

**Efficient and safe production processes in sustainable  
agriculture and forestry,  
XXXIV CIOSTA CIGR V Conference 2011 , Vienna 29 June - 1 July, 2011**

# **The role of human factor in ensuring the efficient production processes in sustainable agriculture**

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The area of agricultural machinery can be considered as a sector which significantly effects the efficiency of

- agrotechnical,
- agrobiological and
- agrochemical processes

related to the process of the production of farm products and their processing.



- **Function efficiency of this system, being a part of the European agriculture, depends upon technical and technological capability of the key factors and also**



**on the ability to respond to external effects of the competitive environment.**

# Agriculture of Slovak Republic

Slovakia is small country: population 5.1 millions

Area of agricultural land in use is 1,930,348 ha

of which

- arable land: 1,351, 779 ha,

- permanent meadows and pastures 523 609 ha



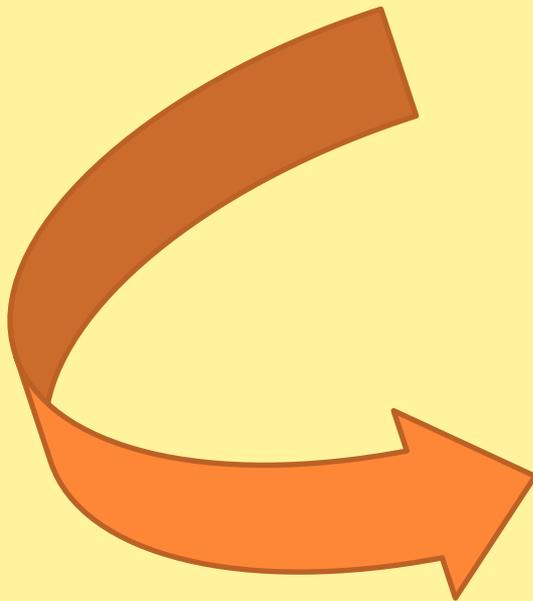
In last year the employment in agriculture dropped down by 9.7% to 65,300 persons, but...

**...Slovak agriculture has a large-scale character**

# Indicators of farm structure according to legal form

Legal form	Number of farms	Agricult. land, ha	Average area, ha	Share in agricultural land, %
State farms	5	9 862	1 972	0.54
Cooperatives	598	1 018 085	<b>1 367</b>	<b>44.96</b>
Farming companies	966	779 359	<b>719</b>	<b>38.20</b>
of which:				
- partnerships	1	420	430	0.02
- Ltd liability companies	863	562 805	652	30.96
- Joint stock companies	102	131 055	1 285	7.21
- Other CO	102	7 634	75	0.42
- CO with land total	1671	1 528 924	915	84.12
TOTAL, farms	8378	1 817 588	217	100.00

- This comparative advantage is used also by the farmers from Netherlands and Denmark, who rent a land and
- they are farming on the farms with the acreage 3,000 – 5,000 hectares.



**In order to study the role of human factor  
at the current stage of development of  
agricultural engineering  
the following steps was taken:**

1. definition of the basic factors effecting the system of agricultural engineering,
2. characterization of trends in the development of human resources in Slovak agriculture and assessment of their impact,





3. characterization of trends in machinery development (case of John Deere combine harvester).
4. specification of the trends in development of management of agricultural mechanized production systems.



# 1. Basic factors effecting the system of agricultural engineering



- **the requirements to reduce production costs and increase the profitability of agricultural production,**
- **development of employment in agriculture and food industry,**
- **diversion from the philosophy of achieving "the maximum yield" to philosophy and preference of "maximum efficiency" in cropping systems and livestock breeding,**
- **compliance with environmental rules in agronomic practice.**



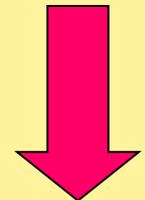
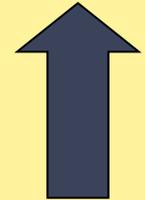
## 2. Trends

in the development of human resources in Slovak agriculture and assessment of their impact



**Due to the restructuring of the Slovak agriculture the significant changes in employment occurred:**

- **The total number of the persons employed in agriculture decreased (positive change).**
- **The age and education structure of the employees in agriculture continues to worsen (negative change).**



# Human resources in Slovak agriculture

Agriculture is characterized by the highest decline in the labour force compared with other sectors

## Number of workers in Slovak agriculture



1989	1995	1997	2002	2003	2010
360 699	145 640	117 943	108 900	99 400	65 300

## Age structure in agriculture of Slovak Republic, %

Age group	2008	2009
15- 34 years	15.4	16.5
35- 49 years	46.5	52.3
50-59 years	36.5	39.2
60 years and more	5.5	4.8

Source: SO SR - Slovak Labour Force Sample Survey

## Education structure in agriculture of Slovak Republic, %

Type of education	2008	2009
Elementary education	14.7	14.7
Persons with vocational training	52.4	50.2
Secondary education	26.0	26.5
University education	6.7	7.5
Total	100.0	100.0

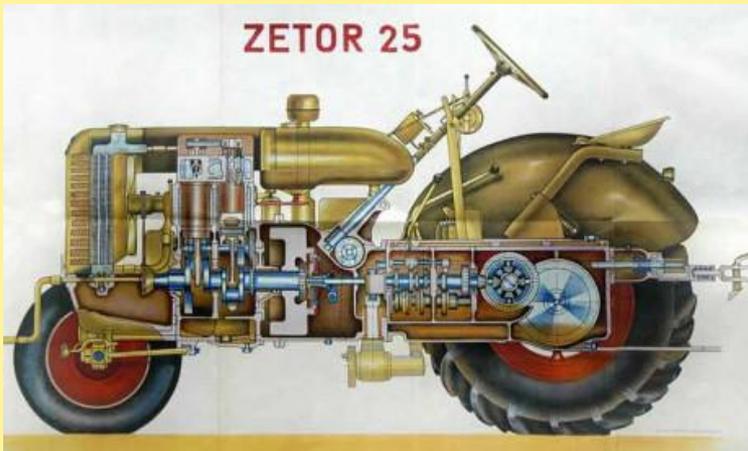
Source: SO SR - Slovak Labour Force Sample Survey



**On the other hand, in the sector of agricultural mechanization occurs:**

- an extend acceleration of technological development,**
- the arrival of sophisticated machinery and equipment supported by information technology.**

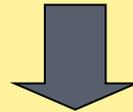
**ZETOR 25**



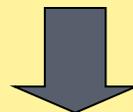
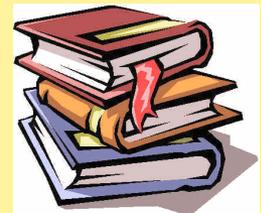
**Relation between  
the current trends  
in resort  
of human resources  
and farm machinery  
(case of Slovak agriculture)**

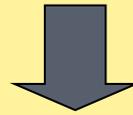
# Reality in the area of education and training

**Reducing the number  
of secondary schools  
and restructuring the study branches  
related to agricultural mechanization**



**Admission of less able students  
for the study branch  
„Operator of the farm machinery  
at the secondary schools**





**Decreasing the quality of teaching  
and training in the study branch  
„Operator“ of the farm machinery**

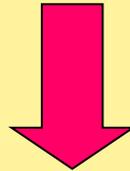
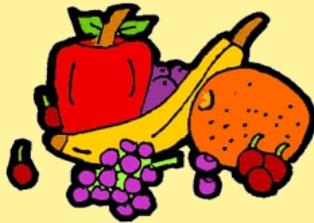


**Decreasing the attractiveness of the professions  
„Mechanician“  
and „Operator of farm machinery“**

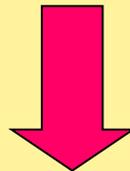
# Reality in the area of agricultural production



**A large proportion of the worn-out and obsolete agricultural machines**



**Slowdown of the machinery fleet renewal**

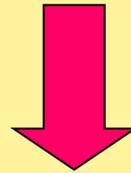




**Lack of funds for farm machines  
fleet renewal**



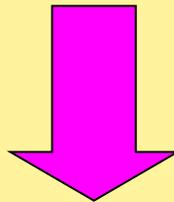
**Reducing the number of workers  
able to competently operate and manage  
modern farm machines**

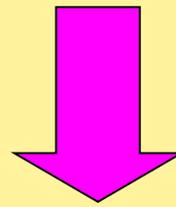


**....and result is:**

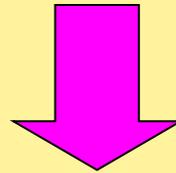


**Reduction of capacity to competently  
operate and manage  
the modern farm machines  
with the support  
of sophisticated systems  
and information technology**

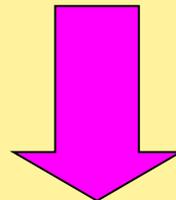


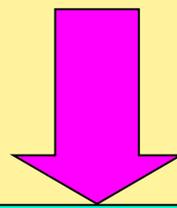


**Low level of management  
of mechanized production  
systems**

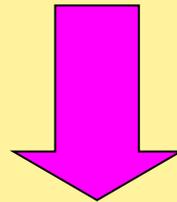


**Insufficient use of technical potential  
of modern machines  
causing a high share of variable costs  
within the operating costs**





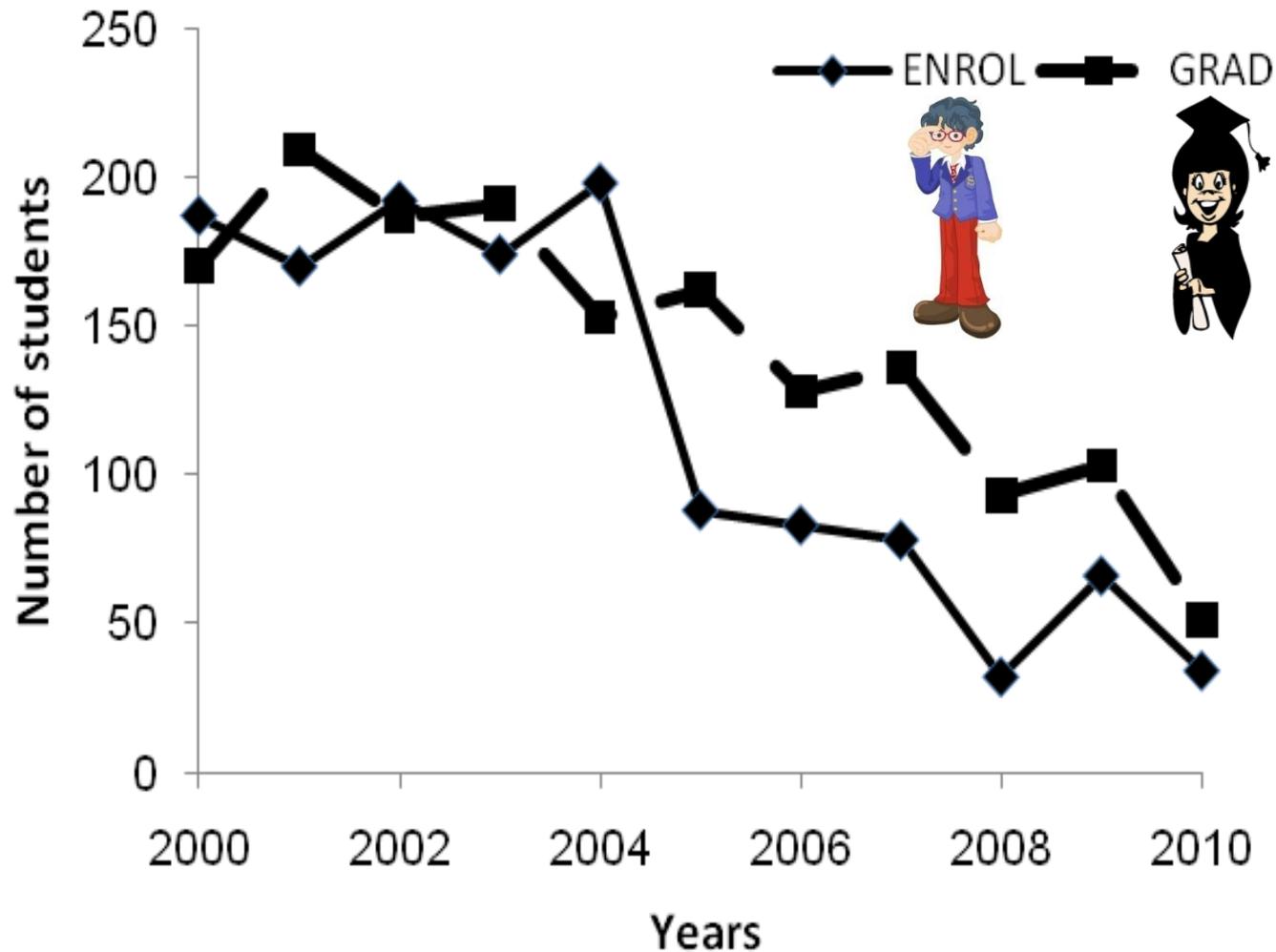
**Low profitability  
and low return on investment**



**Negative economic impact  
on farm economy  
and competitiveness of the farms  
and resort agriculture as a whole**



# Number of students in the Agricultural Engineering study programme, Faculty of Engineering, Slovak University of Agriculture,



**All the above mentioned trends can be considered  
as a very negative  
because they cause a poor ability  
of the area of agriculture  
to absorb  
the new more efficient production technologies  
supported by information technologies.**



**Aging of human resources  
can result in retrograde factor  
for further development  
and implementation of new technologies**

**Gradually, there is an imbalance between the technical level of machinery and educational level of the human factor.**



**Loss of workers using the machinery is not compensated by increasing the number of workers having higher skills.**

**Human factors acts as a brake in using of benefits of modern technologies**

3. Trends in machinery  
development  
(case of John Deere combine  
harvester).

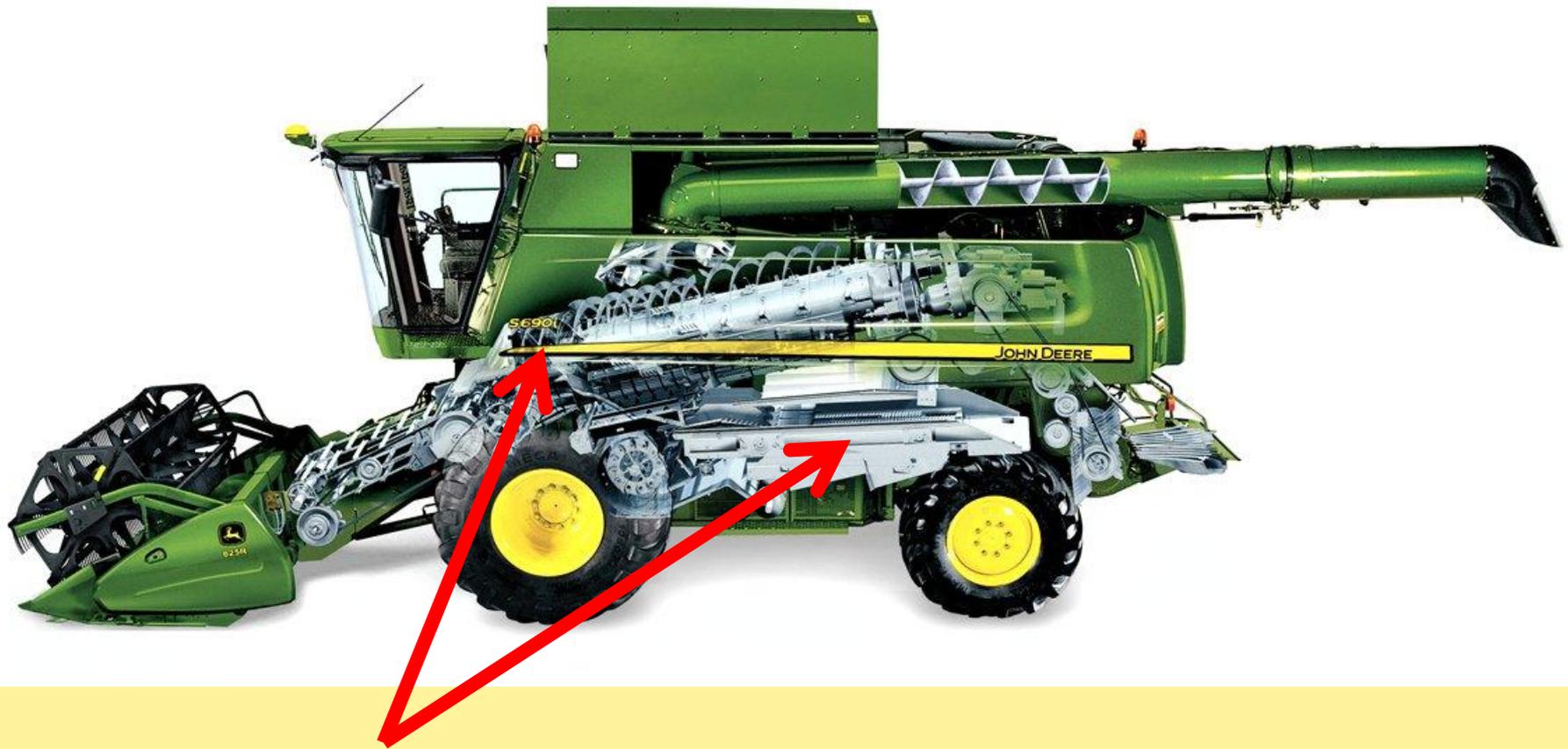
# Combine harvester John Deere S 690i



**Engine power 395 kW; platform working width: 7.60 m;  
Hi-performance rotor design; tine separation technology...**

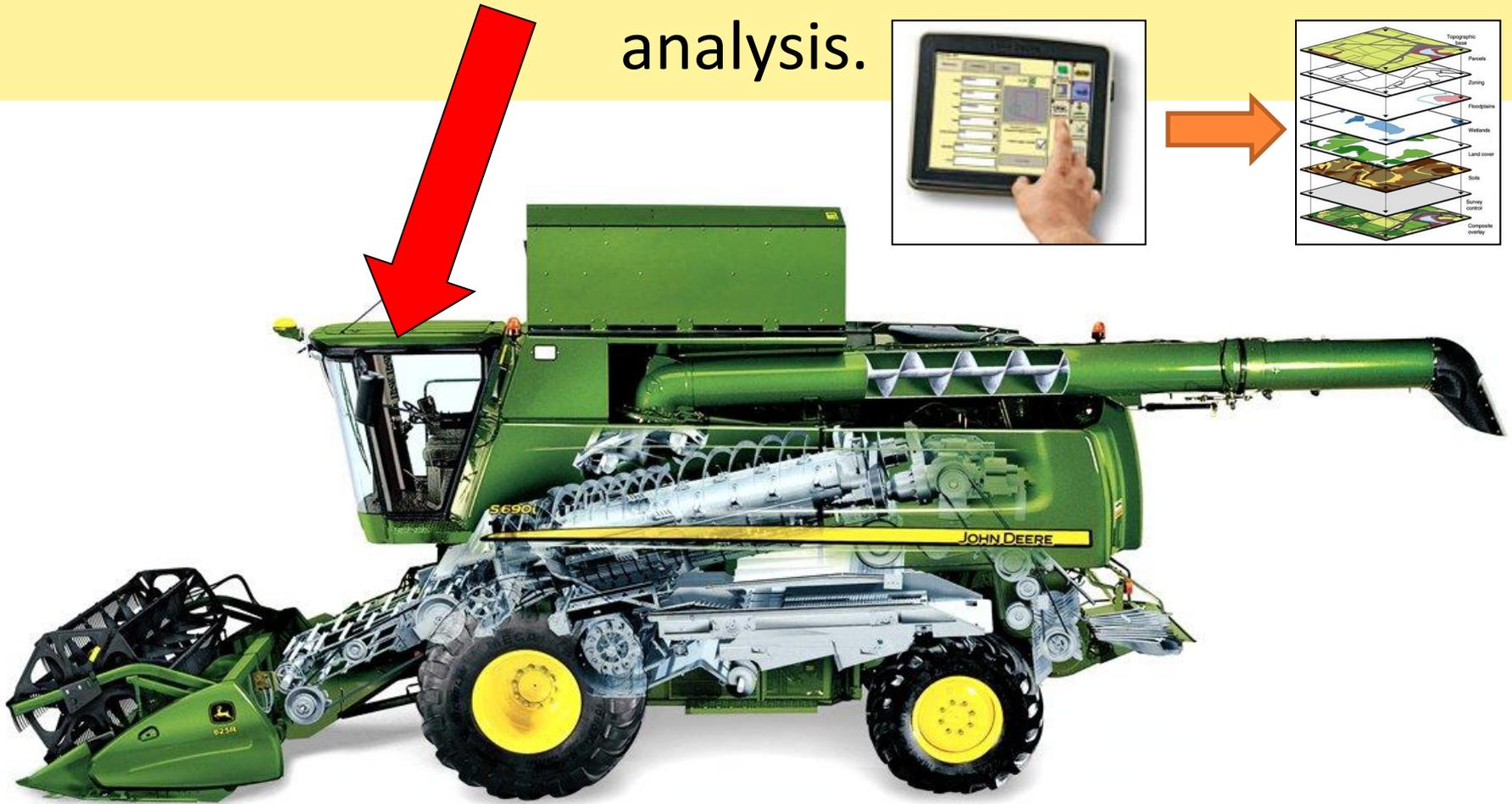
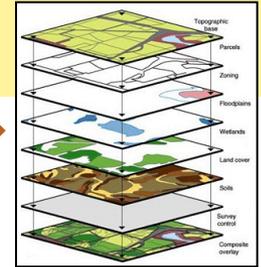
**AutoTrac** uses satellite navigation signals to steer combine harvesters with reduced overlaps to ensure that combine finish each pass with a full platform increasing the productivity.





**HarvestSmart Automatic Feedrate Control**  
continually adjusts the combine forward speed until  
either machine capacity limit or grain loss limits are  
reached

**HarvestDoc** automatically collects all harvesting data such as grain yield and grain moisture content for lateral documentation and analysis.





## **HeaderTrak DISPLAY**

**provides the operator with information on the header functions: active resume button, HeaderTrak operating mode, stubble height or ground pressure and the tilt angle of the header.**



**VisionTrak DISPLAY**  
lets operator  
to monitor  
and control  
the performance  
of the cleaning shoe  
and separator.

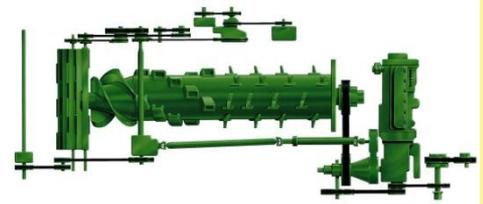


## **TRIPLE DISPLAY Tachometer**

**allows operator to monitor 3 functions simultaneously. In addition to ground speed of combine harvester, operator can select engine rpm, cylinder rpm, concave clearance or cleaning fan speed.**

On the combine harvester John Deere S690i  
it is possible to identify

**16 basic calibration procedures**, which are  
very important for the proper combine harvester  
functions.



Using of combine harvesters for a the harvest of the cereal crops is done within the production system.

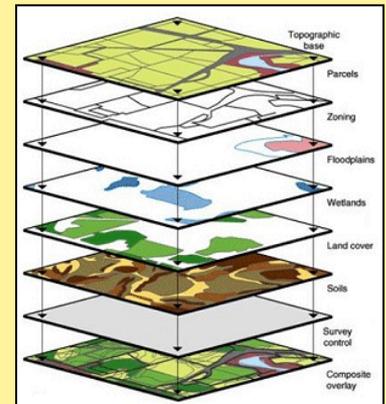
This system includes also labour forces operating at 3 levels:

- 1.level: **Farm production manager.**
- 2.level: **Machine operator.**
- 3.level: **Technician.**



# 1.level: Farm production manager.

He makes decision about the ways of machine exploitation, about the organization of the work with regard to the weather condition, grain moisture content and other factors.



He uses his knowledge, skills, information and experience to choose the appropriate way of harvesting process and machine selection

## **2.level: Combine harvester operator.**

The knowledge, skills and training allows him to use the available technical and technological potential of the combine harvester, which represents some incurred capital costs.



**3.level: Technician.** Combine harvester needs technical maintenance, exchange of worn machine-parts, adjustments of mechanisms, diagnostics of electronic units, repairs, etc.



**All these procedures require specific knowledge, skills, training and experience.**

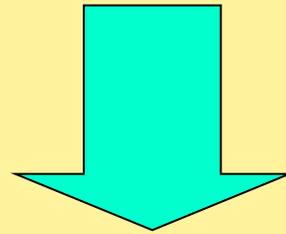
# The labour force must be able:

- to know the function, design and engineering principles of all subsystems used on combine harvester,
- to understand the importance of implementing of the calibration to ensure proper function of sophisticated systems of the combine harvester,
- to organize and perform the calibration procedure accurately, timely and in the right way.

4. Specification of the trends in development of management of mechanized production systems.

# Nowadays we can see:

- **continuous improvement of design of agricultural machinery,**
- **the use of new advanced production technologies,**
- **but also gradual penetration of information technology in process of control and management:**



- **exchange of information and communication between the subjects participating in the production process, delivery of inputs and sale of outputs,**
- **managerial decision making and skills,**
- **using adequate and early information.**



**Production manager of the agricultural production will be involved in the following activities:**



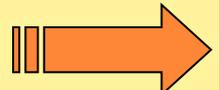
## **Agronomic and information services:**

- Meteorologic conditions data,**
- Cropping systems,**
- Agro-chemical management,**
- Cost finding,**
- Crop advisors,**
- Mapping services.**



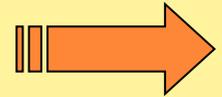
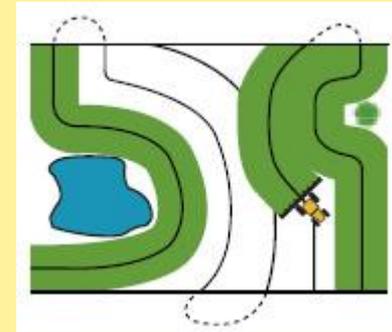
# Farm management:

- Computer based planning,
- Budget planning,
- Pricing and accounting
- Field administrative maps,
- Resource planning
- Taxes, insurance.



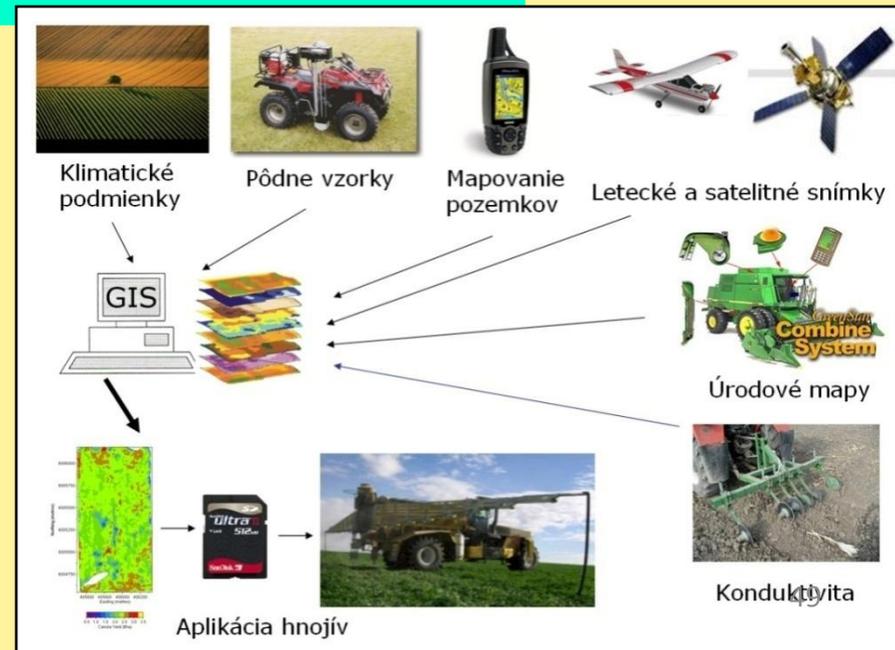
# Vehicle communication:

- Fleet management,
- Preventive maintenance,
- Remote diagnostics,
- Machine guidance,
- Mobil office.



# Precision farming:

- Additional field information,
- Variable rate applications,
- Field monitoring and mapping,
- Yield mapping.



**Based on previous development it can be seen that Integrated agricultural management system seeks to structure consisting of hardware and software components.**

**Priority is given to hardware components, installed on mobile machinery, providing the information to the system.**

**Each of these components significantly increases requirements on the knowledge and skills of the operator, but also the production manager.**

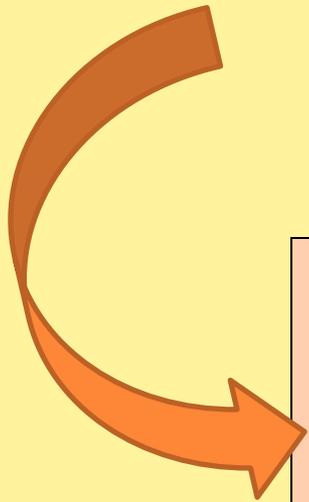
# **What is the role of agricultural mechanization in this process?**

**In large-scale conditions, which are typical for the prevailing part of the Slovak agriculture, the issues of**

- agricultural machine exploitation,**
- machine scheduling**
- and monitoring**

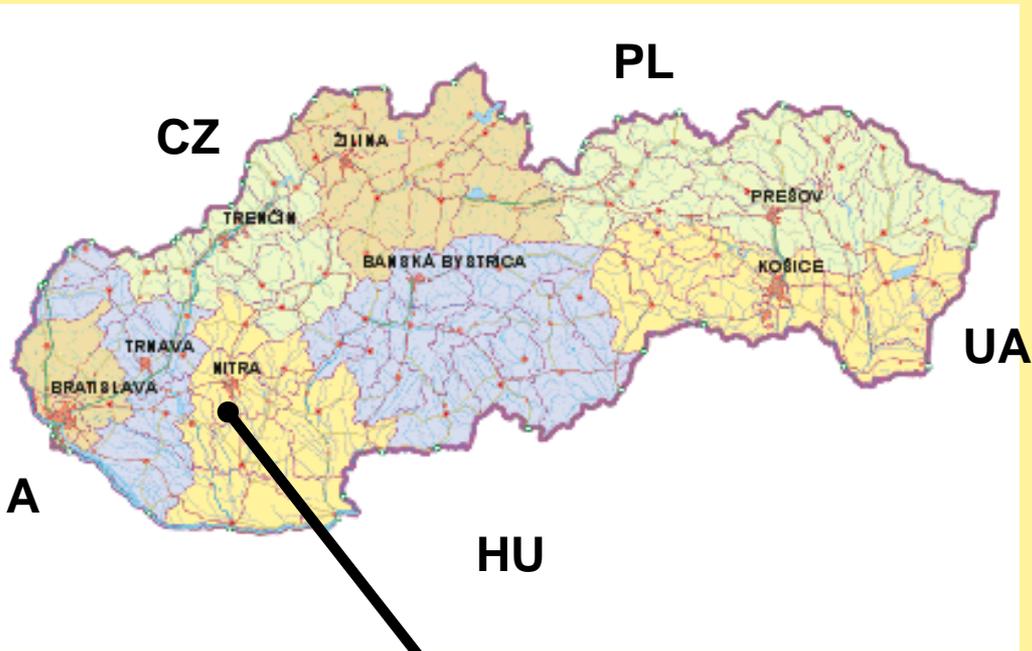
**are very important from the point of cost reduction.**

- The machines moving on the fields can be considered as basis units producing very important data from the point of farm management.



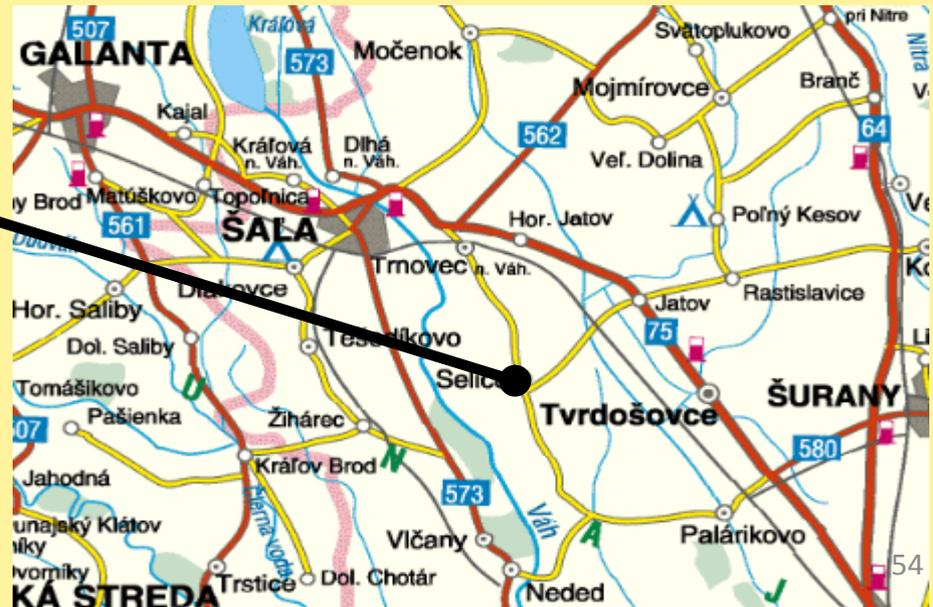
And therefore we should not be indifferent to the **education level** of farm production managers, machine operators and technicians.

- The human factor will play a key role in the whole system, whereas the quality of its decisions will determine the effectiveness of system operation in which it operates.
- Activities of the farm production manager, managing agricultural technologies and machines, will be linked to a higher system, - **Agricultural Management System** functioning within the farm.



**Company  
AGRODIVISION Selice,  
(southwest Slovakia)**

**SELICE**



## **Company AGRODIVISION Selice, southwest Slovakia.**

- **Three farms with the acreage of 4,500 ha in maize growing region,**
- **32 mobile units (high-powered tractors, combine harvesters, forage harvesters, self-propelled loaders, self-propelled sprayers, etc.).**
- **The company has introduced its own AgroCont information system to achieve the higher level of farm management.**

# AGRICULTURAL MANAGEMENT SYSTEM AgroCont

**Agronomic records  
AgroDoc**

**Records of material inputs  
AgroMat**

**EU Subsidies  
EuroDot**

**Farm Management  
FarmCont**

## Agricultural management solutions

**AutoTrac** for machine guidance

**FieldDoc** system for data recording

**JDLink** telematics for wireless communication

**iTEC Pro** for implement control

## Requirements for education, knowledge, skills, training

### HUMAN RESOURCES:

1. Level: Farm production managers
2. Level: Machine operators
3. Level: Technicians

**Currently, there is a lack of a comprehensive system of education of staff and managers for each level of management of mechanized agricultural production systems.**

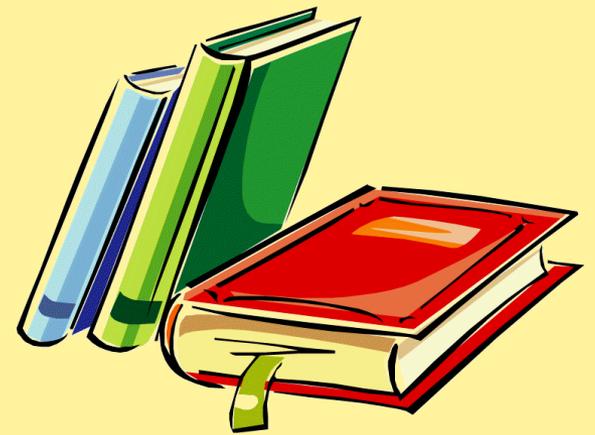
**A part of the education was taken over by the trading companies focusing on sales of agricultural machinery, but it does not solve the situation.**



**The solution:  
to create an accredited  
comprehensive  
lifelong learning programme  
for all levels of staff  
involved in management and  
exploitation of the farm machinery.**



**It should be very effective to establish an international network based on EU project, for example **Grundtvig programme**, focused on the teaching and study needs of learners taking adult education in the area of advanced agricultural machinery.**



**Such a solution would allow to overcome the imbalance between the technical level of modern, advanced and sophisticated technology, and educational level of farm managers, operators and technicians.**





**Thank you  
for your attention**

