Past, present and future of Agriculture and Agricultural Engineering (globally and in SA)

Felix Reinders
President Honoraire: ICID
Chair Honoraire: WASAG

WASAG The Global Framework on Water Scarcity in Agriculture

International Commission on Irrigation and Drainage

ICID·CIID

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ICID·CIID

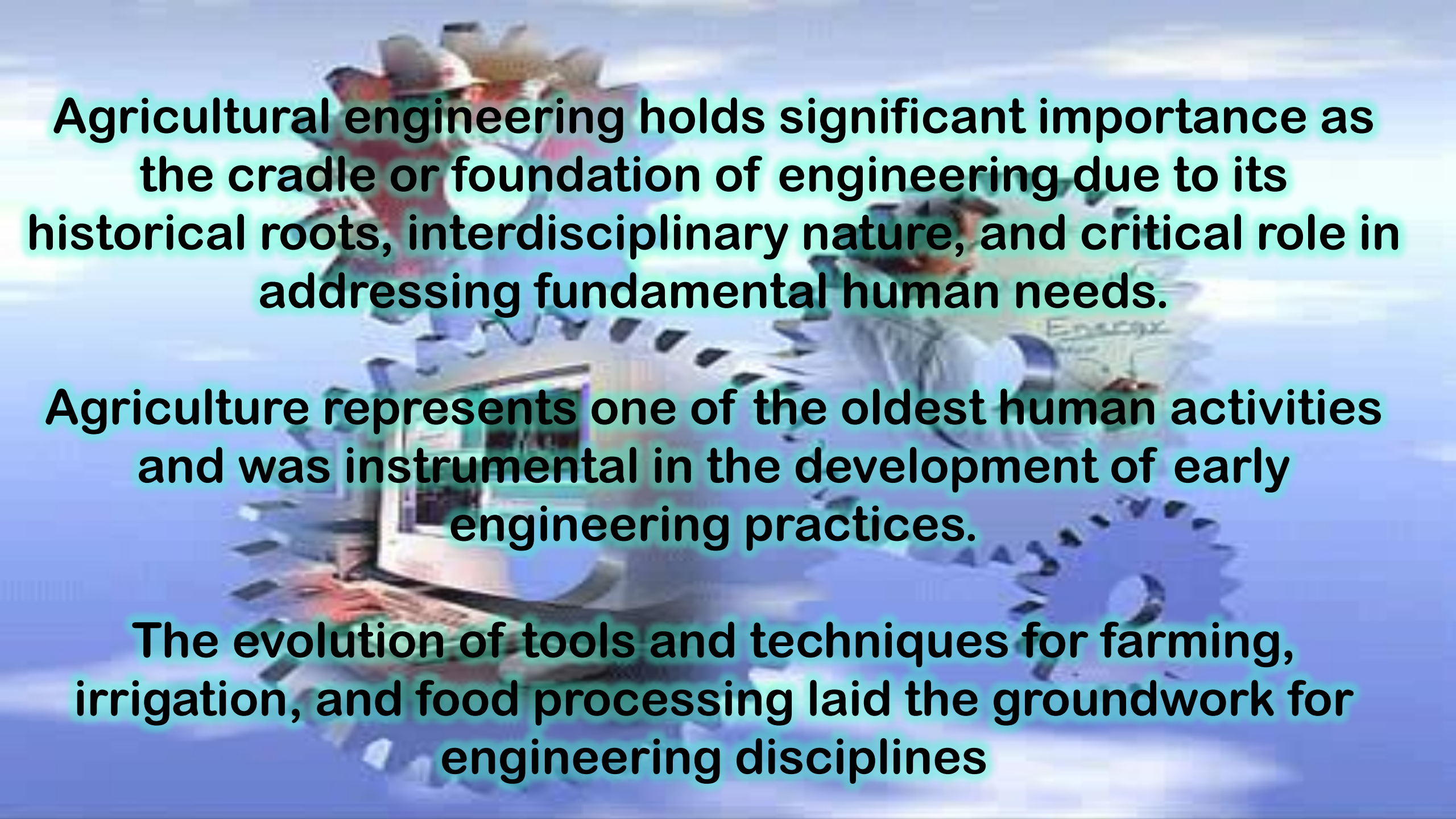

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI
Agricultural Engineering
XII
2025
1950

1950-2025

Celebrating 75 Years of Agricultural Engineering Excellence

Diamond  Jubilee

Past, present and future of Agriculture and Agricultural Engineering (globally and in South Africa)



Agricultural engineering holds significant importance as the cradle or foundation of engineering due to its historical roots, interdisciplinary nature, and critical role in addressing fundamental human needs.

Agriculture represents one of the oldest human activities and was instrumental in the development of early engineering practices.

The evolution of tools and techniques for farming, irrigation, and food processing laid the groundwork for engineering disciplines


Past

History of the World in 2 minutes

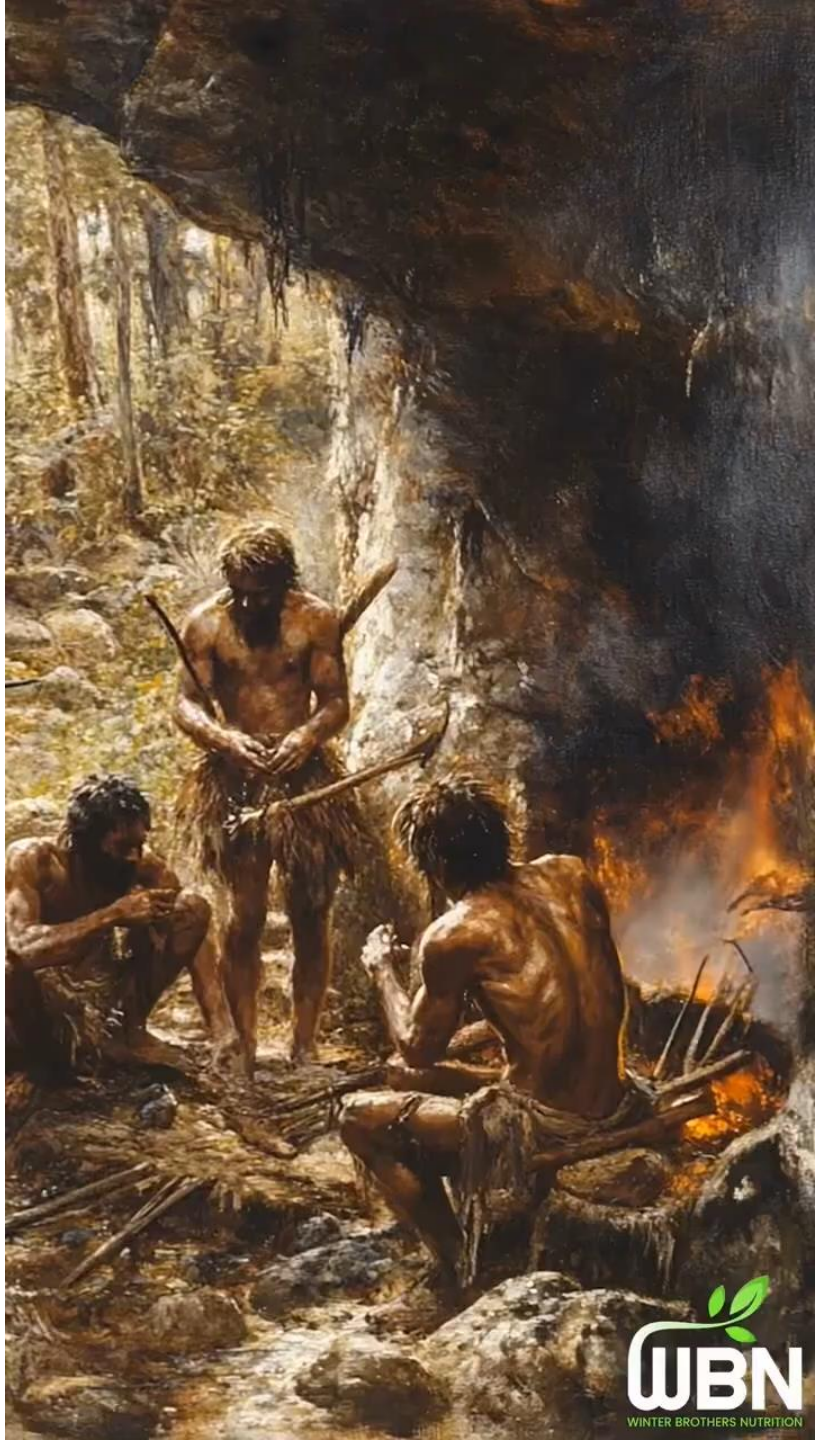
Agricultural Engineering

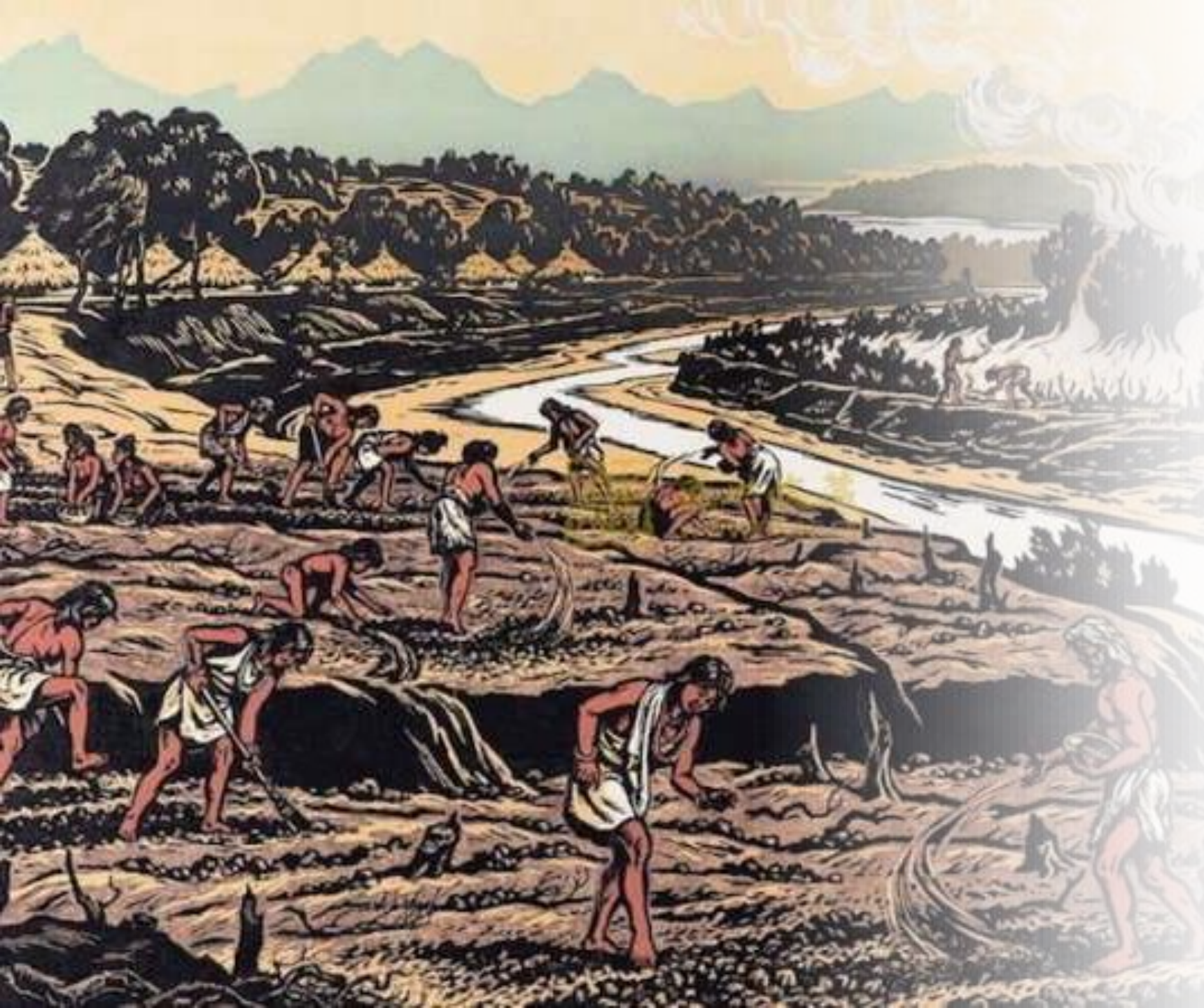
Ancient Beginnings:

Agriculture began independently in various parts of the world around 10 000 BCE during the Neolithic Revolution, transitioning humans from a nomadic hunter-gatherer lifestyle to settled farming communities.

Key developments include the domestication of plants and animals, the invention of irrigation, and later, the plow, which enabled the rise of civilizations, population growth, and more complex societies.

Significant innovations like crop rotation, selective breeding, and mechanization in the 18th century further increased agricultural productivity and continue to shape modern farming.





8000 BCE to 1890 AD

During this period, it was man`s innovative achievements and efforts to replace muscle-power by other forms of energy such as steam, water, wind, animals, etc.

Mesopotamia 6000BC

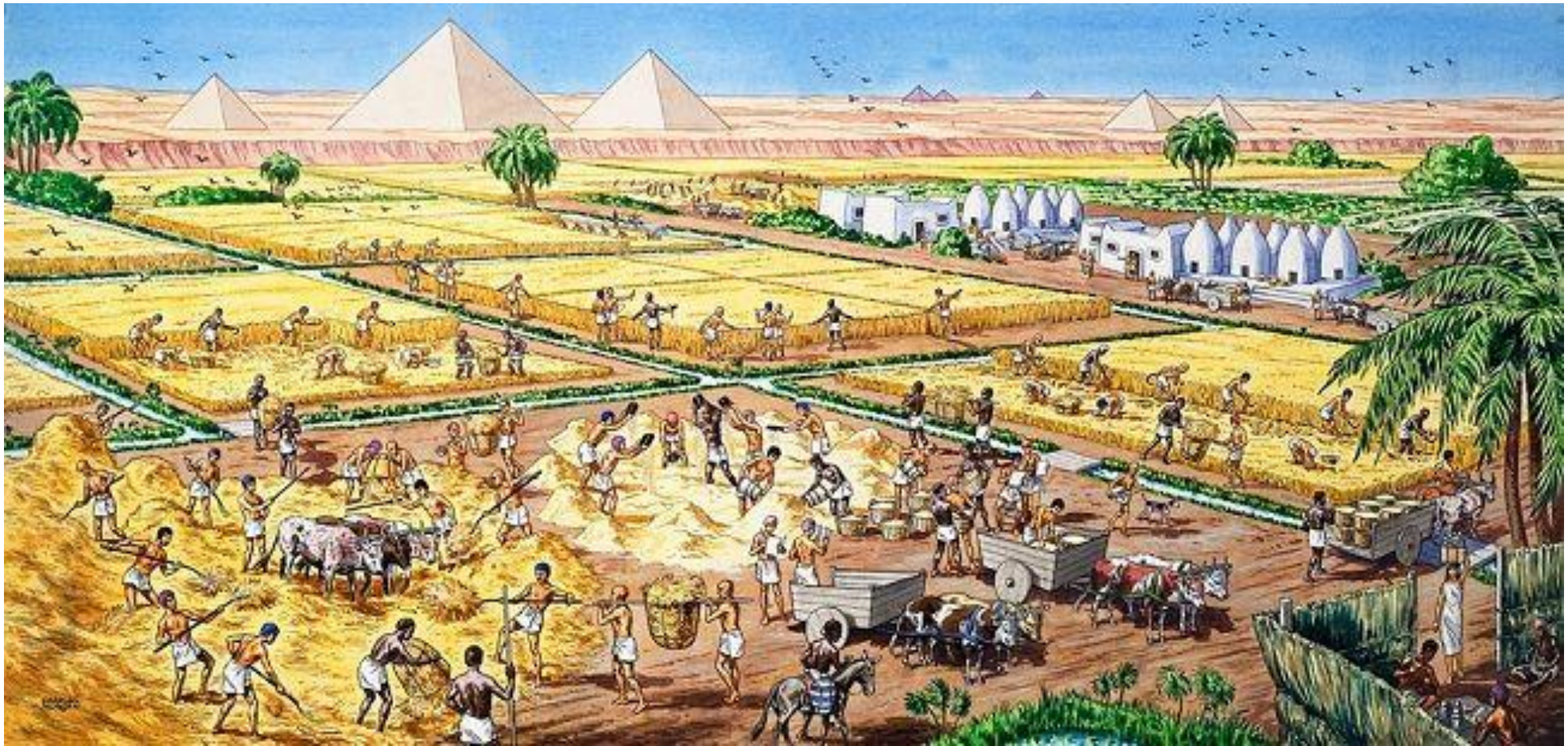
"The land between the two rivers"
also called
"The cradle of Western civilization"

The Birth of Irrigation

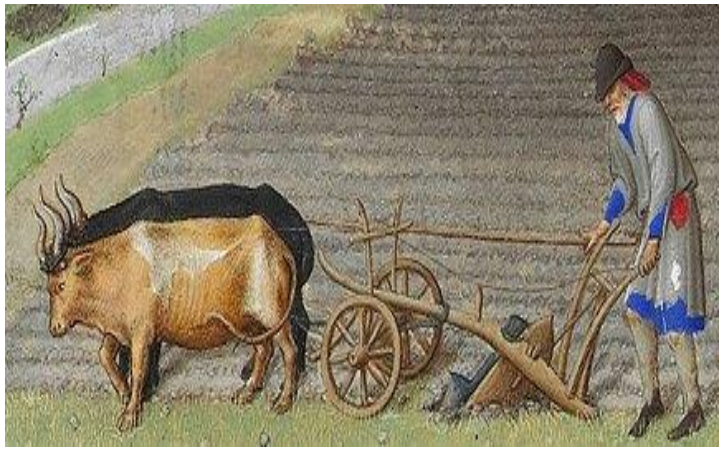
The earliest known irrigation systems date back to ancient Mesopotamia, around 6000 BCE.

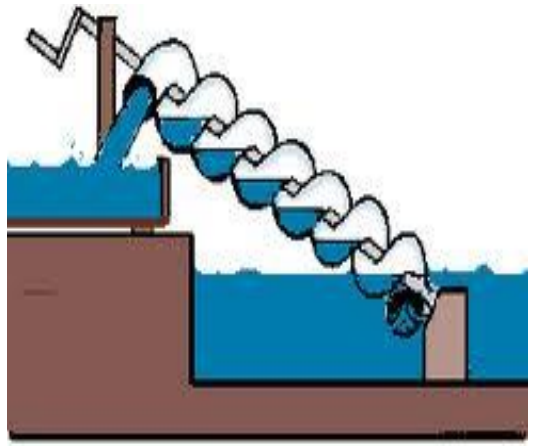
The Sumerians, living in the fertile crescent between the Tigris and Euphrates rivers, developed simple yet effective methods to channel water to their fields. Using a network of canals, dikes, and gates, they could control the flow of water, ensuring their crops received adequate water during dry periods.

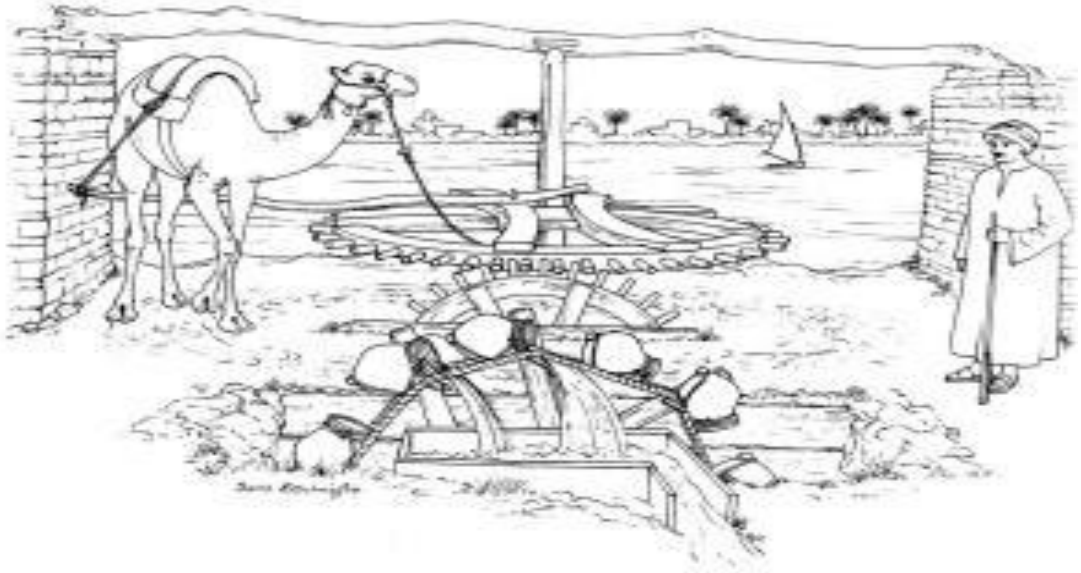
Similarly, in ancient Egypt, the annual flooding of the Nile River was harnessed through basin irrigation.
Farmers built earthen embankments to capture floodwaters, which then slowly seeped into the soil, nourishing crops.
This technique was instrumental in supporting the agricultural productivity that underpinned the rise of Egyptian civilization.

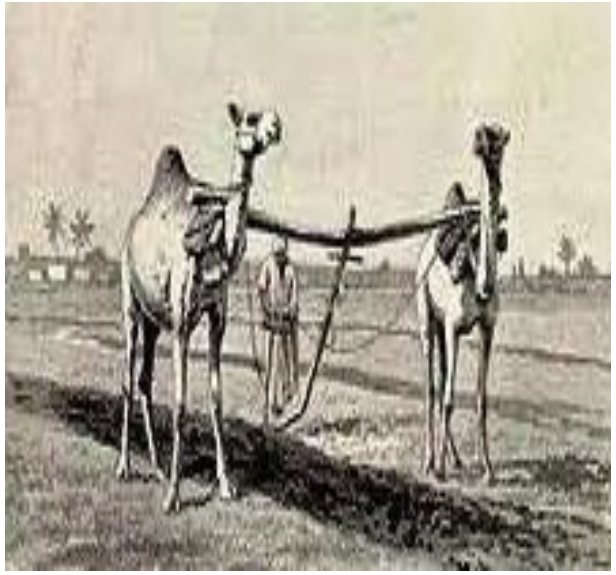


Ancient Egypt, 3000 BC







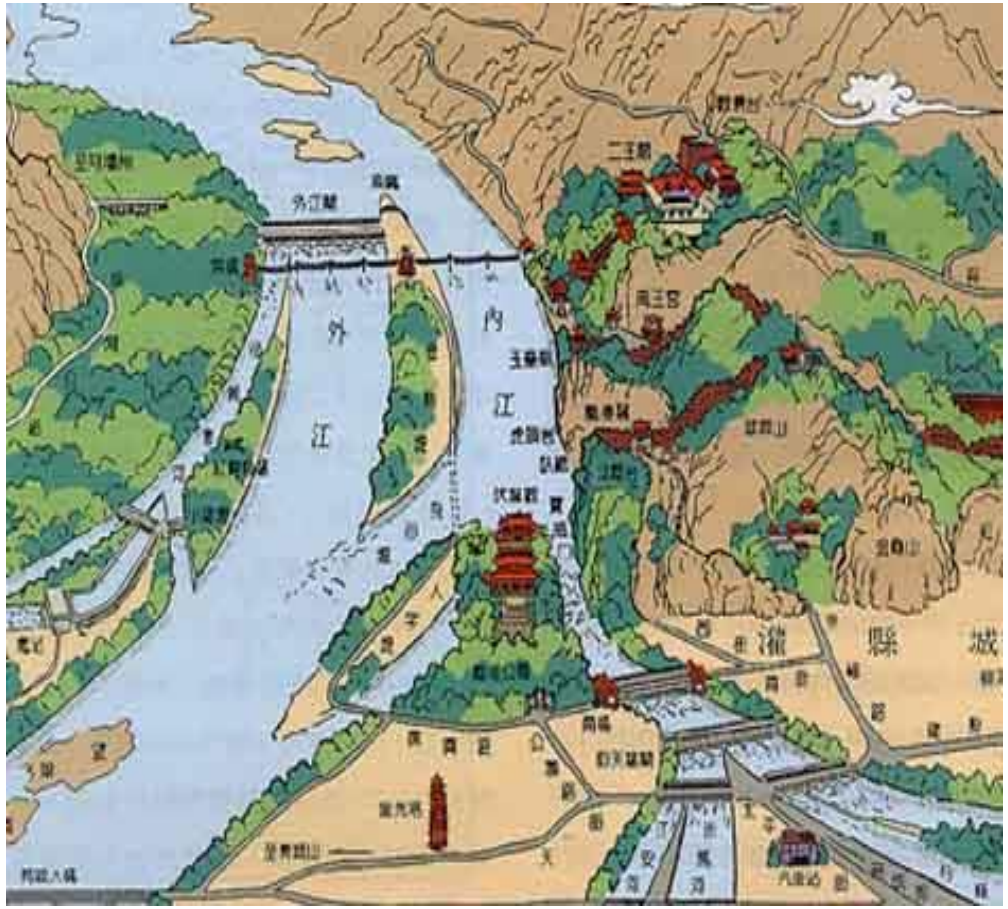


Human muscular and animal power were employed in harnessing the Nile

Pumping water for flood irrigation

This water propelled water wheel or SAKIA could "lift" water 10m to the aquaduct to flood irrigate wheat fields

Ancient China,3000 BC



Irrigation schemes equipped with innovative technologies

Agricultural techniques in Biblical times 2000 BC

Grapes were trampled by foot to extract the juice

A typical olive oil press in Israel driven by humans or animals

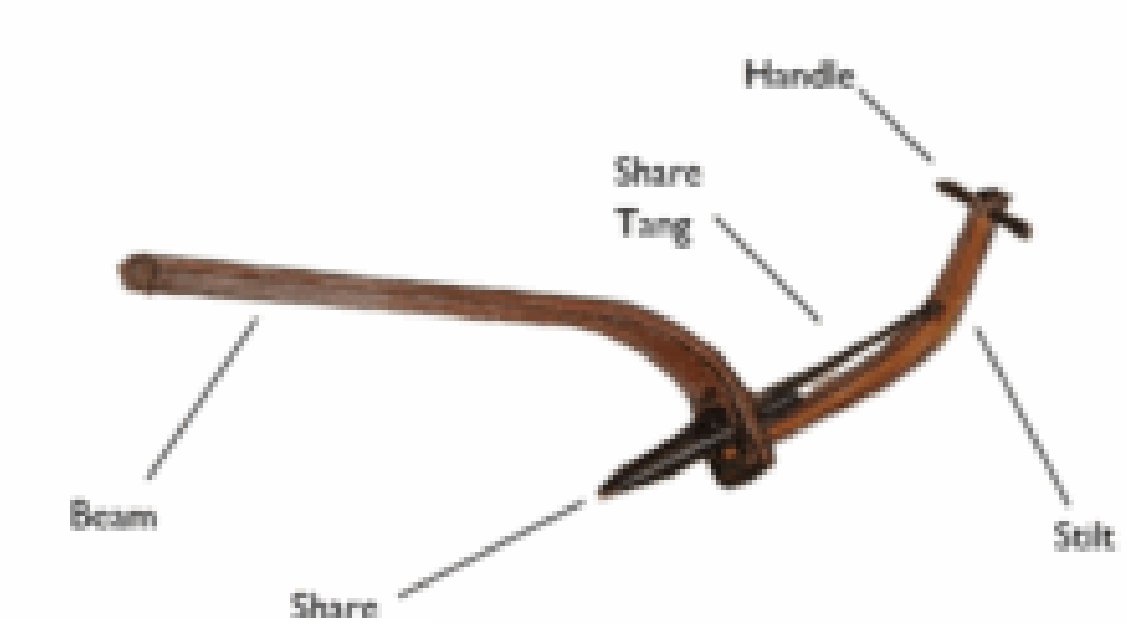
Grain grinding by women

A women weaver making cloth of flax (linen) or wool

Ancient origins and early mechanization

- **Neolithic Age (8000–4000 BC):** The invention of fundamental agricultural tools allowed early societies to shift from hunting and gathering to settled farming.
  - **Plow:** The earliest versions, dating from before 5000 BC, were forked sticks used to scratch trenches for planting. Animal domestication, particularly oxen around 4000 BC in the Indus Valley, enabled more efficient tilling.
- **Bronze and Iron Ages (3500–600 BC):** Metalworking improved agricultural tools, making them more durable and effective.
  - **Iron Plow:** Developed in China around 475 BC, the iron plow enabled cultivation in previously unworkable, clay-based soils.
  - **Animal power:** The use of draft animals like oxen became the primary method for tilling by 1500 BC.

The Development of the Plough in Britain – Stone Age to Iron Age



The Industrial Revolution: Steam and automation

The Industrial Revolution in the 19th century brought steam power and new automated machinery, revolutionizing agriculture.

- **Steam power (1800s):** Early in the century, portable steam engines were used to power farm machines like threshers. By mid-century, steam traction engines were pulling plows across fields.
- **Mechanical reaper (1831):** American inventor Cyrus McCormick patented the mechanical reaper, which greatly increased the speed of harvesting grain and reduced the required labor.
- **Combine harvester (1830s):** Hiram Moore patented the first combine harvester in the U.S. in 1834. This machine integrated the functions of reaping, threshing, and winnowing into a single process.
- **Steel plow (1837):** John Deere developed the first steel plow, which was far stronger than its iron predecessors and could handle tough Midwestern soils in the U.S..

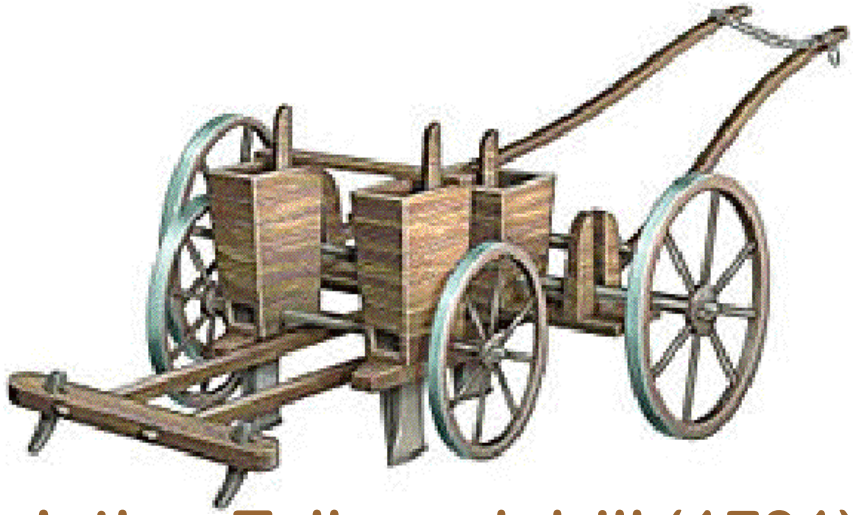
The Industrial Revolution in England was the movement in Britain from about 1750, in which machines changed people`s way of life as well as their methods of manufacture.

The most important changes were:

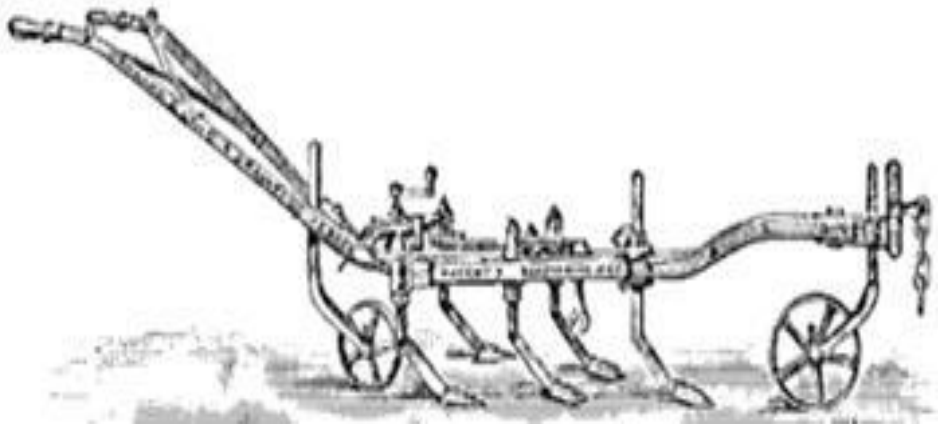
1. **the invention of machines to do the work of human hands and hand tools;**
2. **the use of steam and later of other kinds of power/energy to replace the muscles of human beings and animals;**
3. **the adoption of the factory system to manufacture goods swiftly by the process of mass production by industrialization and**
4. **a growing interest in**

original scientific and engineering inventions.

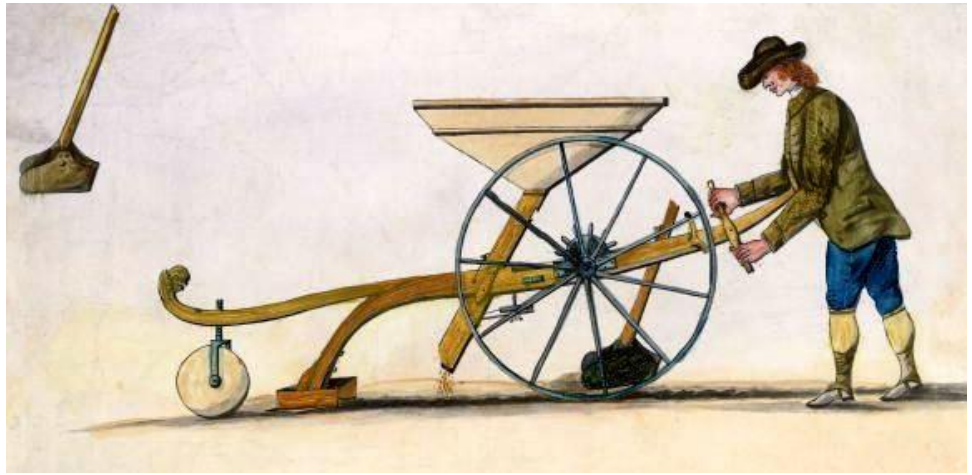
Examples of the newly innovated agricultural machines in England



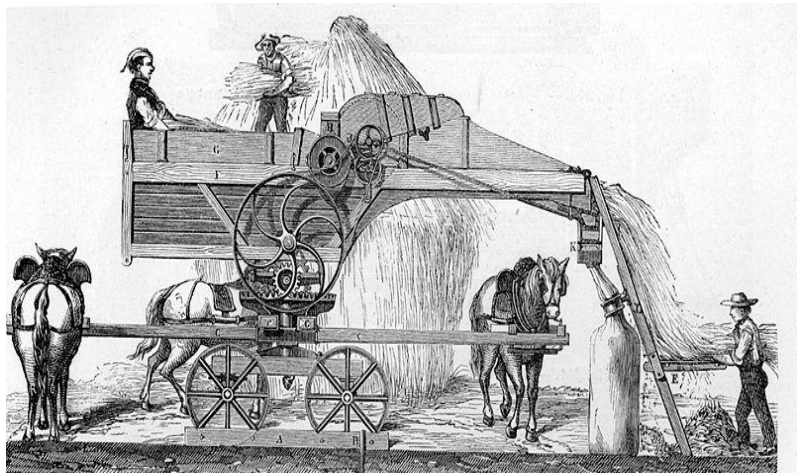
Jethro Tull seed drill (1701)



Jethro Tull horse-drawn hoe

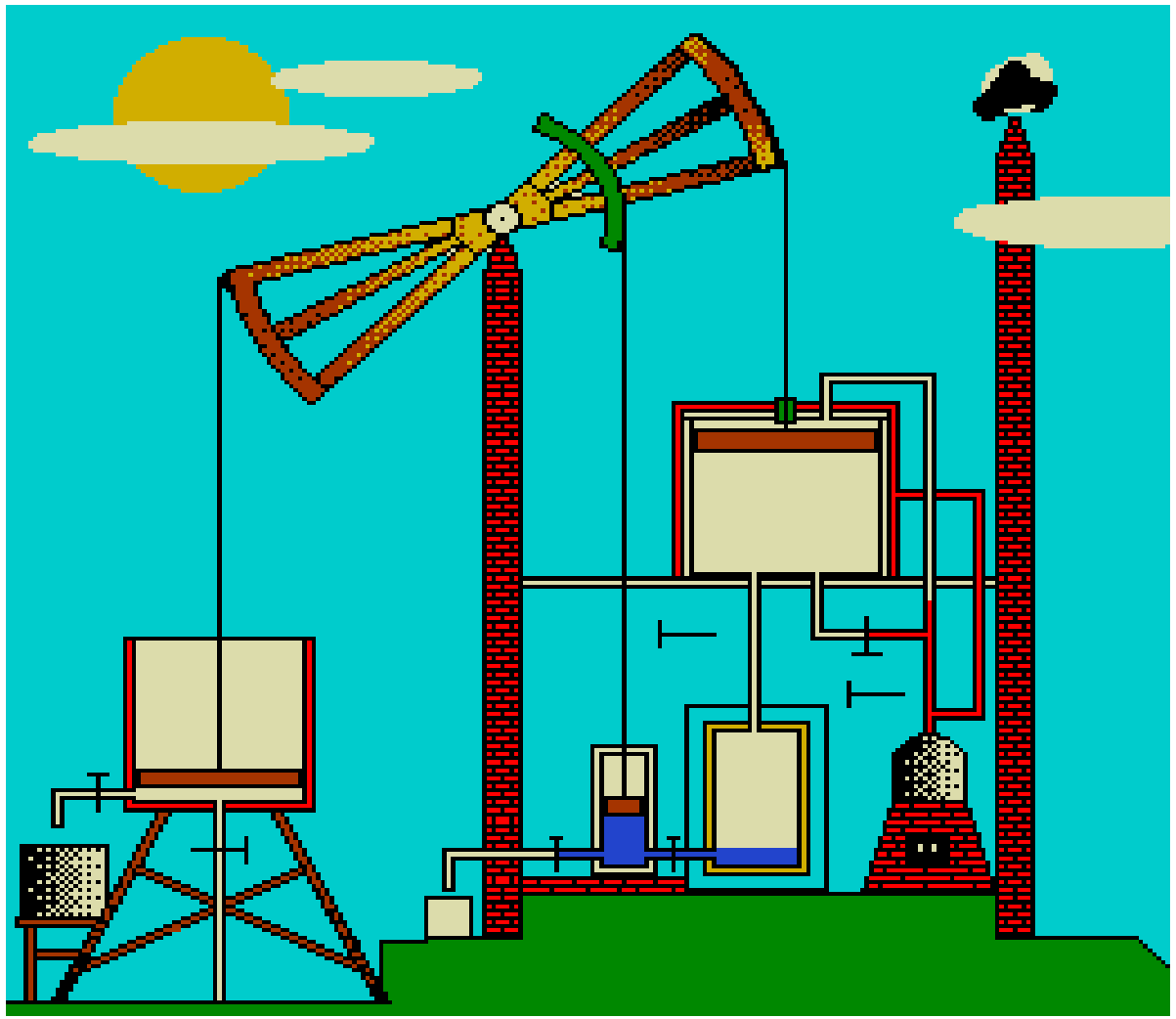


Rotherham iron plough (1730)

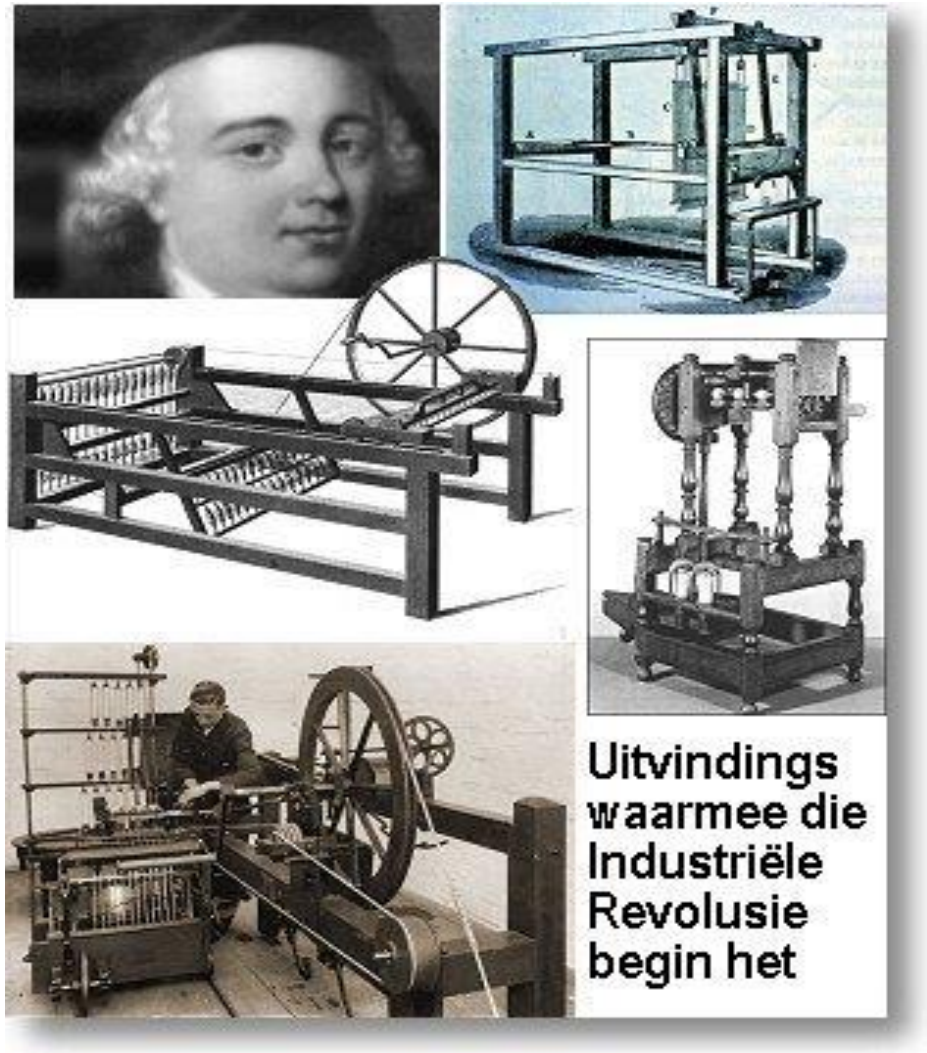


Andrew Meikle`s horse-drawn threshing machine

Important inventions during the Industrial Revolution in England

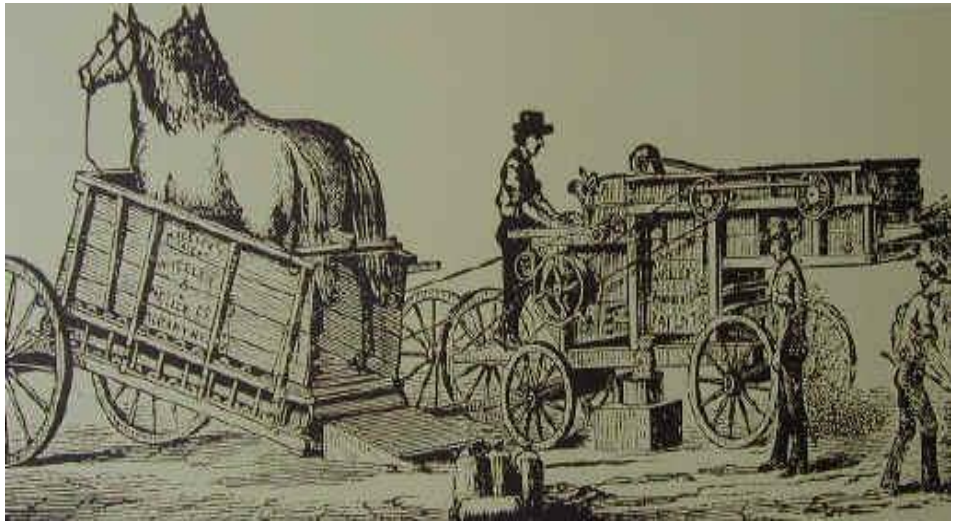


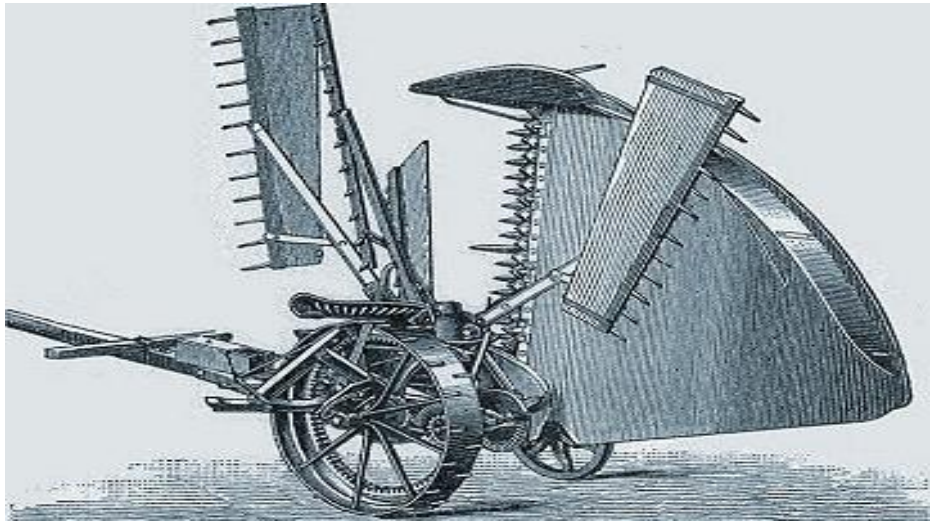
Newcome's steam engin
pump water out of mines (1705)



The jenny, roller frame and mule
to spin cotton thread (1779)

In the period from ± 1840-1900, many new agricultural machinery appeared in England, the USA and Europe, such as:

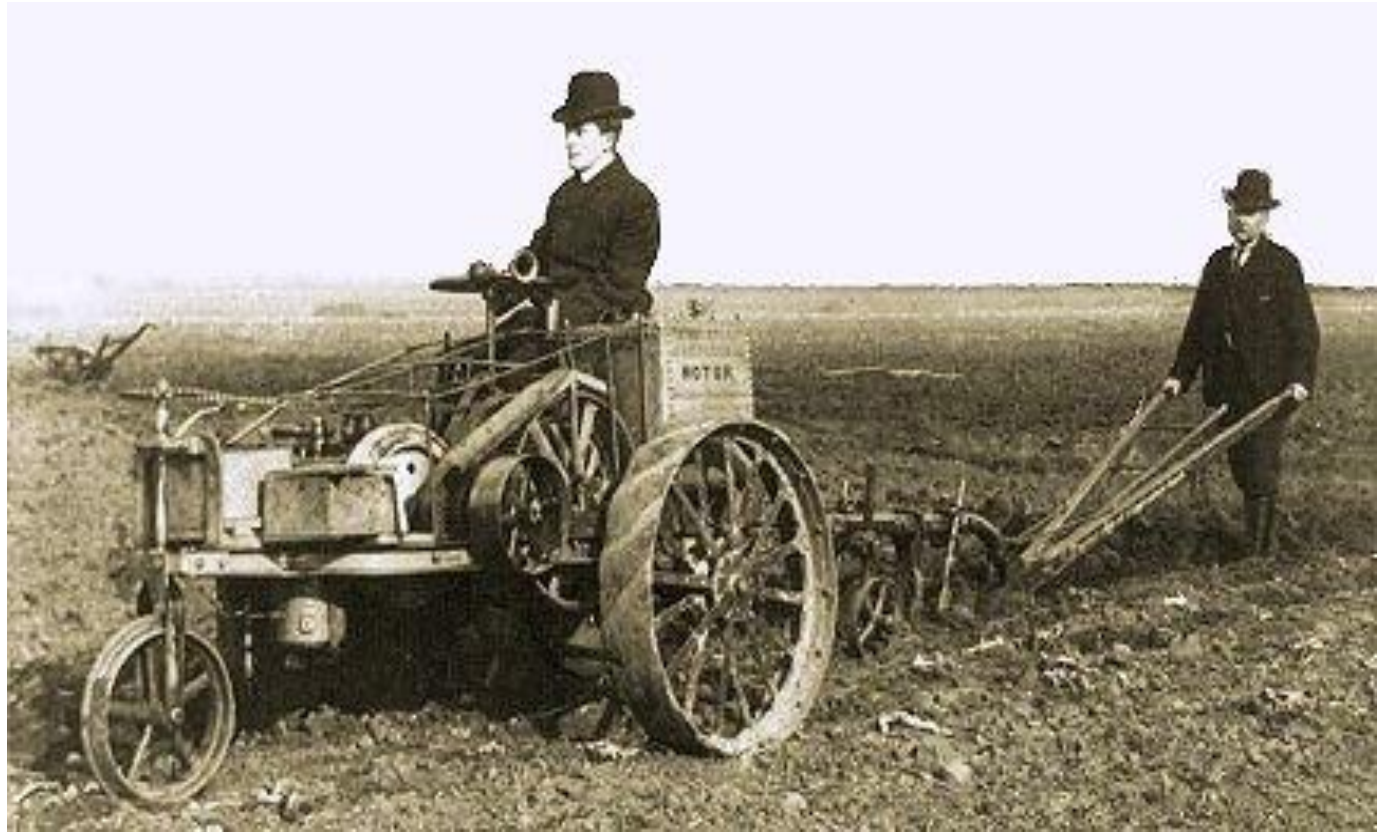




1840:Cyrus Mc Cormick`s horse drawn thresher and mower/reaper

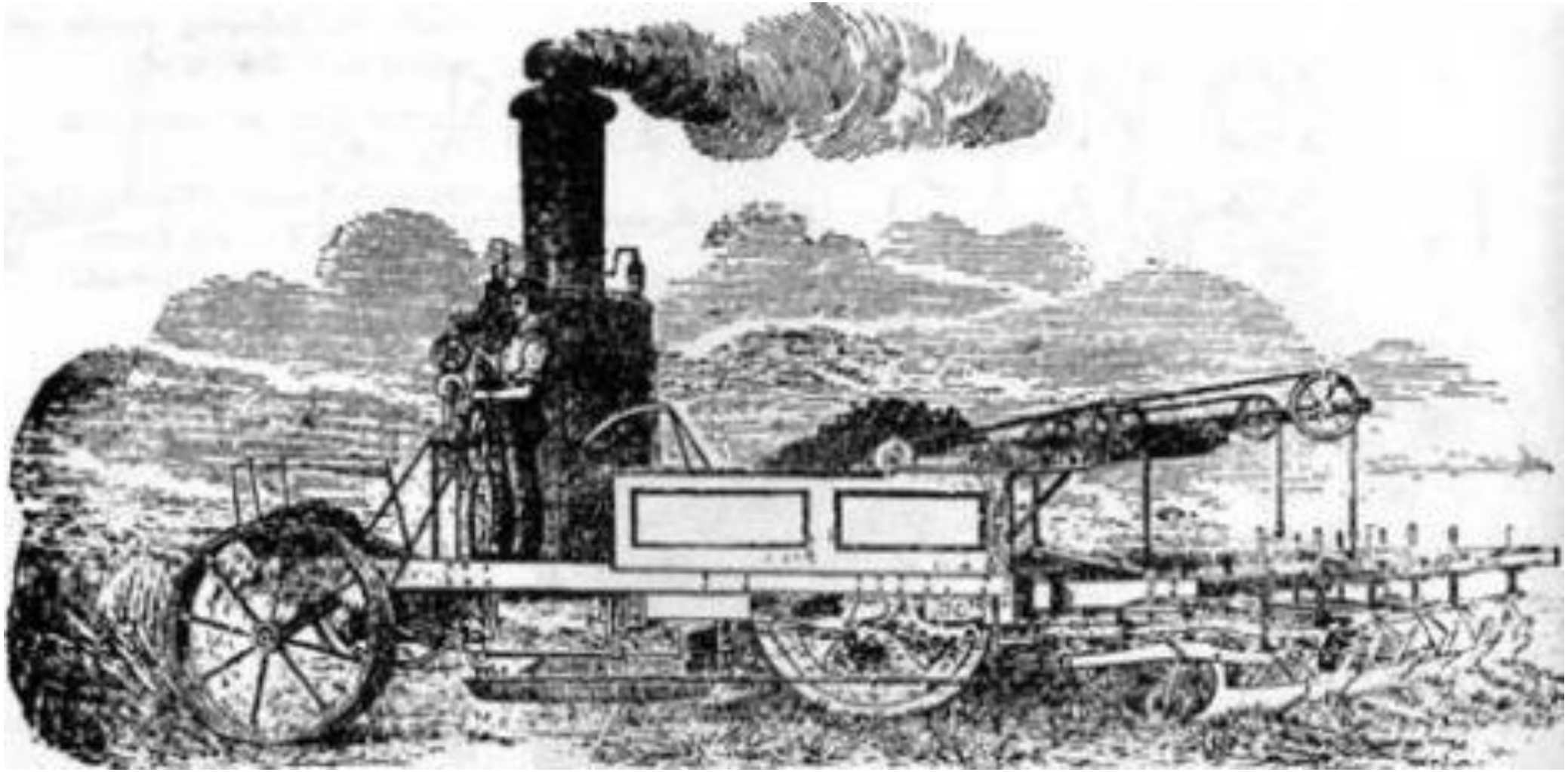
Steam driven threshing machines

Examples of large scale agricultural mechanization in Britain, USA, Canada and European countries

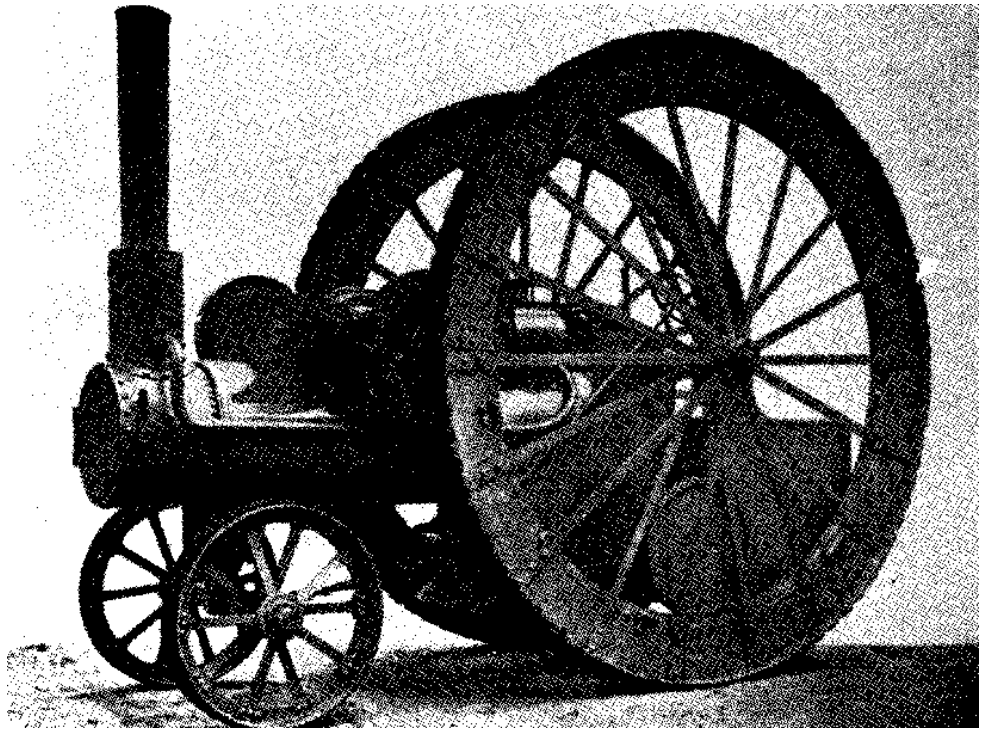


Tractors and pull type implements in action!

In 1858 J.W. Fawkes built the first steam engine that could pull 8 ploughshares at 5 km per hour in fallow land.

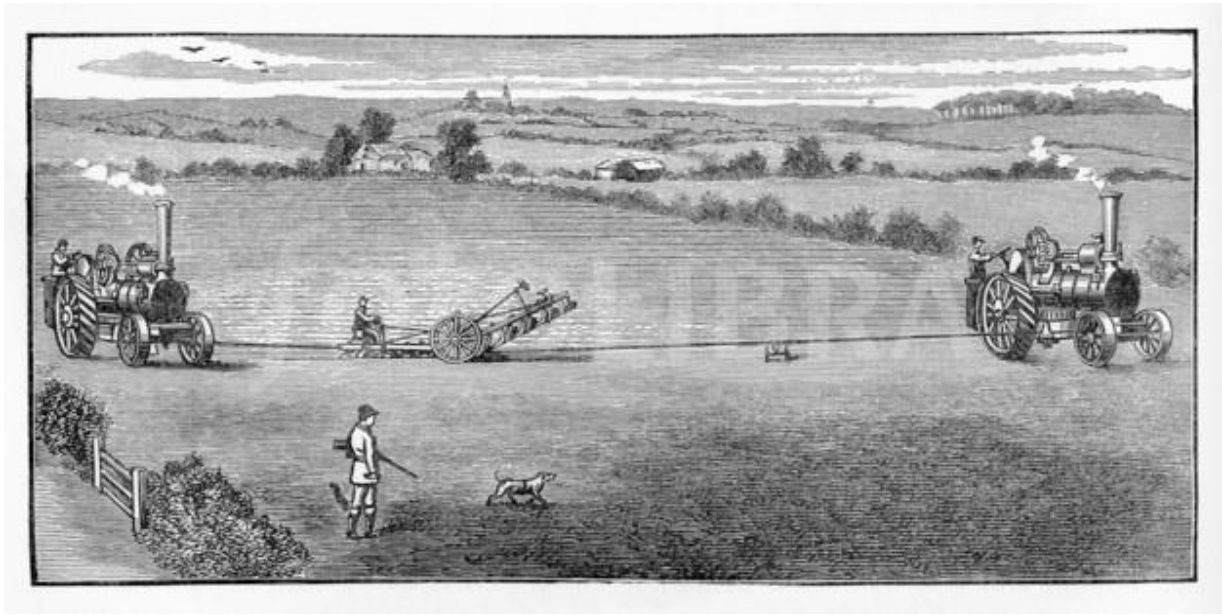


The John Fowler steam tractors



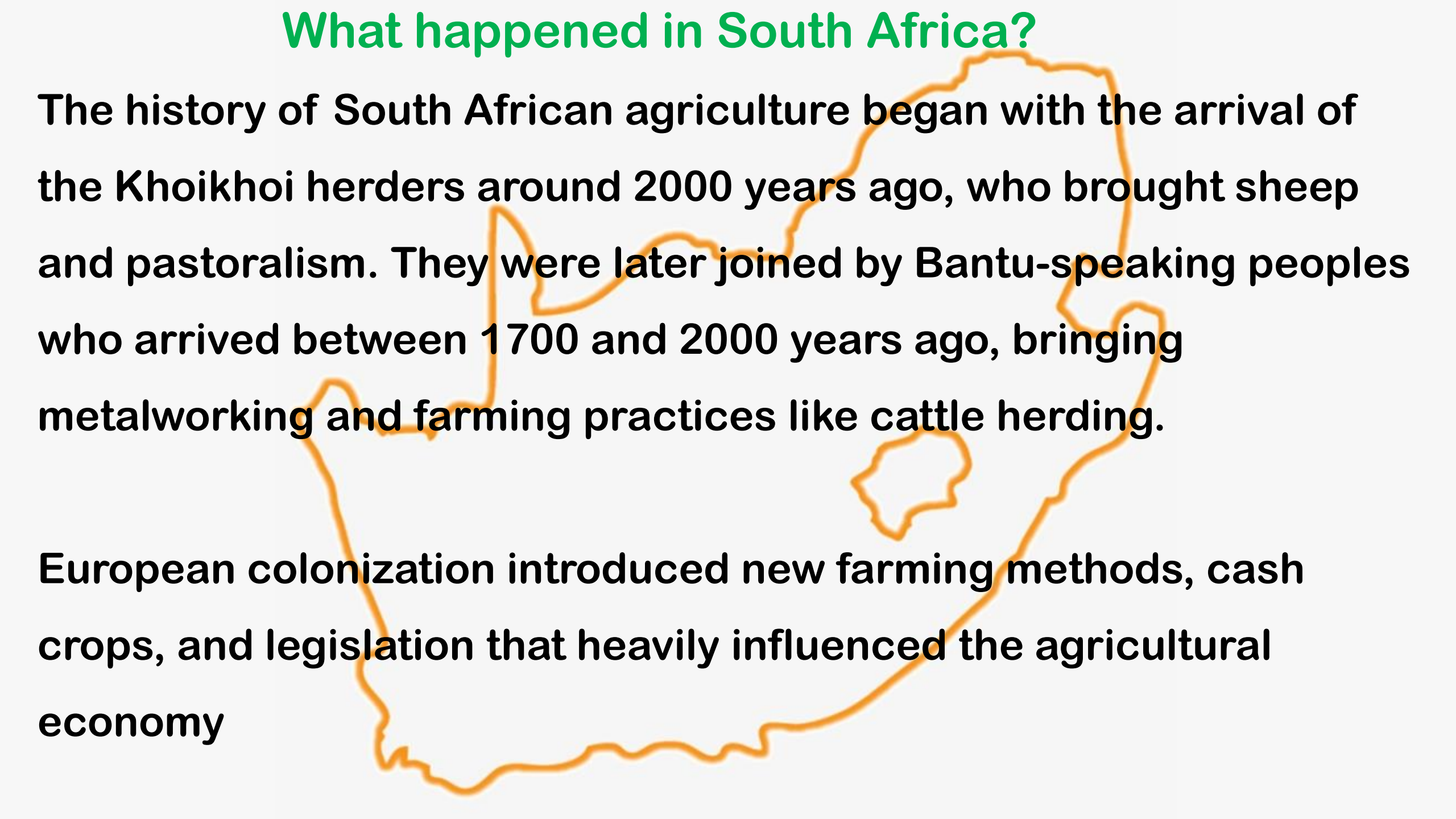
1884:Equipped with
4m diameter rear wheels

1888: Cable plowing machine



Plowing simultaneously with
two engines Capacity=25 ha per day

What happened in South Africa?



The history of South African agriculture began with the arrival of the Khoikhoi herders around 2000 years ago, who brought sheep and pastoralism. They were later joined by Bantu-speaking peoples who arrived between 1700 and 2000 years ago, bringing metalworking and farming practices like cattle herding.

European colonization introduced new farming methods, cash crops, and legislation that heavily influenced the agricultural economy

With the settlement at the Cape in 1652, the Dutch and the French Huguenots brought their European agricultural technological knowledge to South Africa, such as:-

Vineyard and wine production

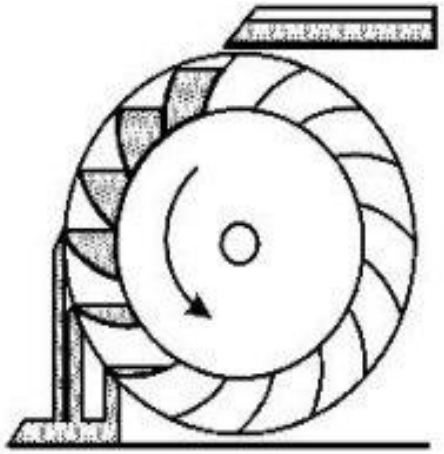
Grain production

Dairy farming

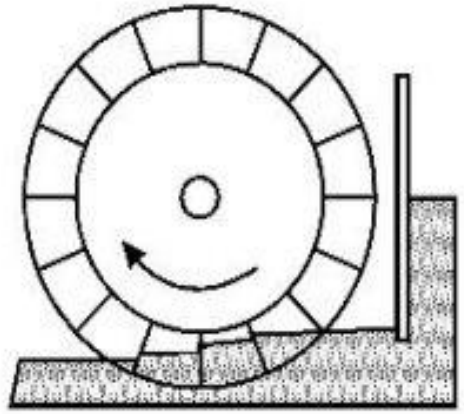
Wagon making and repairs

Horse-driven mills were imported from Holland in 1657 and later converted into water driven mills.
By 1870 there were 110 such mills in the Malmesbury and Picketberg districts.

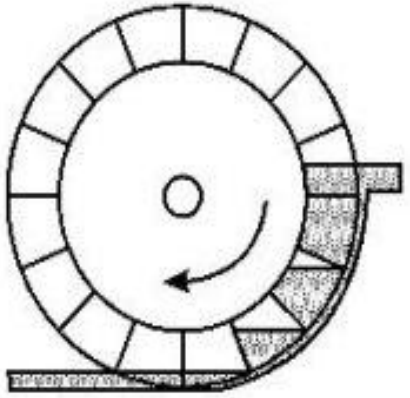
Various types of water wheels to power mills and bucket pumps, to lift water from wells, were used in the Cape



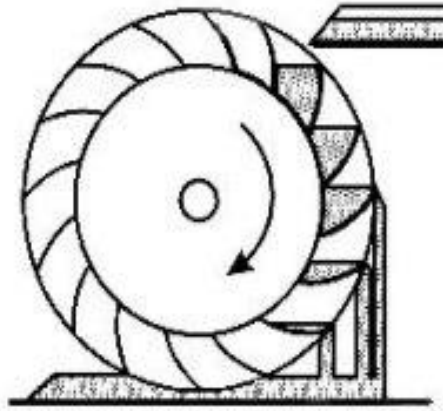
Overshot



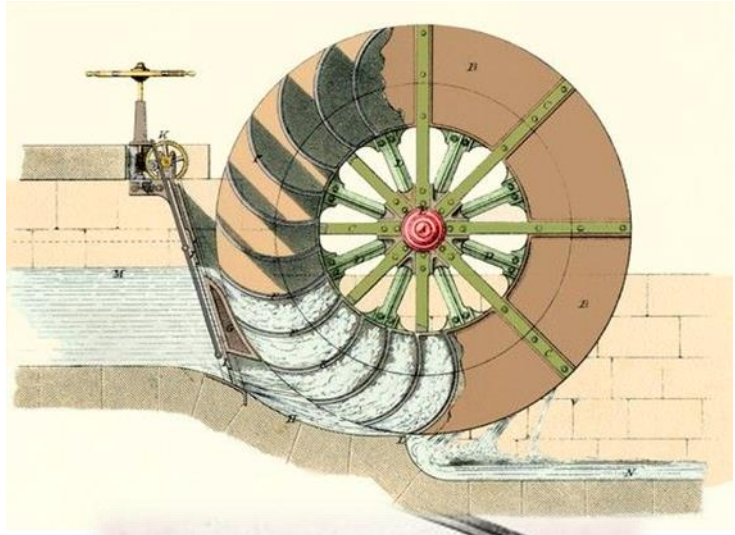
Undershot

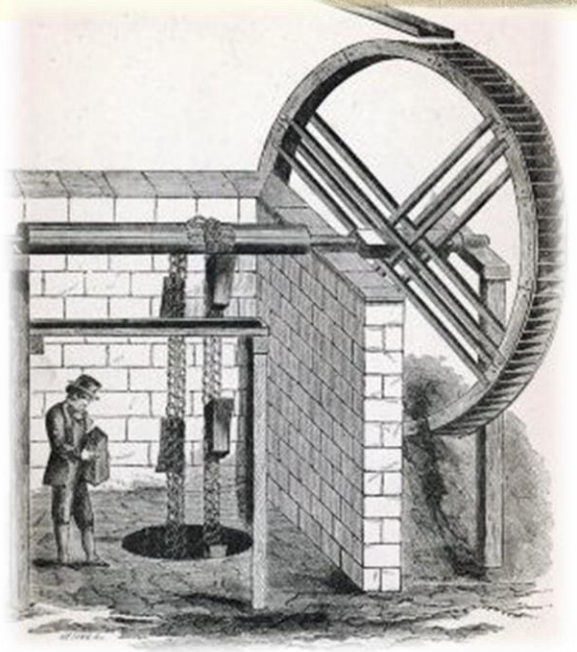


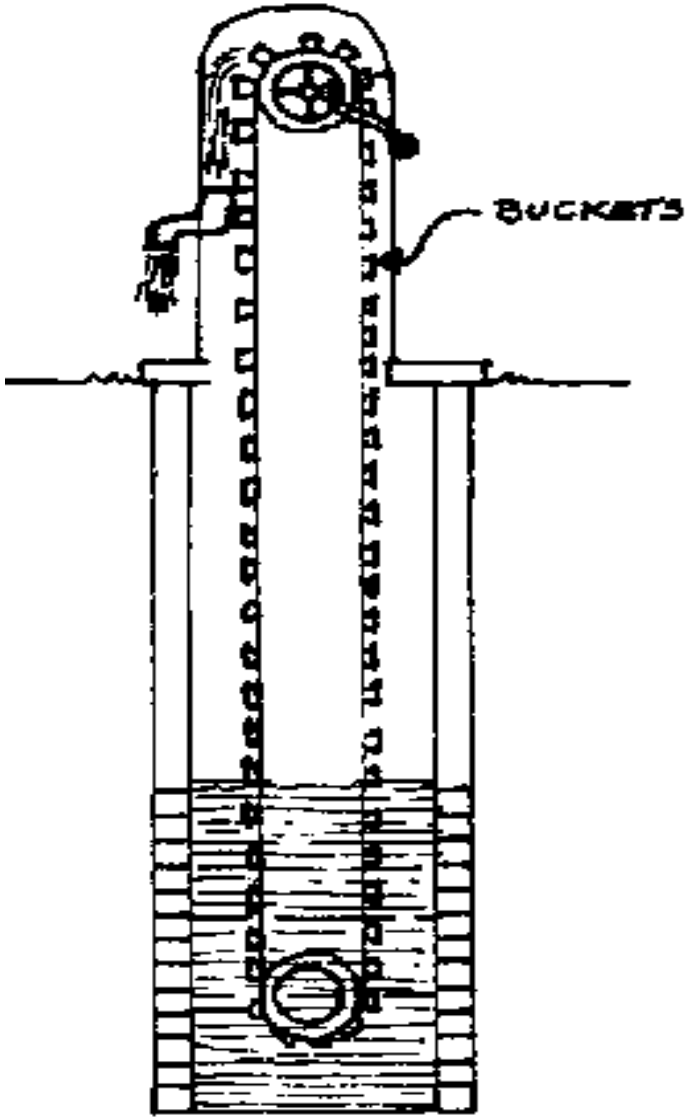
Breastshot



Pitchback







Before the Great Trek in 1838, farmers in the Cape Colony made extensive use of animal draft power and labour on farms.

After the discovery of diamonds and gold (1870-1890) the mines started to import mining equipment.

Railway lines were erected and steam locomotives were imported.

Steam, diesel, petrol/paraffin, trucks were imported.

Also motor cars and tractors were imported.

So, after the Anglo Boer War in 1902 and Unification in 1910 an

INDUSTRIAL and AGRICULTURAL REVOLUTION

also followed in this country with very severe and unique problems for the agricultural sector.

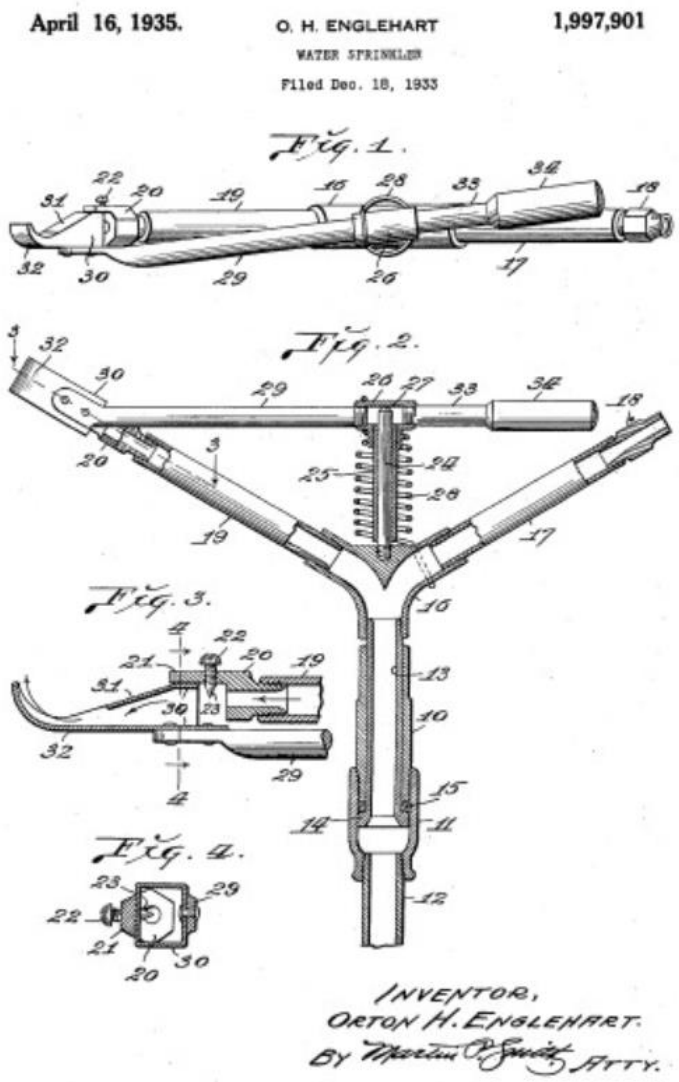
The 20th century: Internal combustion and early electronics

The 20th century saw the widespread adoption of the internal combustion engine and the first uses of electronics in farming.

- **Gasoline-powered tractor (1892):** John Froelich built the first gasoline-powered tractor.
- **Mass production (1917):** Henry Ford's mass-produced Fordson tractor made the technology affordable for many farmers.
- **Diesel engines:** Starting in the mid-20th century, diesel engines began replacing gasoline-powered ones, offering greater power and efficiency.
- **Hydraulics:** The development of hydraulic systems further enhanced tractor capabilities, enabling the use of more sophisticated implements.
- **Precision agriculture (1990s):** The integration of Global Positioning Systems (GPS) and computer technology enabled early forms of precision agriculture, allowing for more targeted application of seeds, fertilizers, and pesticides.


1800
Wooden Plow
ATTRIBUTES
TYPE: HORSE-DRAWN PLOW
POWER: 1 HP
CUT WIDTH: 0.3 M
CAPACITY: 0.1 HA/H

In 1935 Orton Englehart invents the first impact sprinkler to water his orange groves in Glendora, California.



April 16, 1935. O. H. ENGLEHART 1,997,901

WATER SPRINKLER

Filed Dec. 18, 1933

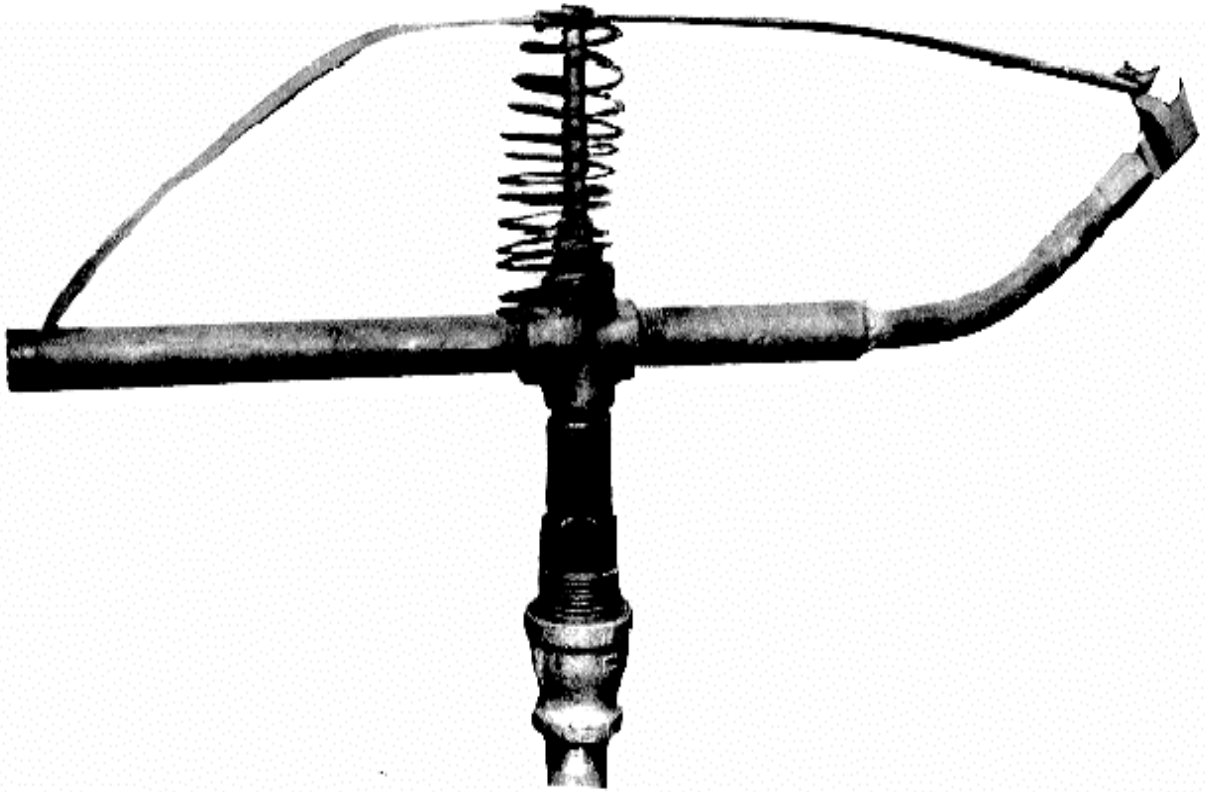
Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

INVENTOR,
ORTON H. ENGLEHART.
BY Martin P. Smith ATTY.



July 22, 1952 F. L. ZYBACH 2,604,359

SELF-PROPELLED SPRINKLING IRRIGATING APPARATUS

Filed June 27, 1949 3 Sheets-Sheet 1

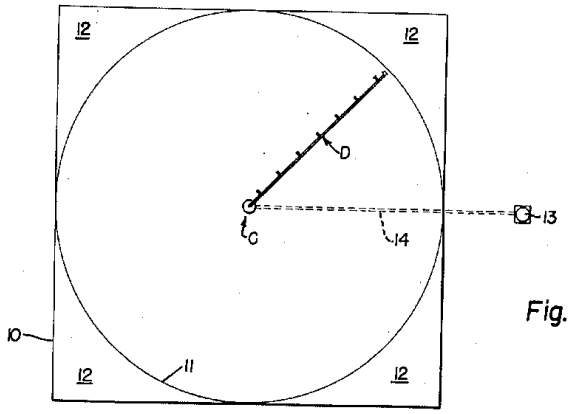


Fig. 1

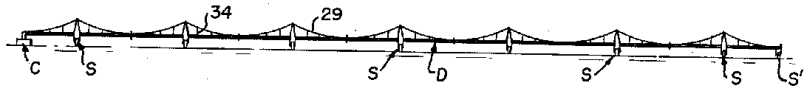


Fig. 2

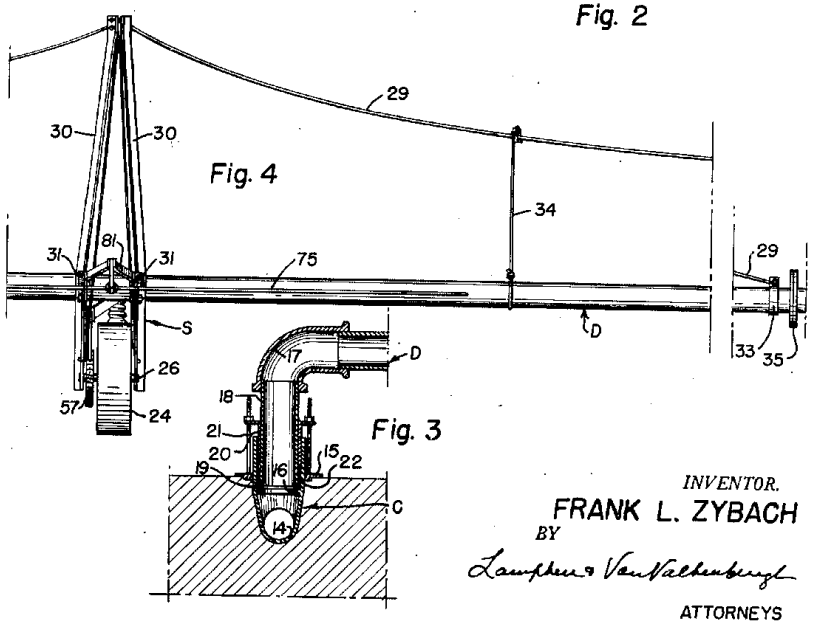
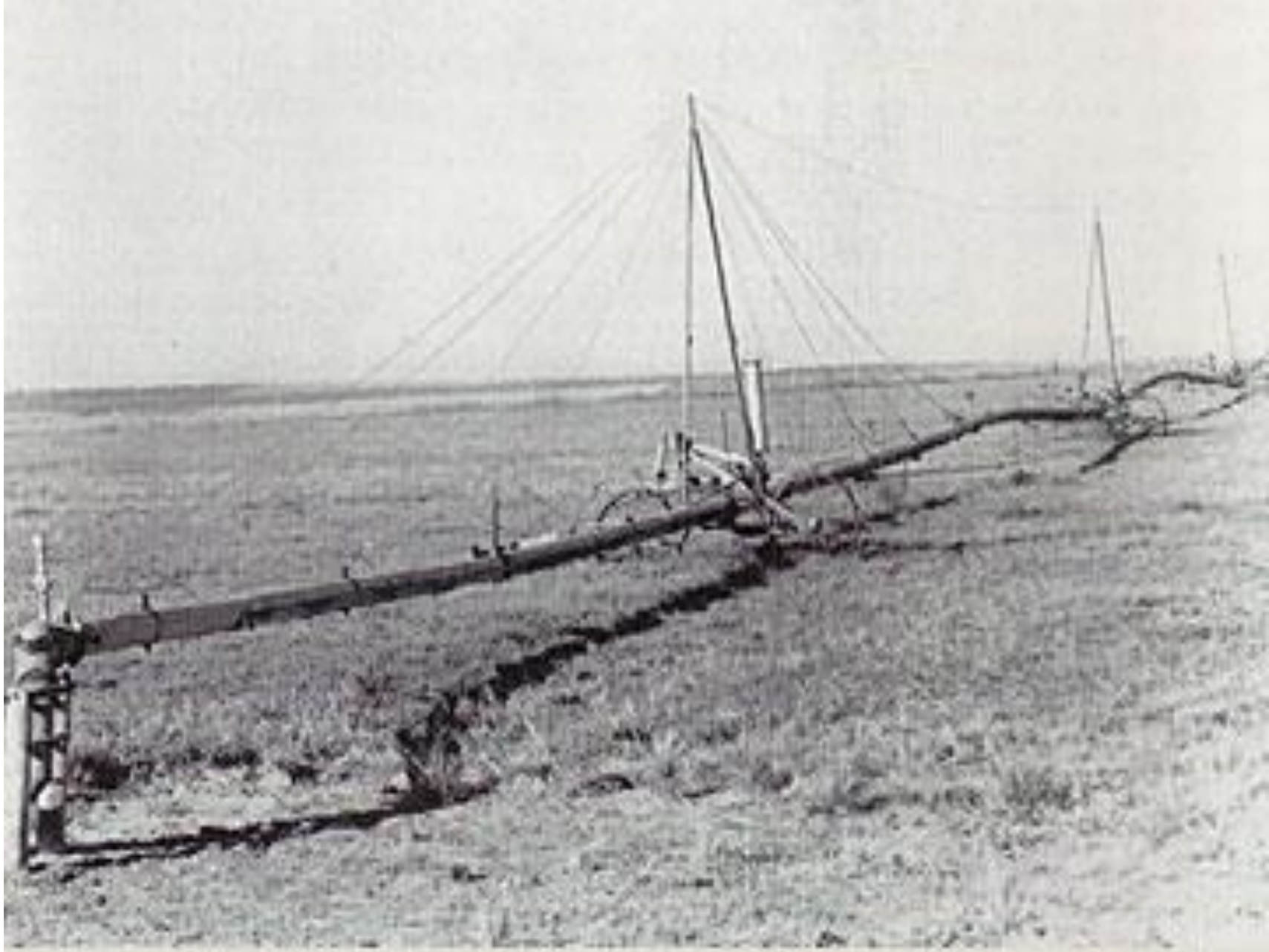


Fig. 4

Fig. 3

INVENTOR.
FRANK L. ZYBACH
BY
Lauphen & VanValkenburgh
ATTORNEYS



Frank Zybach's first center-pivot irrigation system, near Strasburg, Colorado. He started with a low pipe that was later raised to run over corn fields. UNL.

History of the Pivot in the World

Centre Pivot irrigation

Areas under irrigation

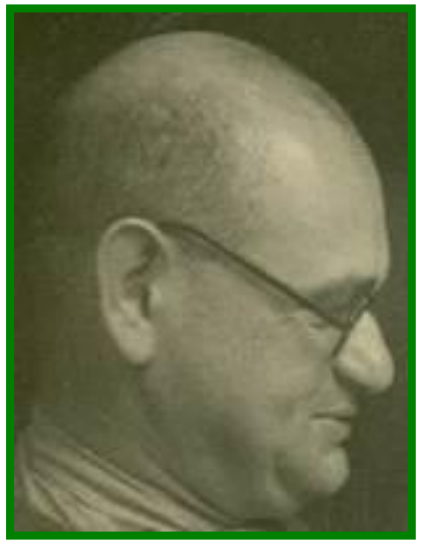
- All types of irrigation in the world — 300 x 10^6 ha
- Centre Pivot irrigation in the world — 21 x 10^6 ha

Number of centre pivots

Total in use in the world		500 000
With the:	USA	200 000
	Brazil	33 000
	USSR	30 000
	South Africa	28 000
	Saudi Arabia	20 000

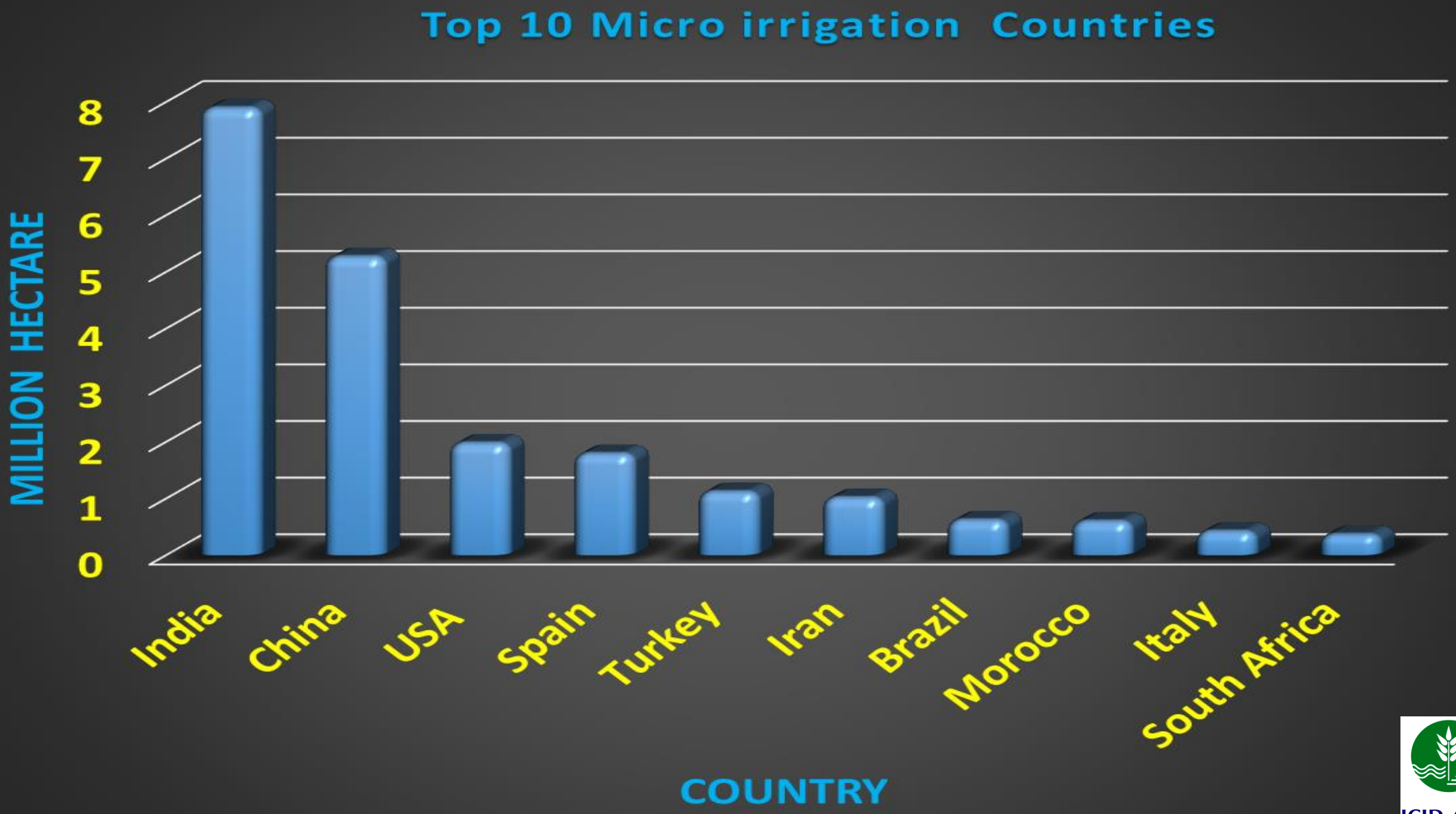
In 1959, a new technology of drip irrigation was introduced in Israel by Simcha Blass and his son Yeshayahu where they developed and patented the first practical surface drip irrigation emitter

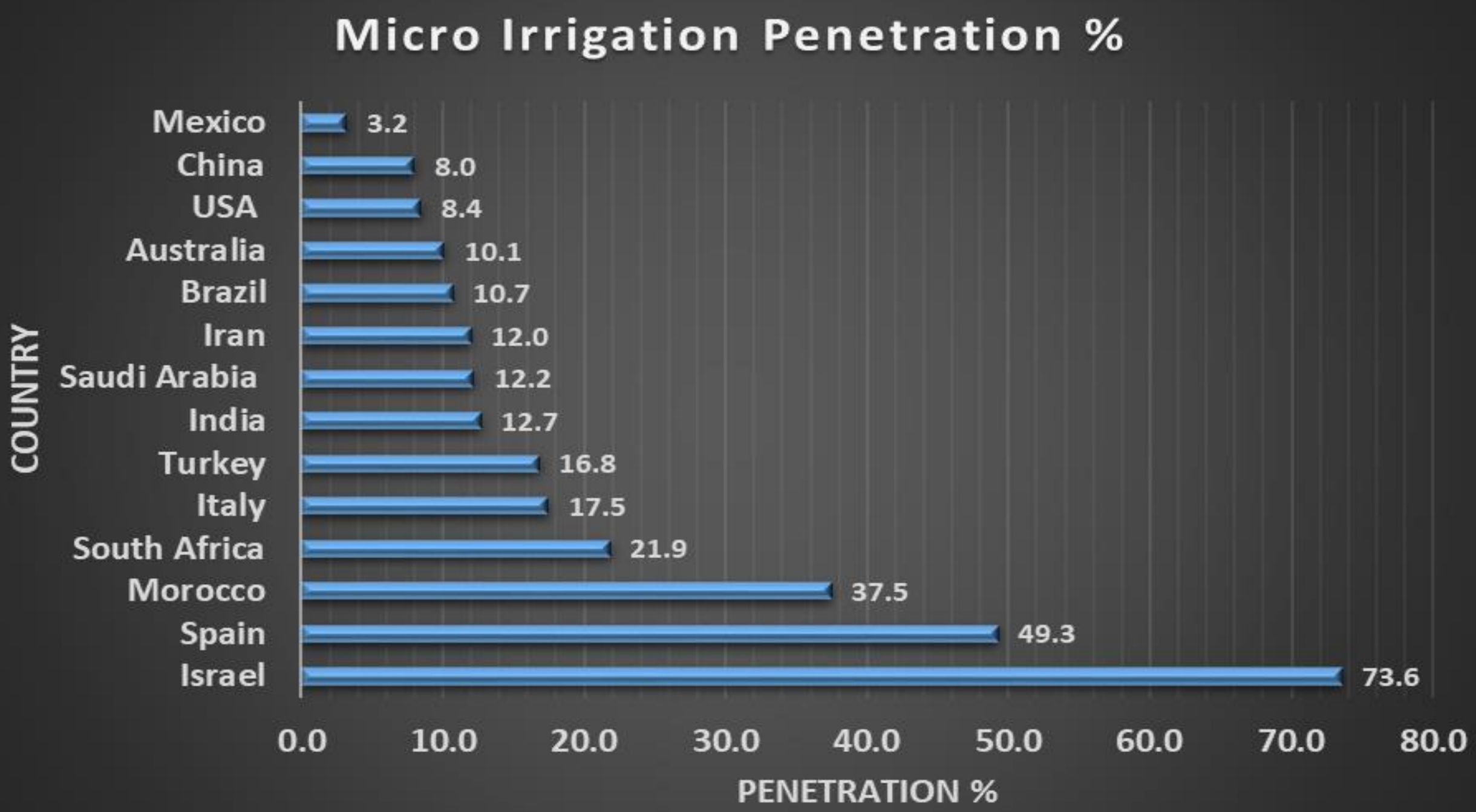
Drip Irrigation Evolution



Simcha Blass

Courtesy of Netafim SA


Top 10 Micro irrigation Countries
MILLION HECTARE
0
1
2
3
4
5
6
7
8
India
China
USA
Spain
Turkey
Iran
Brazil
Morocco
Italy
South Africa
COUNTRY


Micro Irrigation Penetration %
COUNTRY
Mexico
China
USA
Australia
Brazil
Iran
Saudi Arabia
India
Turkey
Italy
South Africa
Morocco
Spain
Israel
3.2
8.0
8.4
10.1
10.7
12.0
12.2
12.7
16.8
17.5
21.9
37.5
49.3
73.6
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
PENETRATION %

Historical Evolution of Agricultural Engineering

The history of agricultural engineering dates back to ancient times, with early applications including the introduction of irrigation systems in large-scale agriculture along the Nile and Euphrates rivers before 2000 BCE Over the centuries, agricultural engineering has evolved significantly, driven by technological advancements and the need for increased food production.

"The development of agricultural engineering has been pivotal in transforming agricultural practices, from simple tools to complex machinery and sophisticated irrigation systems.“

The industrial revolution marked a significant turning point, with the introduction of mechanized farming equipment and the development of more complex irrigation systems. In the 20th century, the advent of **precision agriculture** and the use of computers and sensors further transformed the field.

Agricultural engineering as a degree is a relatively new profession whose organised origin is the United States with 115 years ago.

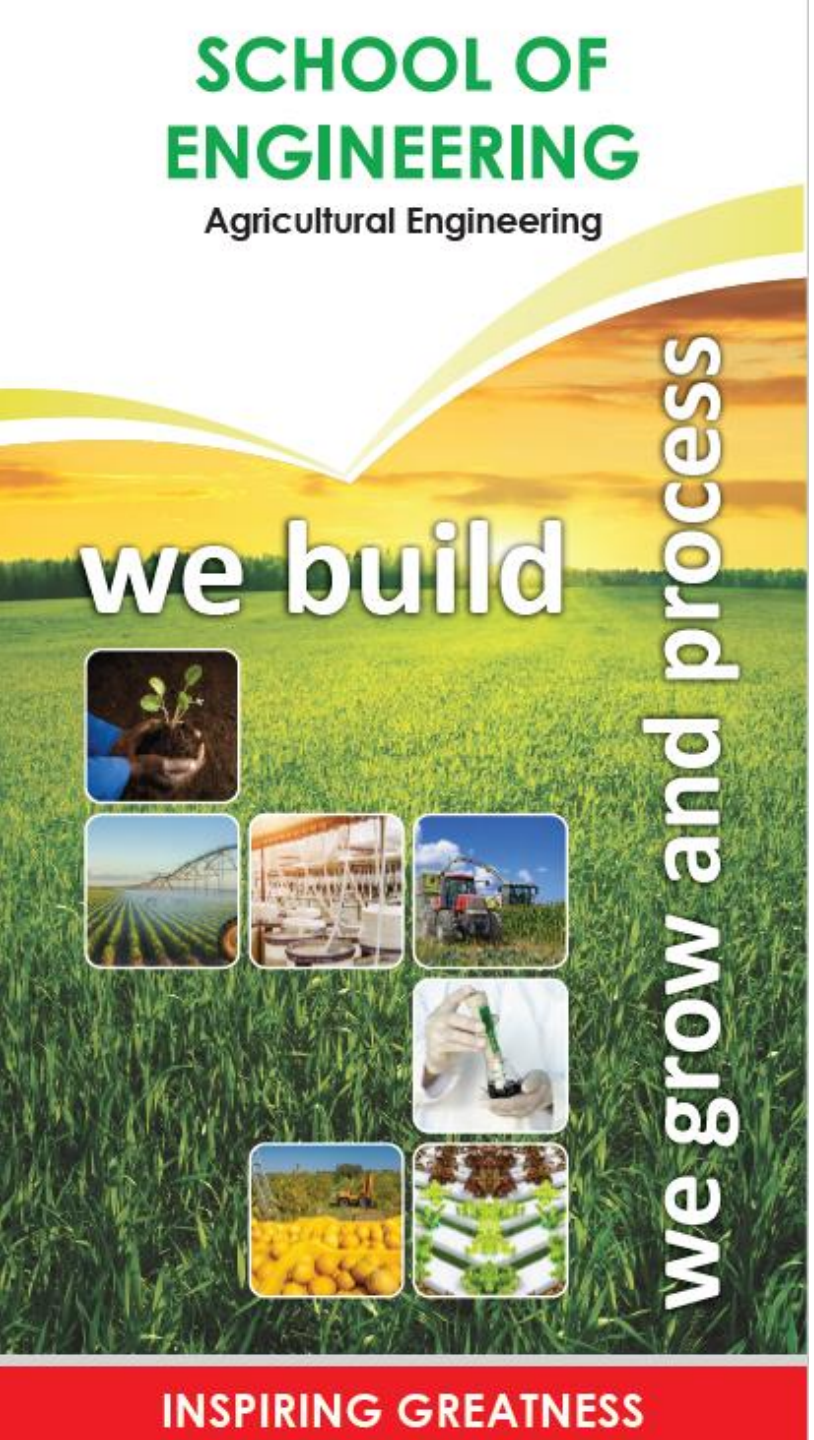
In Europe, the profession is about 105 years old; whereas the African profession is 75 years.

Agricultural engineering has generally been recognised as serving in four main areas of agriculture, namely:

- ✓ power and machinery,
- ✓ soil and water,
- ✓ structures and environment, and
- ✓ agricultural processing.

First Agricultural engineering degree

The first agricultural engineering degree in the world was granted at Iowa State University in 1910. J. Brownlee Davidson led the development of the discipline which applied engineering and agricultural sciences to biological systems.
The graduate, Jacob E. Waggoner, became widely known, organizing similar departments at other universities, and specializing in rural electrification and agricultural communications. Today, universities around the world have agricultural and/or biological engineering departments."



What happened in South Africa?

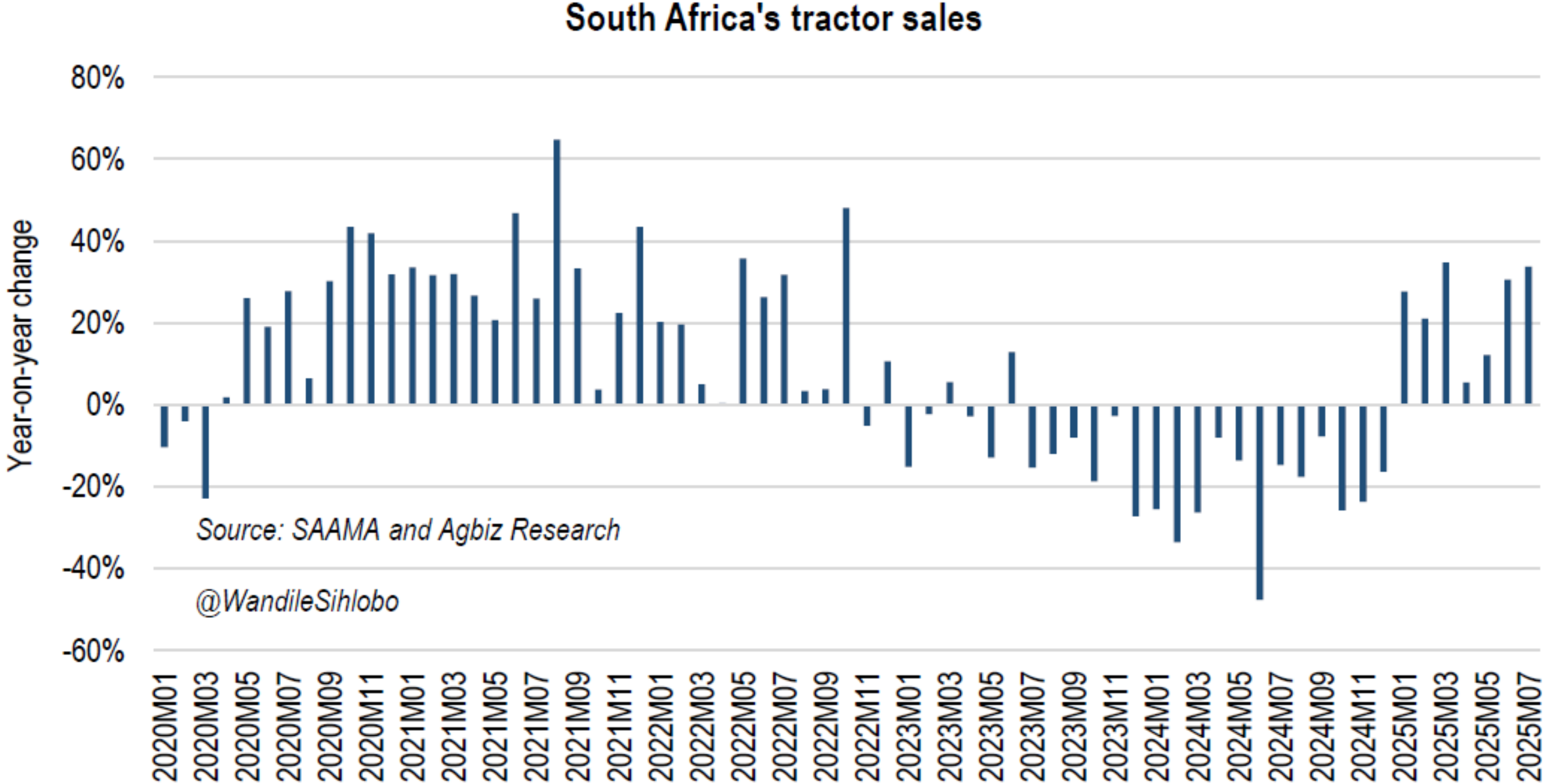
Agricultural Engineering as a subject was introduced in the BSc (Agriculture) courses offered at the Universities of
Pretoria in 1920, at Elsenburg Agricultural College in Stellenbosch in 1928 and Natal in 1948.

A degree in Agricultural Engineering was first introduced in 1950, 75 years ago, at Natal University with the first Agricultural Engineer graduated in 1955.

Seven years later, in 1957, Pretoria University followed. After 46 years, in 2003, the course in Pretoria was closed.
Stellenbosch University started in 1960 with a 5-year B.Sc. B.Eng. degree, but after 13 years, in 1973, had to close due to rationalization


Present


OMBU
OMBU
FIELD CULTIVATOR


South Africa's tractor sales
Year-on-year change
80%
60%
40%
20%
0%
-20%
-40%
-60%
Source: SAAMA and Agbiz Research
@WandileSihlobo
2020M01
2020M03
2020M05
2020M07
2020M09
2020M11
2021M01
2021M03
2021M05
2021M07
2021M09
2021M11
2022M01
2022M03
2022M05
2022M07
2022M09
2022M11
2023M01
2023M03
2023M05
2023M07
2023M09
2023M11
2024M01
2024M03
2024M05
2024M07
2024M09
2024M11
2025M01
2025M03
2025M05
2025M07

Broadly, the strong tractor sales primarily reflect the positive sentiment in the sector regarding the 2024-25 field crop, horticulture, and wine grape harvest, supported by the favourable weather conditions. For example;

- The Crop Estimates Committee forecasts the 2024-25 summer grains and oilseeds harvest at 18.74 million tonnes (up 21% year-on-year).
- South African sugar production for the 2024-25 production season is forecast to recover by 7% year-on-year to 2.09 million tonnes.
- South Africa's wine grape harvest was 1.244 million tonnes, an 11% recovery from the exceptionally poor harvest of 2024.
- The South African Table Grape Industry has also posted some upbeat production figures, indicating that the 2024-25 total harvest inspected is 78.9 million cartons, 4% higher year-on-year.
- We also see encouraging production data from citrus, various fruits, and vegetables.
- The 2025-26 winter crop plantings are also fairly decent.

Modern era: Smart farming and sustainability

Today's agricultural engineering is focused on integrating data-driven technology and automation to enhance efficiency, productivity, and sustainability.

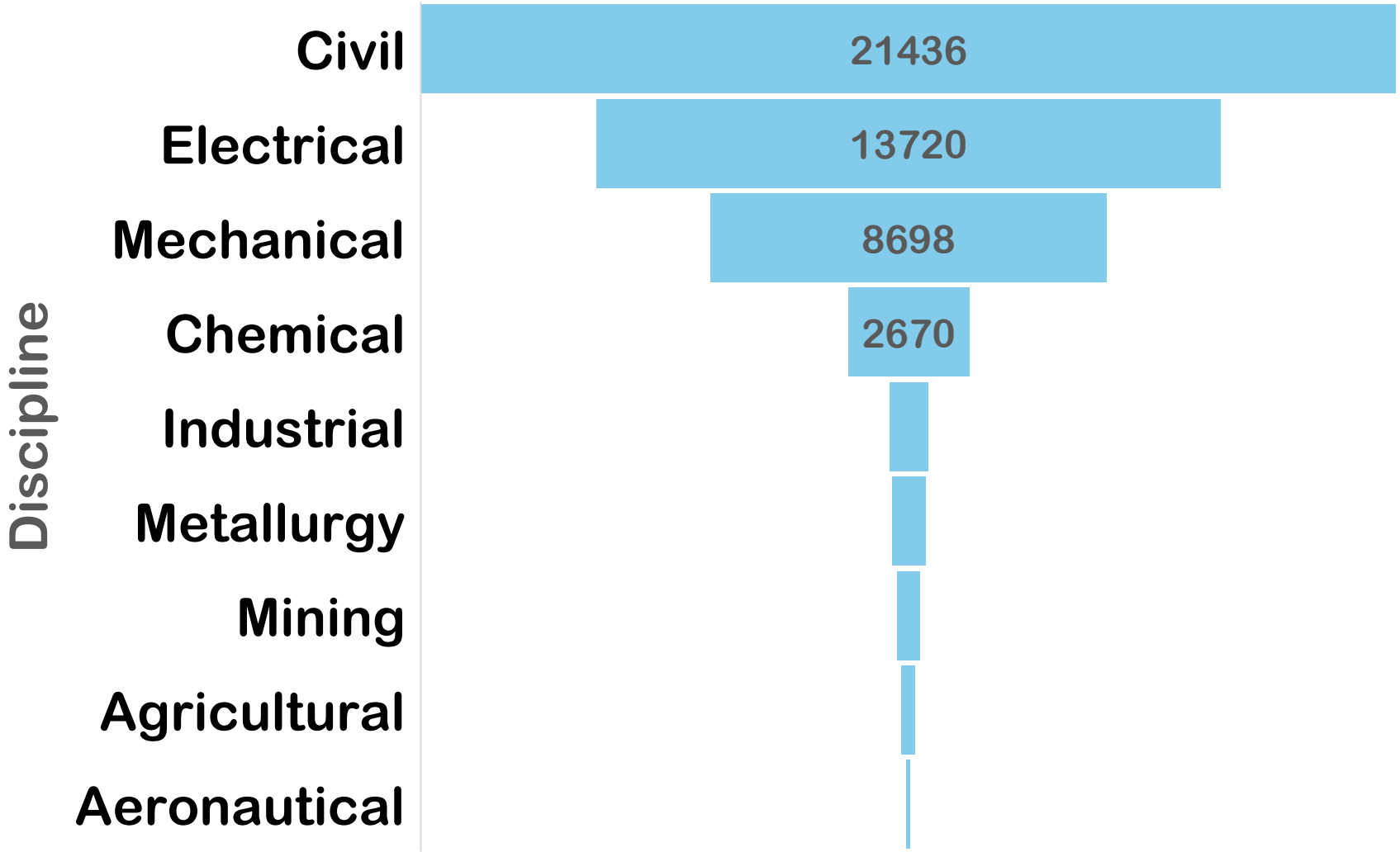
- **AI and Machine Learning:** Algorithms analyze vast amounts of data from sensors, drones, and satellites to provide valuable insights for farm management.
- **Robotics and Automation:** Automated machinery and robots perform labor-intensive tasks such as planting, weeding, harvesting, and sorting.
- **Precision and Sustainable Farming:** Smart systems use AI and GPS to optimize resource use, reduce water and chemical consumption, and minimize environmental impact.
- **Internet of Things (IoT):** Connected sensors monitor environmental conditions and crop status in real time, enabling data-driven decision-making for farmers.
- **Livestock Monitoring:** AI-powered computer vision and sensors track animal health, behavior, and welfare, allowing for early detection of issues.

Total Database of Registered Persons (by category) - 30 September 2025

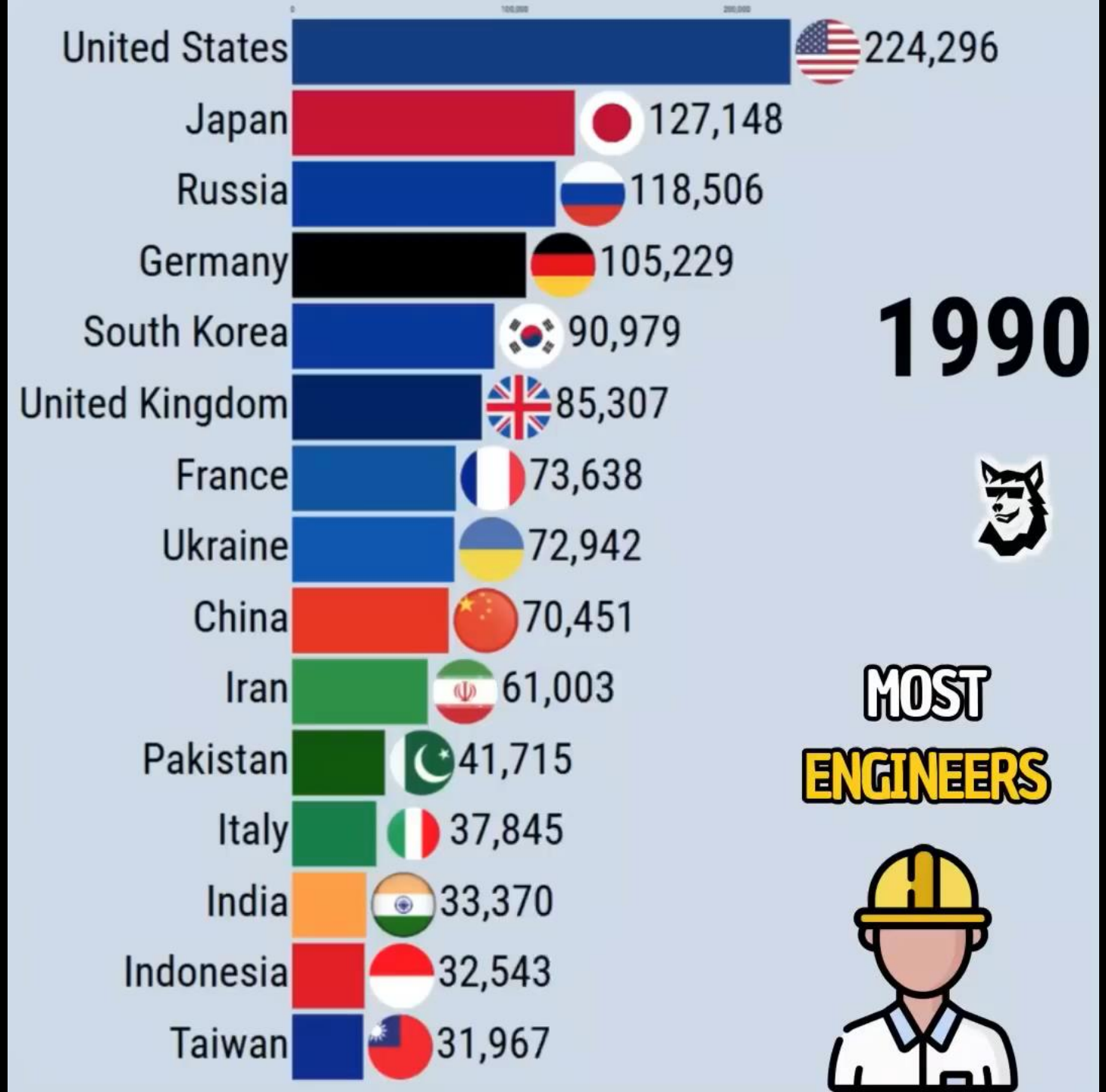
CANDIDATES	**23 649**
Candidate Engineer	9 884
Candidate Engineering Technologist	6 804
Candidate Engineering Technician	6 724
Candidate Certificated Engineer	237
PROFESSIONALS	**28 226**
Professional Engineer	14 848
Professional Engineering Technologist	7 253
Professional Engineering Technician	5 334
Professional Certificated Engineer	791
SPECIFIED CATEGORIES	**1 026**
Registered Lifting Machinery Inspector	874
Registered Lift Inspector	106
Registered Fire Protection System practitioner	19
Registered Civil Technical Laboratory control	4
Registered Medical Equipment Maintainer	4
Fire Protection System Rational Design	19
INTERNATIONAL	**65**
Professional Engineer	57
Professional Engineering Technologist	6
Professional Engineering Technician	2
TOTAL	**52 966**

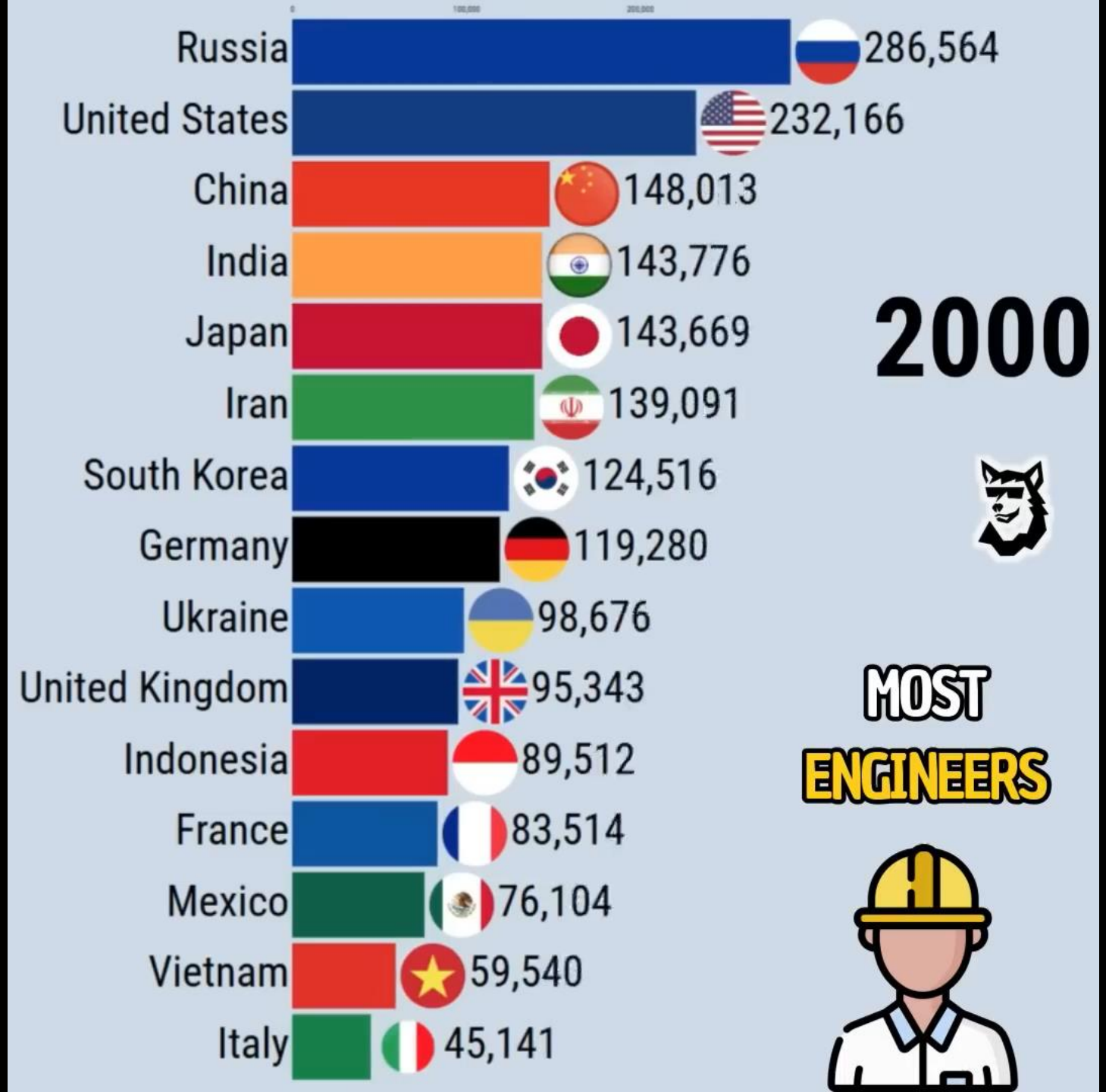
Professionals	28 226
Candidates	23 649
Specified categories	1 026
International	65
Total	52 966

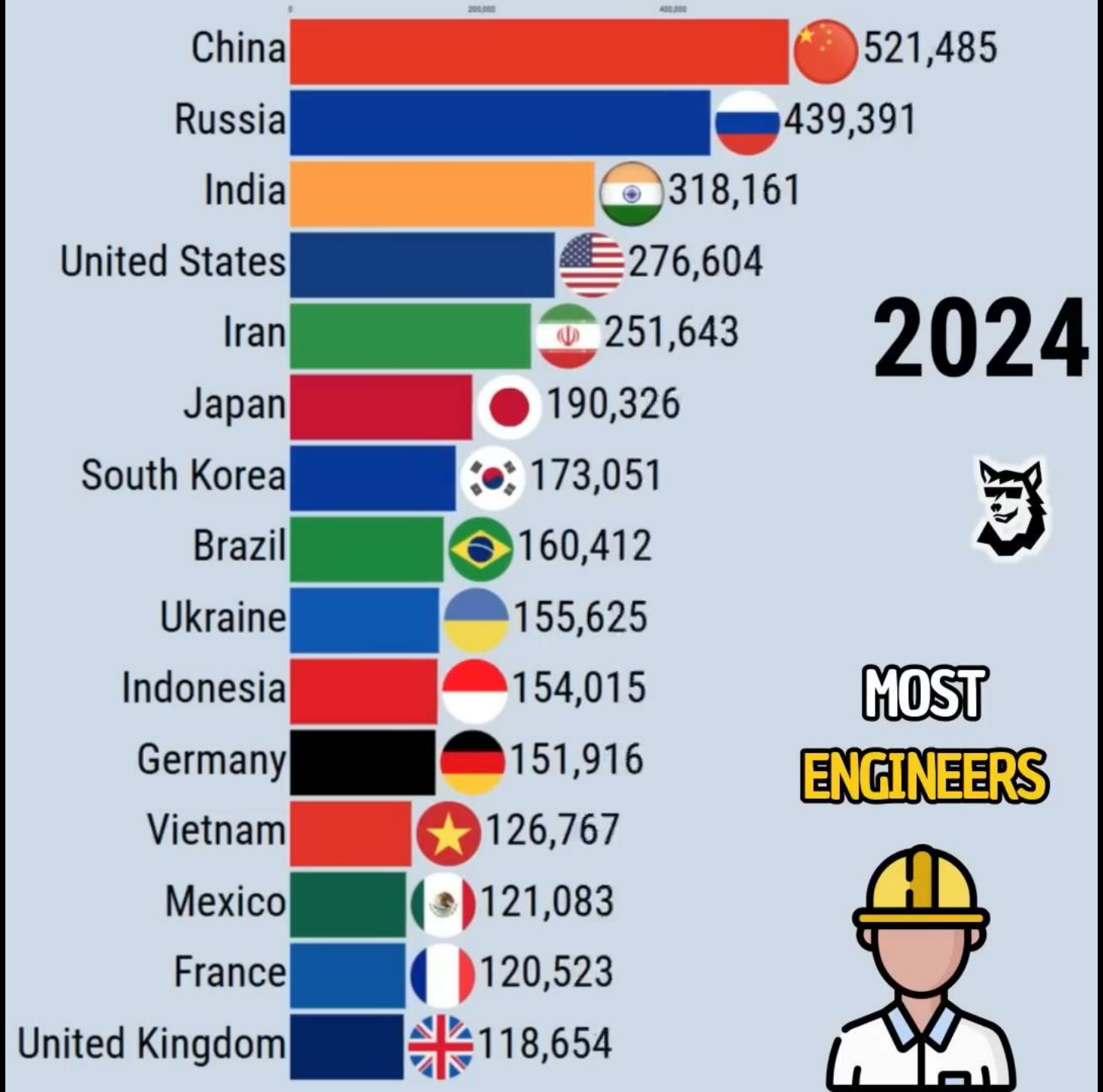
Total Database of Registered Persons (by discipline)

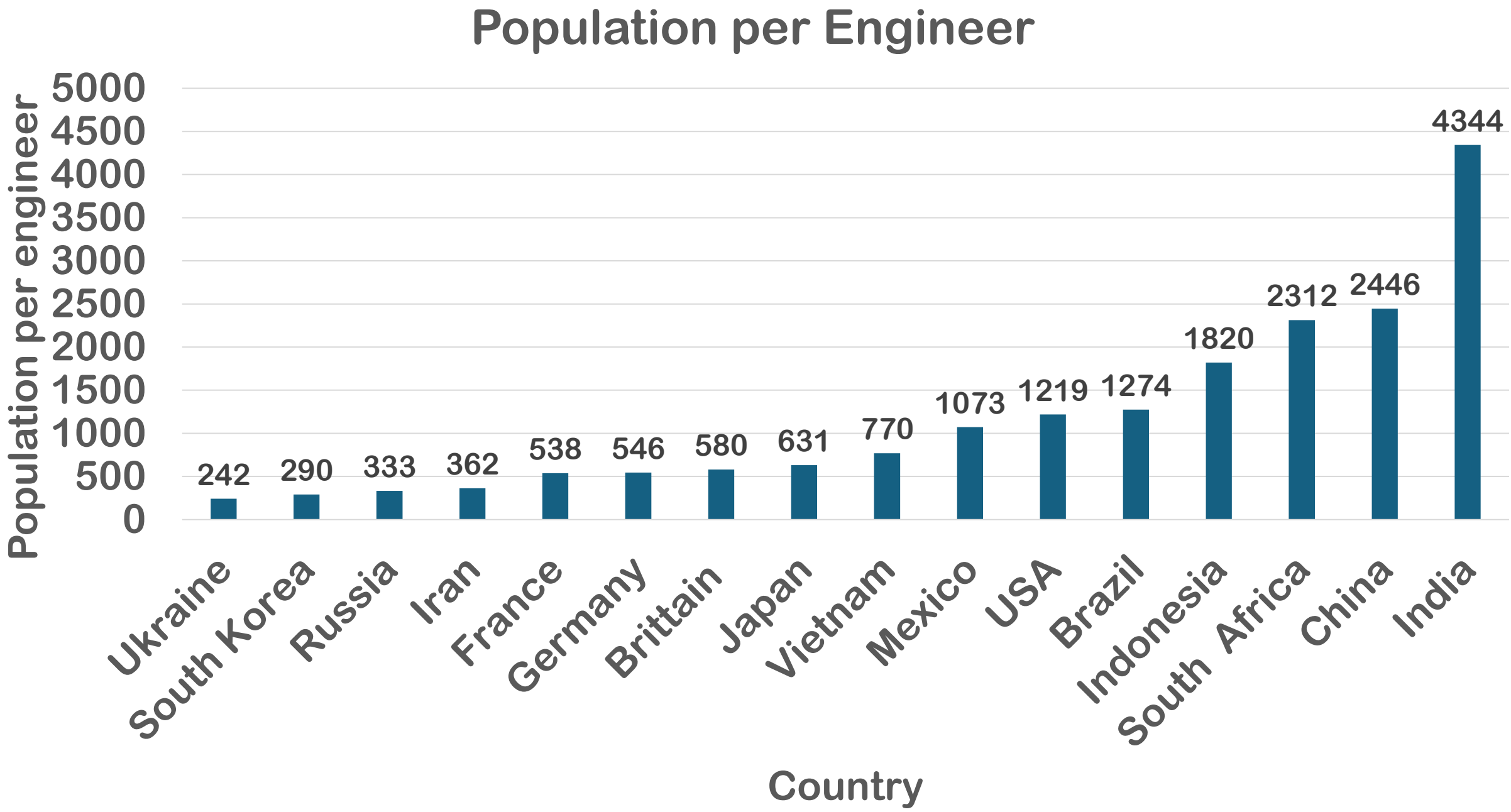


Civil	21 436
Electrical	13 720
Mechanical	8 698
Chemical	2 670
Industrial	851
Metallurgy	742
Mining	511
Agricultural	307
Aeronautical	88
Total	49 023

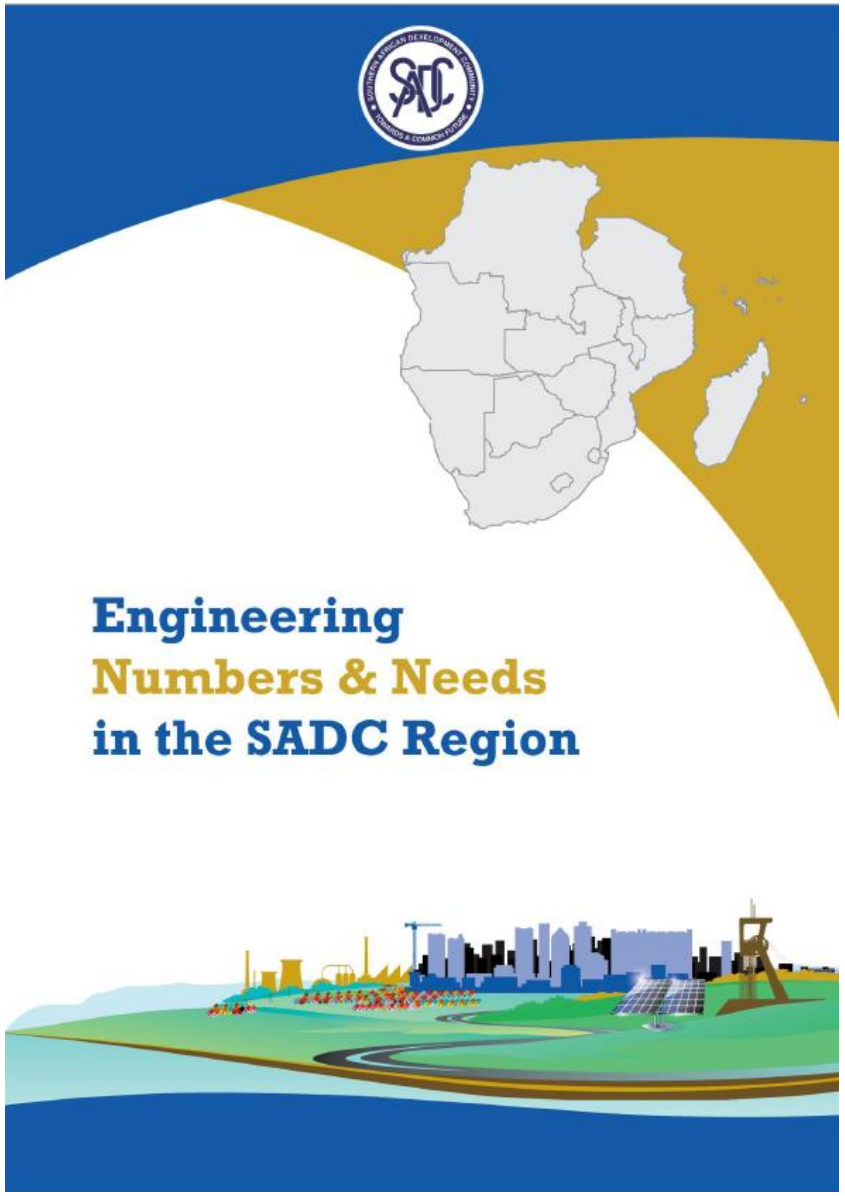

United States
224,296
Japan
127,148
Russia
118,506
Germany
105,229
South Korea
90,979
United Kingdom
85,307
France
73,638
Ukraine
72,942
China
70,451
Iran
61,003
Pakistan
41,715
Italy
37,845
India
33,370
Indonesia
32,543
Taiwan
31,967
1990
MOST
ENGINEERS

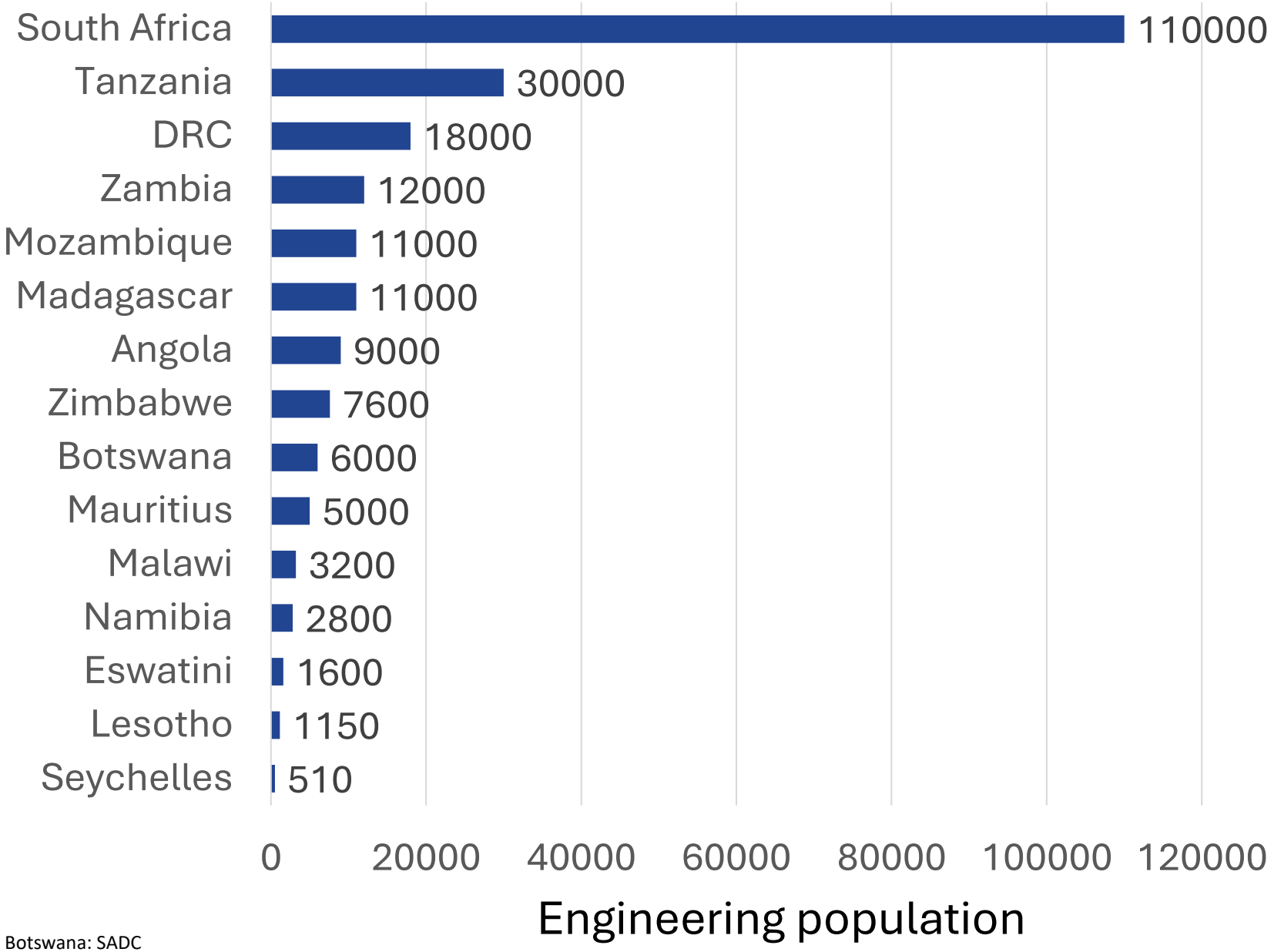

Russia
286,564
United States
232,166
China
148,013
India
143,776
Japan
143,669
Iran
139,091
South Korea
124,516
Germany
119,280
Ukraine
98,676
United Kingdom
95,343
Indonesia
89,512
France
83,514
Mexico
76,104
Vietnam
59,540
Italy
45,141
2000
MOST
ENGINEERS


China
521,485
Russia
439,391
India
318,161
United States
276,604
Iran
251,643
Japan
190,326
South Korea
173,051
Brazil
160,412
Ukraine
155,625
Indonesia
154,015
Germany
151,916
Vietnam
126,767
Mexico
121,083
France
120,523
United Kingdom
118,654
2024
MOST
ENGINEERS


Population per Engineer
Population per engineer
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
242
290
333
362
538
546
580
631
770
1073
1219
1274
1820
2312
2446
4344
Ukraine
South Korea
Russia
Iran
France
Germany
Brittain
Japan
Vietnam
Mexico
USA
Brazil
Indonesia
South Africa
China
India
Country

The engineering population in SADC





SADC. 2018. *Engineering Numbers and Needs in the SADC Region*. Gaborone, Botswana: SADC


Future

The Future of Agricultural Engineering

The future of agriculture and agricultural engineering is bright and filled with possibilities.

With advances in AI, robotics, and genetic engineering, farming is becoming more efficient and less reliant on manual labour. Vertical farming, aquaponics, and automation are all areas where agricultural engineering is breaking new ground.

As the world focuses more on climate resilience and sustainable practices, agricultural engineering will play an even more critical role.

Agricultural engineering is poised to play a vital role in addressing the challenges facing modern agriculture, from increasing food production to mitigating the impact of climate change.

The future of agricultural engineering depends on the next generation of problem solvers, who will leverage cutting-edge technologies, such as precision agriculture, biotechnology, and renewable energy, to create more efficient, productive, and sustainable farming systems. By combining technical expertise with a deep understanding of agricultural practices and environmental concerns, agricultural engineers can develop innovative solutions to pressing problems.

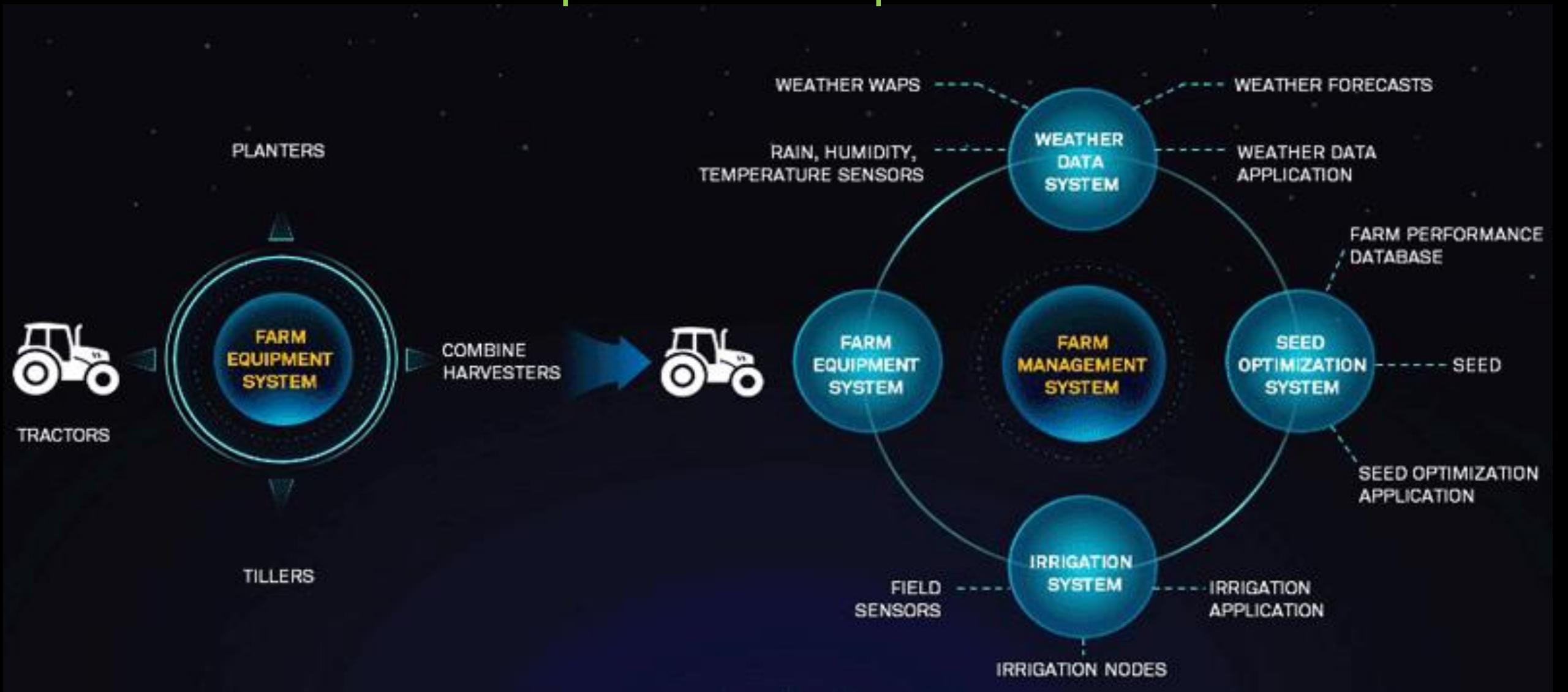
As the field continues to evolve, it is essential to stay abreast of the latest developments and advancements in agricultural engineering. By doing so, we can unlock the full potential of this critical field and create a more sustainable and food-secure future for generations to come, shaping the future of agricultural engineering.


Agricultural Engineering
Farm Machinery and Power
Harvesting Machinery
Robotics Agriculture
Drone Spraying
Agriculture and Energy Systems
Soilless Agriculture
Next Generation Greenhouses
Postharvest Storage
Poultry Sheds
Irrigation and Drainage
Drip Irrigation
Sprinkler Irrigation
Center Pivot Irrigation
Agriculture and Environment
Air Pollution
Water Treatment
Wastewater in Agriculture

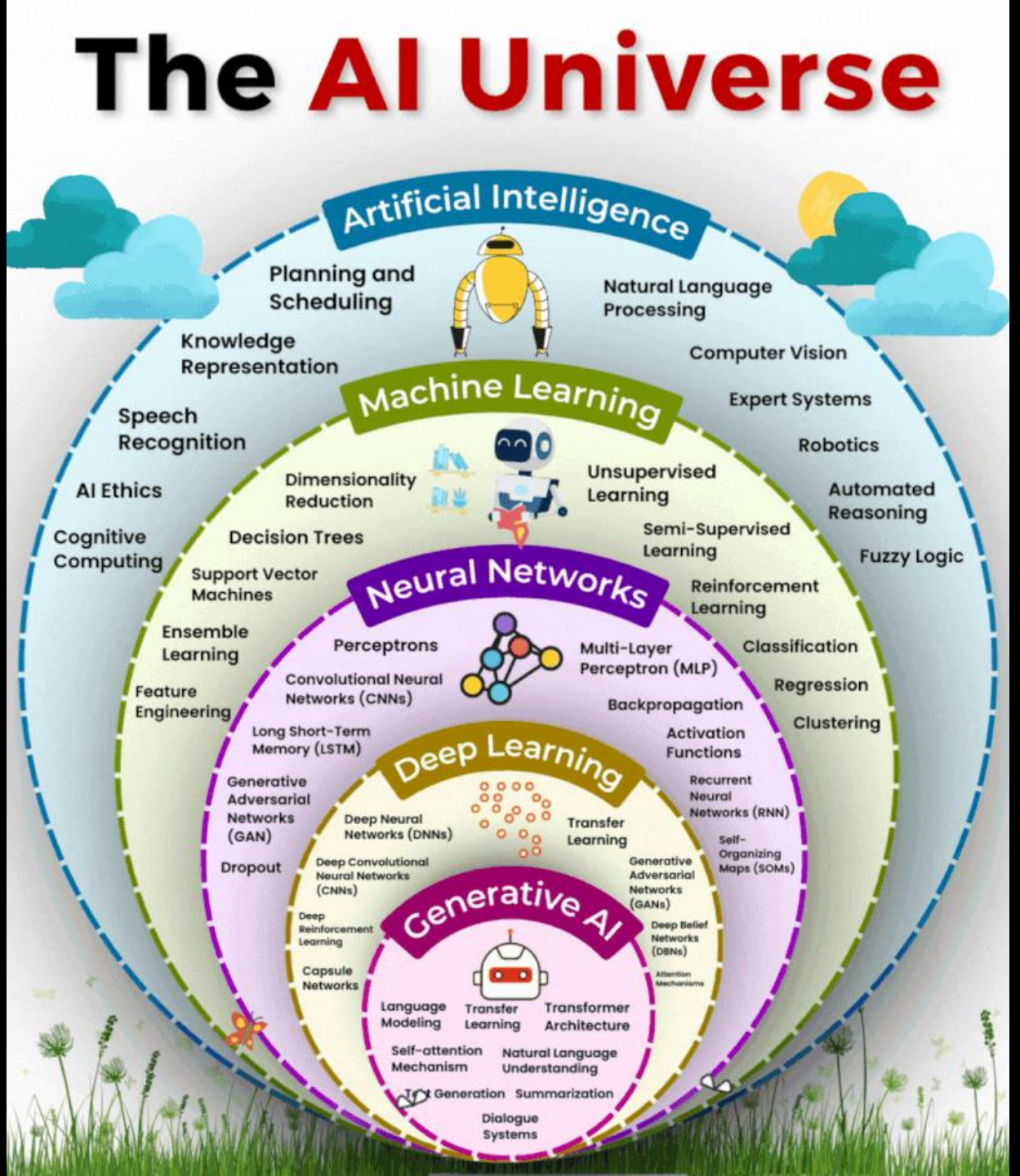
Looking ahead, agricultural engineering will continue to address the challenges of food security and sustainability through innovative technology:

- **AI-driven optimization:** Predictive modeling and advanced analytics will further improve resource management and crop resilience to climate change.
- **Fully autonomous farms:** Advances in robotics and AI are paving the way for fully autonomous farms with minimal human intervention.
- **Advanced analytics for new cultivars:** AI will play a critical role in crop breeding by analyzing genomic and environmental data to develop more resilient, higher-yielding, and nutritious crops.
- **Increased focus on sustainability:** As concerns about climate change grow, agricultural engineering will continue to innovate with a focus on resource conservation, renewable energy, and waste reduction.

Digitization is the future to process information into a digital format by generating a series of numbers that can be used for food production improvement.



The AI Universe




A total reset.


2025
AgXeed 2025 FieldBot
AgXeed
2025
AGXEED
FIELDBOT
ATTRIBUTES
TYPE: AUTONOMOUS ELECTRIC
POWER: 200 HP
CUT WIDTH: 4 M
CAPACITY: 6 HA/H

CONCLUSION

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Agricultural Engineering

Celebrating 75 *Years of*

Agricultural Engineering Excellence

Celebrating 75 Years of Agricultural Engineering Excellence

We must look back at successes achieved and look at what the future holds, because agricultural engineering is an occupation, which requires a lifelong pursuance of technical information, educational updating and professional contact.

Celebrating 75 Years of Agricultural Engineering Excellence

Sir Laurens van der Post once said:

"Remember where we came from and how we got to where we are,

in order to understand how to move forward from here."

Do not go where the path may lead,
go instead where there is no path
and lead the way!

In conclusion, Agricultural Engineer's efforts now and the future must focus on playing a significant role and provide leadership in the agricultural engineering arena

The FUTURE
has many unknowns but we know
we will need
ADAPTIVE LEADERSHIP…

"tomorrow depends on what we do TODAY!"


Celebrating 75 Years of
Agricultural Engineering Excellence

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Agricultural Engineering

1950-2025

Celebrating **75** *Years of*

Agricultural Engineering Excellence

Diamond  **Jubilee**