

• In comparison, agriculture without motorization and without chemical application, the productivity is more than 500 times lower

Different Agro-climatical and Technological Levels

Yields of Main Crops

figures of 2007, FAO
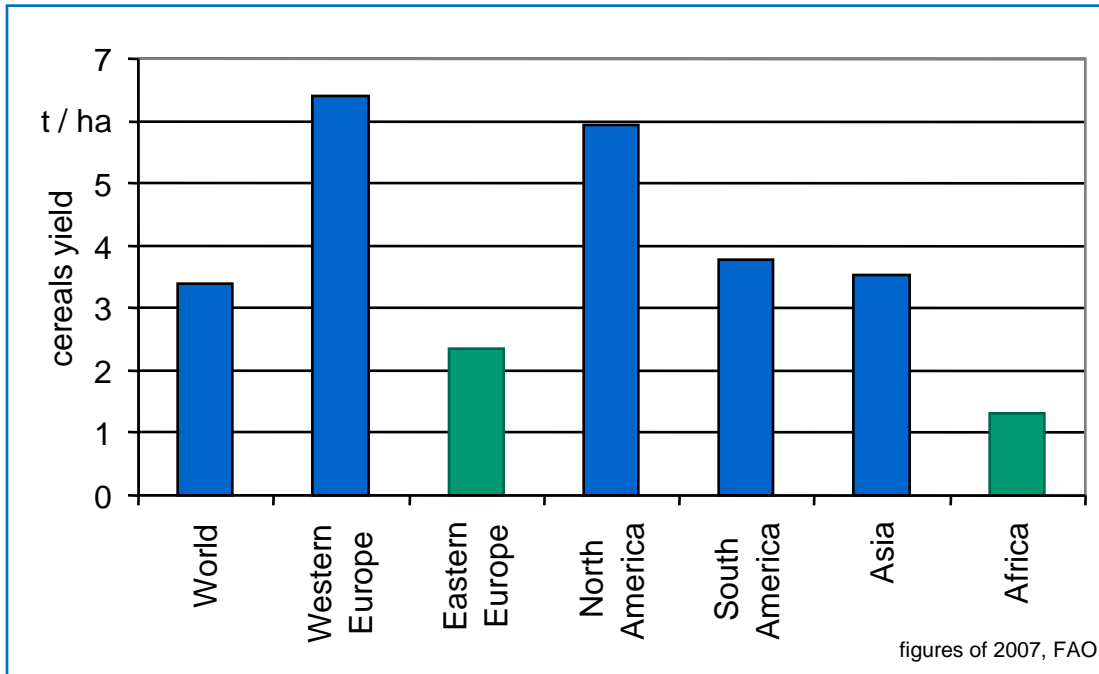
- Cereal yields are reflecting, beside agro-climatical conditions, also the overall development of the farming systems: Mechanization and other farm inputs.

- Every region has its own specific potential.

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2.1 Main Geographical Regions

Political Map of the World, September 2008

Map source: University of Texas Libraries   http://lib.utexas.edu/maps/world_maps/txu-oclc-264266980-world_pol_2008-2.jpg

2.2 Data Sources and their Limitations

(1) Literature review and statistical data:

➤ Predominantly UN data (FAO and UNIDO) and manufacturer
association sources

(2) Questionnaire survey:

➤ Sample of agricultural machinery manufacturer associations worldwide

Questionnaire sought feedback on the following seven (7) issues:

1. Impact Factors
2. Mechanization Levels
3. Cropping Systems,
4. Future Annual Growth Estimates
5. Selected Agricultural Related Issues
6. Machinery Technologies and Trends,
7. Additional Comments

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Overview : Current Status of Mechanization

- **Europe/EU**
  - High numbers of machines per ha reflect over mechanization and great variety of farm structures
  - Tendency to fewer and higher powered machines
  - Strong industry with high rate of export
  - Industry data: 28 billion € production value; 135.000 employees

- **USA**
  - Completely mechanized farms
  - Trend towards larger, higher horsepower equipment
  - Further technical progress tends towards automation
  - Industry data: $32 billion in revenue; 250.000 employees (AEM, 2008)

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Overview : Current Status of Mechanization

- ## Russia
  - Since 1990 decreasing number of machines/tractors
  - Insufficient compensation of aging machines/tractors
  - Production capacity of local industry not renewed – limited investments
  - Additional taxes for imported machines
  - Industry data: $2.23 billion and 100.000 employees (SoyuzAgromach, 2008)

- ## India
  - Agriculture contributes 25 % to the GDP and more than one third of the population gains income from agriculture
  - Small scale farm operations (~ 1.5 ha) are predominant
  - Rapid increase in numbers of machines and of mechanization custom-hire services
  - Fast growing tractors production: from 2002/03 to 2007/08 the production capacity doubled to reach 364.205 units

Overview : Current Status of Mechanization

- **Latin America/Brazil**
  - The numbers of tractors per 1,000 ha are fairly constant over the last three decades and range at about 14 in 2003

  - A significant trend towards tractors of larger scale

  - Developing machinery manufacturing sector, mainly by international companies: sales turnover in 2007 = 3.0 billion US and nearly 41.000 employee (AMIMAQ)

  - The production of bio-ethanol from sugarcane plays a very important role in Brazil which in turn may be a driver for accelerating demand for agricultural machinery

- **Japan**
  - The agricultural sector has been diminishing in recent decades (agricultural land, the number of farm operations and population working in agriculture)

  - However, the sector is highly mechanized with about 461 tractors and 237 harvesters per 1,000 ha.

  - Mostly small, sophisticated and specialized machines.

  - Further technical progress tends towards more automation

  - Strong industry with export to whole Asia and other regions of the world

Overview : Current Status of Mechanization

- **Sub-Saharan Africa**
  - Land productivity is the lowest in the world. Average grain and maize yields range at about 1 ton/ha.
  - 80% of agricultural area cultivated with only human power
  - 5% of agricultural area with tractor - Average number of tractors per 1000 ha is 1,3
  - 70% of tractors in South Africa and Nigeria
  - On large farms in the southern regions machines from Europe, North and South America
  - Increasing imports from India and China

- **North Africa / Middle East**
  - The levels of mechanization are significantly higher than SSA. The average number of tractors per 1000 ha is 11. Large disparities can be observed in the region, for example:
    - in Morocco the number of tractors per 1.000 ha averages about 6 and the number of harvesters 0.5
    - in Egypt the data observed are on average 30.70 tractors and 0.79 harvesters per 1000 ha.

Presentation Outline

4.1 Impact Factors

Impact factors/ Drivers on the demand of agricultural mechanization *

Natural Conditions	Low (+/-)
Rainfall/ Precipitation	Low (+/-)
Temperature	Low (+/-)
Climate change	Low (+/-)

Economic Conditions	Strong (+/-)
Technical progress	Strong (+)
Economic growth	Strong (+)
Oil price	Strong (+/-)
Economic crisis	Strong (-)
Energy supply	Med. (+/-)

Political Conditions	Medium (+)
Food safety goals	Low (+)
Education and training of farm operators	Low (+)
Research	Low (+)
Subsidies	Med. (-)
Farm structure development	Med. (+)
Biofuel production	Med. (+)

Demographic Conditions	Med. (+/-)
Population growth	Low (+)
Excess of age in rural areas	Med. (-)
Change in diets	Med. (+)
Urbanization	Med. (+/-)

* Values for all 8 surveyed countries (Maj.)

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4.1 Impact Factors: Economic Conditions

Parameter Based Assessment:

Economic conditions	ITY	GER	NEL	FIN	RUS	IND	BRA	USA	Maj.
Technical progress	+4	+4	+3	+2	+1	+2	-	-	strong +
Economic growth	+2	+2	+4	+1	+3	+4	+3	-	strong +
Oil price	-3	+3	-3	+2/-2	+4	-4	-3	-4	strong +/-
Economic crisis	-4	-3	-4	-2	-1	-3	-3	-4	strong -
Energy supply	-3	+3	+3/-3	+3/-3	-2	-3	+2	-2	med. +/-

(0) no impact
(4) strong impact
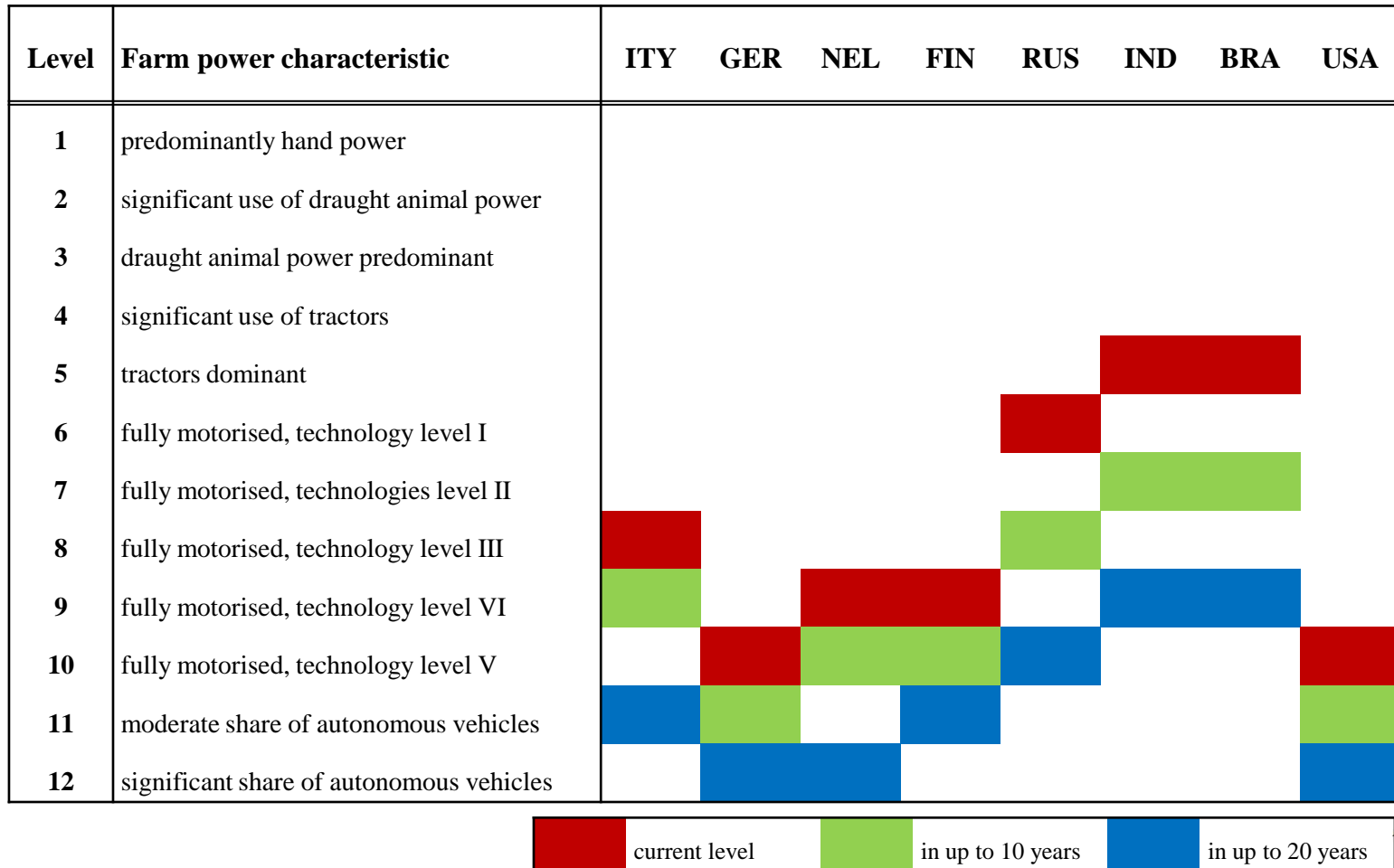
(-) negative
(+) positive
(+/-) both

4.2 Cross Regional Predictions

Levels of mechanization: current and future trends

Level	Farm power characteristic	ITY	GER	NEL	FIN	RUS	IND	BRA	USA
1	predominantly hand power								
2	significant use of draught animal power								
3	draught animal power predominant								
4	significant use of tractors							red	
5	tractors dominant					red	red	red	
6	fully motorised, technology level I					red			
7	fully motorised, technologies level II						green	green	
8	fully motorised, technology level III	red				green			
9	fully motorised, technology level VI	green		red	red		blue	blue	blue
10	fully motorised, technology level V		red	green	green	blue			red
11	moderate share of autonomous vehicles	blue	green		blue				green
12	significant share of autonomous vehicles		blue	blue					blue

Legend: **current level** (red) — **in up to 10 years** (green) — **in up to 20 years** (blue)

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4.3 Cross Regional Predictions

Predicted annual growth rates of import, export and domestic demand

Annual growth rate in % 10 year prediction	Imports							Exports							Domestic demand						
	ITY	GER	NEL	FIN	RUS	BRA	USA	ITY	GER	NEL	FIN	RUS	BRA	USA	ITY	GER	NEL	FIN	RUS	BRA	USA
small size tractors (up to 40 hp)	0	5	5	-	15	-	5	10	-	-	-	…	5	0	5	5	5	-	>17,5	10	0
medium size tractors (up to 100 hp)	5	-5	0	-5	>17,5	-	5	10	-5	-	-5	…	5	0	5	0	0	-5	>17,5	5	0
big size tractors (over 100 hp)	0	0	10	0	>17,5	-	0	10	5	-	0	…	5	5	5	5	10	0	>17,5	0	5
spare parts for tractors	-	0	5	-10	15	-	0	10	5	5	5	…	10	5	10	5	5	-5	>17,5	10	5
self propelled combines	0	5	0	-5	>17,5	-	0	5	5	-	5	…	-	5	5	-5	0	-5	>17,5	5	5
forage harvesters	0	5	0	0	10	-	0	-	5	-	-	…	5	>17,5	0	0	0	5	>17,5	5	5
reapers	-	-	-	-	-	-	0	0	-	-	-	…	-	5	-	-	-	-	-	-	5
threshers	-	-	-	-	-	-	0	0	-	-	-	…	-	5	-	-	-	-	-	-	5
irrigation systems	0	5	5	-5	5	-	0	5	0	0	-	…	5	10	5	5	5	-5	15	10	5
diesel engines	5	5	-	-5	5	-	0	5	0	0	10	…	-	5	5	5	0	-5	10	5	5
power tillers	0	-5	0	-	15	-	0	0	5	10	-	…	5	>17,5	0	-5	0	-	>17,5	0	5
food processing technique	-	0	5	0	15	-	0	-	0	5	0	…	-	5	-	0	0	0	…	15	5
spare parts in general	0	5	5	0	5	-	0	10	5	0	5	…	10	5	5	5	0	0	…	10	5
hand implements	0	-	-	-	-	-	0	5	-	-	-	…	-	0	5	-	-	-	-	5	0
draught animal implements	-	-	-	-	-	-	-	-	-	-	-	…	-	-	-	-	-	-	-	-5	-

Other: non tillage equipment: 10   10

(5) predicted annual growth rate in % with a range of +/ - 2,5 % points

(-) not relevant

(…) no statement

4.3 Cross Regional Predictions

Application of innovative agricultural technologies within the next 10 years

	ITY	GER	NEL	FIN	RUS	IND	BRA	USA
Precision agriculture:								
- tillage	Current application	Established in conventional production	Around double	Around double	-	Around double	Less than current	Current application
- N-fertilizer application	Around double	Around double	Around double	More than double	-	Less than current	Around double	More than double
- other fertilizer application	More than double	Around double	Around double	Around double	-	More than double	Around double	Current application
- plant protection	More than double	Around double	More than double	Around double	-	More than double	Around double	More than double
- guidance systems	Around double	More than double	More than double	More than double	-	Not relevant	More than double	Around double
- yield mapping	More than double	More than double	Around double	More than double	-	Not relevant	More than double	More than double
Precision agriculture overall	More than double	More than double	More than double	Around double	Around double	Not relevant	More than double	Around double
driverless tractors	Current application	Not relevant	Around double	Current application	Not relevant	Not relevant	Not relevant	Established in conventional production
fleet management (telematics)	More than double	More than double	Around double	Around double	Around double	Not relevant	More than double	More than double
smart implements	More than double	More than double	More than double	Around double	Not relevant	Around double	More than double	More than double
ISOBUS	More than double	More than double	More than double	More than double	Not relevant	Not relevant	-	More than double
remote diagnostics	Around double	More than double	Around double	Around double	Not relevant	Not relevant	More than double	More than double
use of sensor technology	More than double	More than double	Around double	Around double	Not relevant	Not relevant	More than double	Around double
robotics	Around double	Around double	More than double	Current application	Not relevant	Not relevant	More than double	Established in conventional production

Legend:
- Established in conventional production
- more than double of today s application
- Around double of today s application
- Current application
- Less than current application
- Not relevant
- not applicable

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4.3 Summary of Trends and Predictions

	ITY	GER	NEL	FIN
	Developed industry			
Status	Strong focus on medium size tractors (40 to 100 hp)	Emphasis on innovation and growing its export share	Places a high importance of irrigation technology	Forecast is for a shrinking domestic demand/ market
Factors that drive the demand for agricultural mechanization	Strong positive impacts are expected from technical progress, subsidies and biofuel production Strong negative impacts are expected from economic crisis			
Predictions on mechanization levels over the next 10 to 20 years	Lowest predicted gains compared to the other Western European countries	Highest predicted levels and reflects Germany's global position, use, and investment in agricultural mechanization	Average predicted movement over the next few decades	
Drivers of demand and the speed of agricultural mechanization	No informations given	Harvest technologies due to innovation potential	Irrigation technology driven by the need to captiure greater water saving efficiencies	Post-harvest technologies (transport, logistics, storage and drying)
Expected growth rates of exports, imports and the domestic demand for agricultural machinery	Medium size tractors (between 40 and 100 hp). Expects highest annual growth rates exports and domestic demand.	Big size tractors (over 100 hp) are expected to see moderate growth in exports and domestic demand.	The domestic demand is predicted to grow as well as the import for big size tractors (over 100 hp).	The domestic demand is predicted to shrink in almost all machinery categories.
Future application of innovative agricultural technologies	All countries are quite optimistic that the use of innovative agricultural technologies will double or even more than double up in the next 10 years compared to today´s application (especially ISOBUS, sensor technology and precision agriculture).			

4.3 Summary of Trends and Predictions

	USA	RUS	IND	BRA
Status	Strong focus on innovation and growing the export potential of the industry	Low self-sufficiency in local production of agricultural machinery. Emphasis on subsitence agriculture	Rapidly developing mechanization profile driven by a national subsidy programme	Net exporter of agricultrual machinery with a high level of importance placed on ethanol fuel production
Factors that drive the demand for agricultural mechanization	Strong negative impact from oil price and strong positive impact from subsidies	Low impact expected from technical progress and negative impact from adverse economic conditions	Medium positive impacts expected from climate change. Subsidies will help drive mechanization	Strong positive impact expected from bio-fuels
Predictions on mechanization levels over the next 10 to 20 years	Fully motorized with a project trend towards moderate use of autonomous vehicles	Russia expects to be fully motorized (over 75% of cultivation area)	Classifies itself as tractor dominant with expected tractor usage rates around 75% of cultivation areas	Fully motorized Level V
Drivers of demand and the speed of agricultural mechanization	Plant genetics, plant protection, and fertilizer application technologies	Predicted speed of development is much lower than predicted demand	Driver of mechanization process is expected in the harvesting and processing technologies	High demand expected in post harvest technologies
Expected growth rates of exports, imports and the domestic demand for agricultural machinery	Domestic demand is expected in almost all machinery categories. High export growth in forage harvesters	Highest growth rates will be in imports and in the domestic demand for all machinery categories	We expect continuous and increasing exports of tractors and implements to Africa	High annual growth rates expected in almost all machinery categories for export and favourable domestic demand profile.
Future application of innovative agricultural technologies	Most futuristic view with predictions of moderate adoption of robotics and driverless vehicles	Innovative agricultural technologies are not expected to paly any significant role in Russia's agriculture	Precision farming is not expected to play any signifcant role in India's agriculture	Optimistic in automation technologies and the application of precision farming technologies

4.3 Summary of Trends and Predictions

Legend:
- Predominantly hand (green)
- Significant use of draught animal power (red)
- Draught animal power predominant (yellow)
- Significant use of tractors (blue)
- Tractors dominant (magenta)
- Fully motorised

Bar chart: Hand / Draught animals / Tractors

Region	Hand	Draught animals	Tractors
Africa (east)	50	32	17
Africa (south)	54	21	25
Africa (west)	70	22	8
Africa (central)	85	11	4
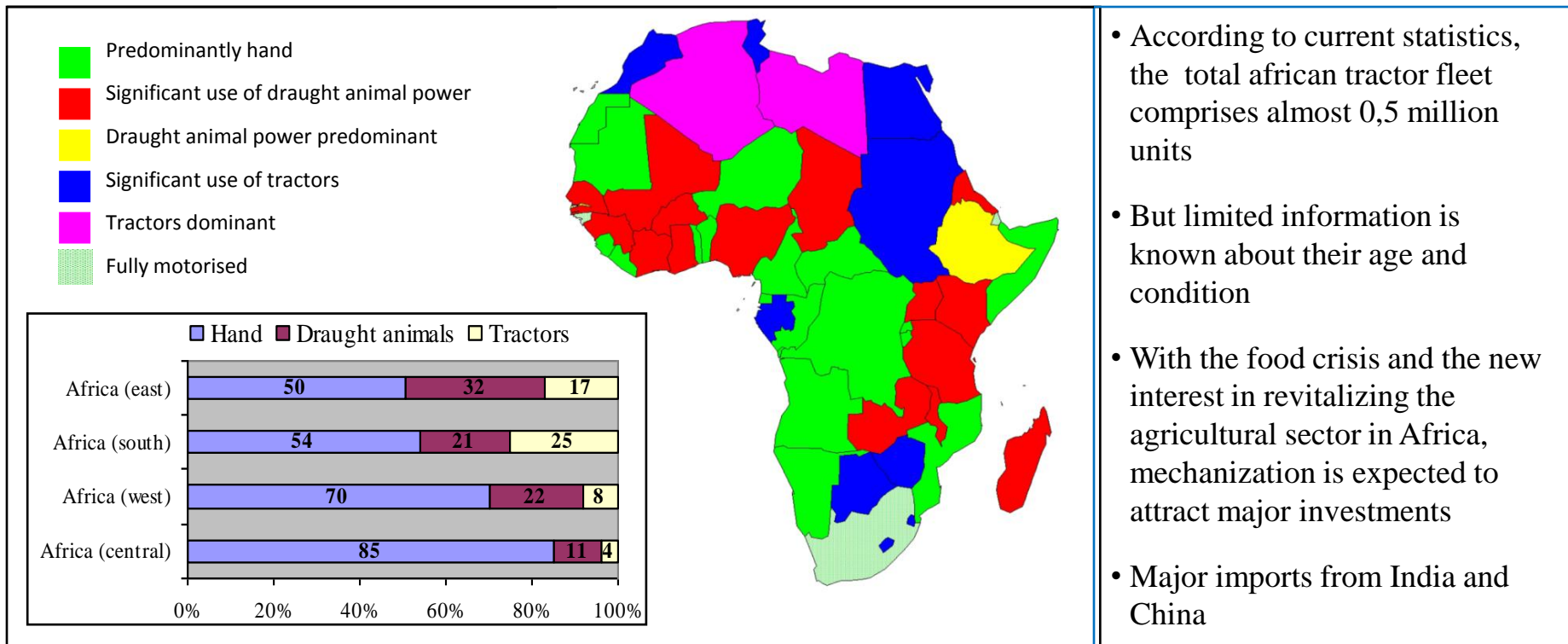
- According to current statistics, the total african tractor fleet comprises almost 0,5 million units

- But limited information is known about their age and condition

- With the food crisis and the new interest in revitalizing the agricultural sector in Africa, mechanization is expected to attract major investments

- Major imports from India and China

Figure: Agricultural power sources in africa
(Source: Clarke et al. 2002, Mrema et al. 2008; changed, own illustration)

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5 Conclusions - Future trends

(1) Developing economies

❖ The political and economical challenges need to be resolved by setting-up a pro-growth environment for the agricultural machinery industry.

❖ Current changes in policy towards agriculture may lead to investment in mechanization , thus increasing demand for agricultural machinery.

(2) Transition economies

❖ Definite needs (imports) but insecure (economic) demand for agricultural mechanization.

❖ Various barriers (e.g. property rights and structural dev., subsidies, etc).

❖ Potential growing markets.

(3) Developed economies

❖ Quantitative saturation of domestic markets.

❖ Future potentials in either export and /or innovative technologies.

❖ Major impacts from biofuel and irrigation development.

"One machine can do the work of fifty ordinary men. No machine can do the work of one extraordinary man"

ELBERT HUBBARD (1856-1915), american writer

Thank you for your attention