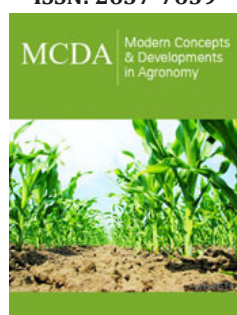


Agricultural Mechanization and Its Worldwide Economic Roles

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Introduction

Discussions of strategic agricultural issues within agronomic systems usually concentrate on the production of food in the future, as the FAO expects a global population of about 9.5 bn by 2050.

Mechanization can and will contribute to achieving food security worldwide, even in decades to come, but this is by far not its only role for the national economies on Earth. In fact, we can see additional environmental and strategic aspects, leading to three important roles of agricultural mechanization:

1. The classical role: mechanization of plant and animal production, storage, and processing (including aquaculture) in order to feed the planet.
2. The environmental role: mechanization of the production of raw materials and green energy along with mechanized landscape maintenance in order to safeguard the planet.
3. The strategic role: agricultural mechanization in general to increase labor productivity in order to reduce the number of agricultural workers in favor of manpower for other economic sectors.

The Classical Role

The classical role of agriculture is the production of food. Within this role, mechanization of plant production supports two important farming factors: land productivity and labor productivity.

The influence of agricultural mechanization on land productivity is important but not dominant; factors such as breeding, fertilization, irrigation, plant production, and post-harvesting methods also have an impact. The benefits of mechanization are, for example, improved yields, higher quality, reduced inputs of materials and energy, reduced human workloads, and reduced harvesting losses, all of which are supported by precision agriculture [1]. Old methods of harvesting cereals using hand tools (as still practiced in developing countries) often resulted in yield losses of 20% or even 30% (FAO), while the losses of a modern combine amount to only 1% under usual conditions. However, the importance of mechanization on labor productivity is extremely dominant, Table 1.

Table 1: The increase in factors of productivity from agricultural mechanization as compared with human hand tools.

Simple milking machine	Factor of 10
Two horses plowing	25
Very small tractor plowing	50
Multi-purpose tractor mowing	500
Large tractor plowing	1,000
Large combine working	5,000

These impressive figures are the main reason that world market prices for basic agricultural products became extremely low owing to mechanization and are still low in spite of recent increases. In Germany, consumers spend only about 15% of income on food and beverages (2020). This figure may be slightly higher in 2022, but in the author's opinion, is still relatively low for a developed country, mainly owing to agricultural mechanization. If we divide the global production of cereals by the number of humans, this results in as much as about 1 kg per capita per day. This seems to indicate a huge surplus, as humans need much less. In fact, a high quantity of cereal grains is used to feed animals. Due to an expected increase in global per capita income, the share of animal production is forecasted to increase further. This, in turn, will require an even higher share of acreage for animal feed, resulting in a reduction of acreage for crop production.

These trends have led to forecasts stating that an increase in global crop production must be higher than a global population increase. For example, while the FAO projects the global population to grow by 34% from 7.1 to 9.5 bn between 2014 and 2050, experts estimate the demanded increase in crop production to be at least about 60%. Some relaxation can be expected from the increasing role of fish farms, which already produce about 50% of all globally offered fish with very high feeding efficiencies (kg fish/kg food is up to even 1). Technical equipment for high productivity in animal production differs completely from that in plant production; nevertheless, its productivity was also considerably improved during recent decades.

The Environmental Role

Technical factors improving environmental quality and affecting the increase in production of green energy and raw materials are more or less identical to those mentioned above for food, with some exceptions or adjustments. Technologies for recirculation or recycling of materials reducing the need for agricultural land are very special [2]. The issue is that acreage dedicated to producing green energy and raw materials (in addition to acreage for feeding animals), competes with acreage needed for producing basic food for humans.

The Worldwide Strategic Role

The strategic role of agricultural mechanization, although rarely addressed, as it has nothing to do with food production, raw materials, or energy, nor with animals, is nevertheless quite important. Agricultural mechanization usually reduces the number of agricultural workers by the mentioned increased productivity factors, enabling the workers to be transferred to other sectors, hence creating additional added value within the national economy.

Studies of the author presented at the Club of Bologna [3] showed that the GDP per capita of extremely poor countries is about 50 times lower than that of industrialized countries such as the USA or Germany. At the same time, the number of agricultural workers (as a percentage of all workers) has the opposite trend: about or even below 2% in highly developed countries such as the USA and Germany and above 60% in very poor countries. Agricultural mechanization, along with adequate education and sustainability principles, is therefore the key in nearly all developing countries to overcoming poverty, suffering, low life expectancy, high illiteracy, high infant mortality, a low level of infrastructure, and so on; see also the 17 Sustainable Development Goals (SDGs) of the United Nations for 2030 as presented in 2016. The tractor is still the most important machine as measured by worldwide agricultural machinery sales [4]. Unfortunately, political instability, along with a low level of human rights, high crime rates, or even terrorism, often hampers progress in poor countries, even complicating external help.

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