RUSSIAN FEDERATION,
GNU VIM
ROSSELKHOZACADEMY

MARCHENKO
OLEG
STEPANOVICH,
REPRESENTATIVES OF RUSSIAN FEDERATION AND CIGR IN OECD
Section “TRACTORS AND CODES”
Regions of Russian Federation
Share of Russia in world resources

- Arable land: 9%
- Pastures: 2.6%
- Fresh water: 20%
- Chernozem soil: 55%
- Fertilizer: 9.3%
- Population: 2.3%

Strategy of resources exhaustion (also of a biosphere) is destructive as for future and for present generations (Rio-de Janeiro, 1992)
The Differentiation of Provision with Farm-Resources and Technique also the Average Level of Profitability in Priority Regions of Russia

<table>
<thead>
<tr>
<th>Farm-resources, Technique, Economy Indices</th>
<th>Number of Priority Regions*</th>
<th>Farm-resources Used in Priority Regions, % of total amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral Fertilizer</td>
<td>9</td>
<td>52</td>
</tr>
<tr>
<td>Machines for Mineral Fertilizer Application</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>
| Chemicals for Plants Protection, including:  
  - diseases control chemicals  
  - pest control chemicals       | 5                          | 70                                                       |
|                                                   | 5                          | 63                                                       |
| Machines for Chemicals Application          | 10                         | 40                                                       |
| Diesel Fuels, Lubricants                   | 12                         | 50                                                       |
| Tractors                                   | 15                         | 44                                                       |
| Grain Harvesters                           | 15                         | 53                                                       |
| Forage Harvesters                          | 15                         | 47                                                       |
| Sugar-beat Harvesters                      | 10                         | 81                                                       |
| Average Gross output of Farm-products per 1 hectare, $ | 16                         | 200 and above                                            |
|                                           | 18                         | 130…200                                                 |
| Profitable Farm-producers, numbers         | 15                         | (5672 numb.) 58                                          |
| Level of profitability on all activity without the State subsidies and compensation | 8                          | 10 and above                                             |
|                                           | 8                          | 3 and above                                              |

*) Total number of regions in Russia – 89 but about 45 regions with developed Agrarian Sector
# The Specific Consumption of Diesel Fuel in Crops Production Technologies (l/ hectare)

<table>
<thead>
<tr>
<th>Farm Crops</th>
<th>USA</th>
<th>Russia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter Wheat</td>
<td>30.9…43.9</td>
<td>71.1…96.4</td>
</tr>
<tr>
<td>Corn for Grain</td>
<td>74…88</td>
<td>161.5…217</td>
</tr>
<tr>
<td>Corn for Silage</td>
<td>52.4…81.3</td>
<td>156.8…206.1</td>
</tr>
<tr>
<td>Oat</td>
<td>30.9</td>
<td>60.6…101.6</td>
</tr>
<tr>
<td>Barley</td>
<td>30.9</td>
<td>56.4…101.6</td>
</tr>
</tbody>
</table>

*) Data of VIM (Drincha V.M.)
About 40 mln. ha of arable long-fallow land in Russia are not used now
Annual Tractors Production and Sales in Russia during 1991-2007 and two ways of its increasing in 2008-2012

158,9 99 88,8 9,3 31,3 8,8 7,3 6 8,9 8,7 17

130 70 60 31,3 14,7 13 13

Tractors Production
Annual Tractor sales
Prognostic variant of development

thous.units


I- Version
II- Version
Russia Agriculture Tractor Fleet decreasing for 1991-2007 and conditions of its stabilization on the level of 2006

1. Version - 175 thous. units for 2008-2012 (35 thous. units per year)

2. Version - 356 thous. units for 2008-2012 (71 thous. units per year)
Tractors Production and Sales in Russia and Belarus during 1991-2007

Belarus Tractor Plant MTZ is loaded on 78%

All Russian Tractor Plants are loaded on 8-9% in average
Grain Harvester Annual Production and the necessary its increasing

To renew the fleet of Grain Harvesters it is necessary to produce during 2008-2012 not less than 182 thous. units.

The necessary Annual Production increasing (20-48 thous. units per year) for stabilization of Grain Harvester Fleet on the level of 2004-2005

Grain Harvester Fleet Decreasing at the same level of Annual Production (6-7 thousand units per year)
Forage Harvester Annual Production for 1991-2007 and the necessary its increasing during 2008-2012 for stabilization of the Forage Harvester Fleet on the level of 2004-2005

To renew the Fleet of Forage Harvesters it is necessary to produce during 2008-2012 not less than 64 thous. units.

Sown area under Forage Crops on arable land was decreased from 43 mln ha up to 27 mln ha

The necessary Annual Production increasing (10-17 thous. units per year) for stabilization of Forage Harvester Fleet on the level of 2004-2005

Forage Harvester Fleet Decreasing at the same level of Annual Production (0.9 thous. units per year)
Analysis of tendencies of development of the agricultural tractors and the proposals for optimization of the tractor fleet structure

1. Analysis of the tractor market in RUSSIA and BELARUS;
2. The tendencies of development of the tractor market in Italy;
3. Comparison of market of tractors in RUSSIA, BELARUS and ITALY;
4. Analysis of the application of the rotary tillage machines in ITALY;
5. Market of Grain and Forage Harvesters in RUSSIA;
6. Tractor Fleets and Arable land Resources of the 8 Countries;
7. Proposals for optimization of Tractor Fleet Structure in the UNION STATE.
THE EXPERIMENTAL DATA OF INFLUENCE OF THE MACHINE AND TRACTOR AGREGGATES ON THE CROPS YIELD LOSSES DEPENDS ON:

- MASS OF TRACTORS and MACHINERY;

- INFLATION PRESSURE in TYRES;

- NUMBERS OF PASSAGES OF THE DIFFERENT WEIGHT TRACTORS AND MACHINES IN THE FIELD.
THE YIELD LOSSES DEPENDS ON NUMBERS OF PASSAGES OF THE DIFFERENT WEIGHT TRACTORS AND MACHINES IN THE FIELD

<table>
<thead>
<tr>
<th>Tractor mark</th>
<th>Inflation pressure, kPa at</th>
<th>Number of passages on the field</th>
<th>Losses of yields, %</th>
<th>Coefficient of variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTZ-80 (3.87t)</td>
<td>150</td>
<td>1</td>
<td>9.0</td>
<td>80.8</td>
</tr>
<tr>
<td>YMZ-62 (4.2t)</td>
<td>150</td>
<td>2-3 4-5</td>
<td>14.1 19.8</td>
<td>66.5 50.0</td>
</tr>
<tr>
<td>DT-75 (6.18t)</td>
<td>Track layer (150)</td>
<td>1</td>
<td>8.2</td>
<td>36.2</td>
</tr>
<tr>
<td>T-74 (4.2t)</td>
<td>Track layer</td>
<td>2-3 4-5</td>
<td>13.3 19.2</td>
<td>62.3 53.1</td>
</tr>
<tr>
<td>T-150 K (8t)</td>
<td>180</td>
<td>1 2-3 4-5</td>
<td>13.3 23.3 30.3</td>
<td>45.7 35.4 39.2</td>
</tr>
<tr>
<td>K-700 (13.0t)</td>
<td>200</td>
<td>1</td>
<td>17.2</td>
<td>41.4</td>
</tr>
<tr>
<td>K-700A (13.6t)</td>
<td>200</td>
<td>2-3</td>
<td>28.0</td>
<td>29.5</td>
</tr>
<tr>
<td>K-701 (14.6 t)</td>
<td>200</td>
<td>4-5</td>
<td>35.1</td>
<td>28.6</td>
</tr>
</tbody>
</table>
THE YIELD LOSSES OF GRAIN AND FORAGE CROPS DEPENDS ON THE SOIL COMPACTION BY THE DIFFERENT TRACTORS WITH THE SAME DRILL SEEDER

<table>
<thead>
<tr>
<th>Indicators</th>
<th>T-150K, ДТ-175</th>
<th>ДТ-75М, Т-74</th>
<th>T-150K</th>
<th>T-150K with double tyres</th>
<th>K-700</th>
<th>K-700 with double tyres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure on the soil, kPa</td>
<td>80</td>
<td>160</td>
<td>180</td>
<td>136</td>
<td>200</td>
<td>135</td>
</tr>
<tr>
<td>Yield, %</td>
<td>100</td>
<td>90,3</td>
<td>82,6</td>
<td>85,5</td>
<td>76,9</td>
<td>84,2</td>
</tr>
</tbody>
</table>

The experiments were conducted in the 18 real agricultural enterprises in different regions of Russian Federation.
TRACTIVE EFFORT TESTS OF TRACTORS MTZ-1221 and MES-200 IN EXPERIMENTAL CENTER OF VIM

TRACTOR MTZ-1221(4WD) TEST ON THE ROAD

Tyres rear axle 28LR26
Power - 90.4 kW
Mass - 4.64 t

MOBILE POWER UNIT MES-200 WITH CHANGEABLE LOAD from 10570 Kg up to 15970 Kg
Power – 147 kW, Mass - 8 t
tractive efforts (kN) and power (kW) of the MES-200 on the stalk field tests at empty capacity \((f=0.69\text{ at } 105.1\text{ kW and } 32\text{ kN})\). When it filled with 5400 Kg \((f=0.724\text{ at } 110.7\text{ kW and } 44.1\text{ kN})\). When mass is 15970 Kg and traction force increased to 70-75 kN, the slippage was ~14\% and ratio of weight usage was decreased on 15-25\%.
The results of tractive efficiency of 225 wheeled tractors of different models at OECD Codes testing

1. As known the increase of the mass of wheeled tractor of different types and their ballasting allows to increase the tractive efficiency at different soil conditions;

2. However the utilization of the very heavy tractors with mass above the 15-18 tons are not justifiable because of high compaction on the soft soils in the fields;

3. The experimental data made by VIM shows that the use of the heavy tractors in different regions of Russia and CIS countries the losses of yields of grain and forage crops increase up to 9-17% at one pass and they reach 25-30% at 4-5 passes of machine-tractor aggregates;

4. So all the real advantages concerning with increasing of the high output at comparatively low specific fuel consumption of powerful and heavy tractors cannot precede of the negative features of soil compaction;

5. The next picture shows that the tractive efficiency of tractors with mass about 10000 Kg (~0,82) not exceed it much when tractors has a mass of 15000 Kg (~0,825) and of 20000 Kg (~ 0,83).
The tractive efficiency ($N_{\text{pull.}} / N_e$) of 225 wheeled tractors at different weight.
# THE CHARACTERISTIC OF THE NEW TYPE OF THE UNIVERSAL POWER UNIT UES-290/450 FOR THE UNION STATE (RUSSIA – BELARUS)

<table>
<thead>
<tr>
<th>Mark of machine</th>
<th>Engine power, HP</th>
<th>Working speed, km/h</th>
<th>Transport speed, km/h</th>
<th>Rated draw bar pull, kN</th>
<th>Lift load of mounted systems, kN</th>
<th>Mass, Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>UES-290/450</td>
<td>290...450</td>
<td>до 15</td>
<td>до 30</td>
<td>50</td>
<td>60</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard Tyres model (rear axle) and inflation pressure, kPa</th>
<th>Standard Tyres model (front axle) and inflation pressure, kPa</th>
<th>Set of changeable wheels</th>
<th>Mass distribution for axles, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>480/70R30 250 kPa</td>
<td>30/35 R32 160 kPa</td>
<td>800/65R32 1050/50 R32</td>
<td>480/70R30 ~50/50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>540/65R30 800/45R30,5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20,8 R32</td>
<td></td>
</tr>
</tbody>
</table>

*UES* - Universal Engine System
INNOVATIONS IN CONSTRUCTION OF UNIVERSAL POWER UNIT
UES-290/450

- application the modern engine (Euro-3) with “Common Rail system” and with optimal fuel consumption;
- utilization of the engine power up to 100% from the front power take off and up to 60% - from rear one with a high efficiency;
- aggregate UES with front and rear harvest machines and other machines with the active working tools;
- application of the double flow hydro-mechanical transmissions to get the draw bar pull up to 50-60 kN and high efficiency on tillage, transportation and other operations;
- improvement of the conditions of operator work, reversible post of steering, safety in work and maintenance of UES;
- application of navigation system;
- the high annually load of UES (1200-1500 hours) for fulfillment of different agricultural and other job in any time of the year;
INNOVATIONS IN CONSTRUCTION OF MACHINES FOR WORKING WITH UES-290/450

-application of rotary plow and rotary tillers on the base of UES gives the high efficiency, low level of resistant because they generate the support strength up to 4 kN/m;

-high quality of tillage of sward land of grasslands and pastures with rotary tillers for one pass of aggregate on the base of UES decrease the labor cost to 1,5-2 fold, fuel consumption to 30-40% and metal materials to 2,4 fold;

-application of the rotary working tools in harvest machines gives the possibility to support the optimal regime of the active working tools and to allow to regulate the parameters of technological processes of the cutting the forages and other materials.
ANALYSIS OF TRACTORS AND SELF-PROPELLED HARVESTERS

AND

PROPOSALS FOR THE OPTIMISATION OF THE STRUCTURE

OF THE TRACTOR FLEET OF UNION STATE

(RUSSIA-BELARUS)
Market of wheeled Tractors in RUSSIA

Σ = 107 models, including:

- 32 Imported models
- 32 Belarussian models
- 11 Ukrainian models
- 32 Russian models

Power, Hp

Number of Models
Market of Tracklaye Tractors in RUSSIA

Number of Models

∑=19 models

Including 10 Russian models

Power, HP
PRODUCTION of TRACTORS in RUSSIA

Number of Models

Σ = 42 models

- Tracklayer Tractors - 10 models
- Wheeled Tractors - 32 models

Power, HP
PRODUCTION of TRACTORS in BELARUS

\[ \sum = 63 \text{ models, including 2 models of perspective tracklayer tractors} \]
MARKET of TRACTORS in ITALY

∑ = 1148 models, Including:

78 models of tracklayer tractors

- Tracklayer Tractors
- Wheeled Tractors
Comparison of Tractor Market (number of models) of Italy, Russia and Belarus

Σ = 1148 models, including:

- 967 Italian models
- 63 Belarusian models
- 118 Russian models
Market of Tillage machinery with passive working tools in ITALY

Number of Models

Σ = 2060 models

- Spring Harrows
- Cultivators
- Disc harrows
- Disc plows
- Subsoiler
- Moul-board Plows

Power, HP
Market of Rotary tillage machinery in ITALY

Σ=1936 models

- Rotary cultivators
- Rotary tillers (garden)
- Rotary tillers (vertical)
- Rotary tillers (horizontal)
- Rotary subsoiler

Number of Models

Power, HP

0/20 41/60 81/100 121/140 161/180 201/220 241/260 281/300 321/340 361/380 401/420 441/460 481/500 521/540 561/580 601/620 641/660
Market of Forage Harvesters (trailed, mounted and self-propelled) in RUSSIA

$\sum = 31$ models, including:

- 9 Belarussian models
- 8 Russian models

**Power, HP**

- 9 models from Belarus
- 8 models from Russia
- 14 models from Imported
# Tractor Fleets and Arable land Resources of the 8 Countries

<table>
<thead>
<tr>
<th>№№</th>
<th>Country</th>
<th>Arable land, mln. ha</th>
<th>Tractor Fleet, Thous. units</th>
<th>Number of tractors per 1000 ha of arable land</th>
<th>Rate of load per one tractor, ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>RUSSIA Agro-Enterprises</td>
<td>72,9 estim.</td>
<td>364,4</td>
<td>5,0</td>
<td>200,0</td>
</tr>
<tr>
<td></td>
<td>Private farms</td>
<td>15,5</td>
<td>70,0</td>
<td>4,5</td>
<td>222,0</td>
</tr>
<tr>
<td></td>
<td>Population plots</td>
<td>3,2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>91,6</td>
<td>434,4</td>
<td>4,7</td>
<td>212,8</td>
</tr>
<tr>
<td>2.</td>
<td>USA</td>
<td>172,0</td>
<td>4760,0</td>
<td>28,0</td>
<td>35,7</td>
</tr>
<tr>
<td>3.</td>
<td>FRANCE</td>
<td>18,4</td>
<td>1264,0</td>
<td>69,0</td>
<td>14,5</td>
</tr>
<tr>
<td>4.</td>
<td>CANADA</td>
<td>45,9</td>
<td>733,0</td>
<td>16,0</td>
<td>62,5</td>
</tr>
<tr>
<td>5.</td>
<td>ITALY</td>
<td>8,0</td>
<td>1680,0</td>
<td>210,0</td>
<td>4,8</td>
</tr>
<tr>
<td>6.</td>
<td>GERMANY</td>
<td>11,9</td>
<td>944,0</td>
<td>79,0</td>
<td>12,7</td>
</tr>
<tr>
<td>7.</td>
<td>GREAT BRITAN</td>
<td>5,6</td>
<td>500,0</td>
<td>89,0</td>
<td>11,2</td>
</tr>
<tr>
<td>8.</td>
<td>JAPAN</td>
<td>4,7</td>
<td>2400,0</td>
<td>510,6</td>
<td>2,0</td>
</tr>
</tbody>
</table>
PROPOSALS FOR OPTIMISATION OF TRACTOR FLEET IN UNION STATE (RUSSIA-BELARUS)

The global standardization and unification of the key types of Tractors and Machinery are necessary for the next reasons:

1. To decrease the mass of the high power Tractors and self-propelled Harvesters with using of the high efficient tyres and tracks systems;

2. To save resources, labor and increase of the agricultural machinery efficiency;

3. To decrease considerably cost of industrial production and maintenance of the agricultural machines;

4. The introduction of the progressive technologies and efficient techniques to decrease the impact on the environment and support the fertility of land.
COMPARISON OF MASS (t) AND POWER (HP) AND TRACTION FORCE (kN) OF THE TRACTOR FLEET IN RUSSIA WITH IMPORTED HEAVY POWERFUL TRACTORS AND A PERSPECTIVE TRACTOR FLEET WITH OPTIMIZED STRUCTURE ON THE BASE OF SYSTEM OF UNIVERSAL POWER UNITS,

WITH INTERVAL OF POWER (60-700 HP) AND POSSIBLE APPLICATION OF TRACKS FOR ONE OR TWO AXLES (STEP BY STEP):

UES - 60/100;
UES - 120/200;
UES - 210/280;
UES - 290/450;
UES - 500/700.
System of universal mobile power units:
UES-60/100; UES-120/200; UES-210/280; UES-290/450; UES-500/700
(interval of power, HP)
System of universal mobile power units:
UES-60/100; UES-120/200; UES-210/280; UES-290/450; UES-500/700
(interval of power, HP)
System of universal mobile power units:
UES-60/100; UES-120/200; UES-210/280; UES-290/450; UES-500/700
(interval of power, HP)
THE FUTURE OF AGRICULTURAL MECHANIZATION IN RUSSIA

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