IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 10, Issue 2, February 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.122

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 2, February 2021||

|DOI:10.15662/IJAREEIE.2021.1002020 |

Agricultural Engineering - An Important Issue in Agricultural Economics in the Present Scenario

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ABSTRACT: Agricultural engineering, also known as agricultural and biosystems engineering, is the field of study and application of engineering science and designs principles for agriculture purposes, combining the various disciplines of mechanical, civil, electrical, food science, environmental, software, and chemical engineering to improve the efficiency of farms and agribusiness enterprises[1] as well as to ensure sustainability of natural and renewable resources.[2]An agricultural engineer is an engineer with an agriculture background. Agricultural engineers make the engineering designs and plans in an agricultural project, usually in partnership with an agriculturist who is more proficient in farming and agricultural science. Agricultural economics is an applied field of economics concerned with the application of economic theory in optimizing the production and distribution of food and fiber products. Agricultural economics began as a branch of economics that specifically dealt with land usage. It focused on maximizing the crop yield while maintaining a good soil ecosystem. Throughout the 20th century the discipline expanded and the current scope of the discipline is much broader. Agricultural economics today includes a variety of applied areas, having considerable overlap with conventional economics. Agricultural economists have made substantial contributions to research in economics, econometrics, development economics, and environmental economics. Agricultural economics influences food policy, agricultural policy, and environmental policy.

KEYWORDS: agricultural engineering, biosystems, farming, project, economics, food policy, econometrics

I.INTRODUCTION

With growing mechanization and steam power in the industrial revolution, a new age in agricultural engineering began.[1] Over the course of the industrial revolution, mechanical harvesters and planters would replace field hands in most of the food and cash crop industries. Mechanical threshing was introduced in 1761 by John Lloyd, Magnus Strindberg and Dietrich. Beater bar threshing machine was built by Andrew Meikle in 1786.[5] A cast iron plow was first made by Charles Newbold between 17960 and 1796.[3] Agricultural engineers may perform tasks such as planning, supervising and managing the building of dairy effluent schemes, irrigation, drainage, flood water control systems, performing environmental impact assessments, agricultural product processing and interpret research results and implement relevant practices. A large percentage of agricultural engineers work in academia[2] or for government agencies. Some are consultants, employed by private engineering firms, while others work in industry, for manufacturers of agricultural machinery, equipment, processing technology, and structures for housing livestock and storing crops. Agricultural engineers work in production, sales, management, research and development,[3] or applied science. In the Philippines, the professional designation is registered agricultural and biosystems engineer. They are licensed and accredited after successfully passing the Agriculturist and Biosystems Engineering Licensure Examination. A prospective agricultural and biosystems engineer is required to have a four-year Bachelor of Science in Agricultural and Biosystems Engineering.[4]

The practice of agricultural and biosystems engineering also includes the following:

- Consultation, valuation, investigation and management services on agricultural and biosystems engineering;
- Management or supervision and the preparation of engineering designs, plans, specifications, project studies and estimates for agricultural and biosystems, aquaculture and fishery, and forest product machinery, agricultural and biosystems buildings and structures, farm electrification and energy systems, agricultural and biosystems processing

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equipment, irrigation and soils conservation systems and facilities, agricultural and biosystems waste utilization systems and facilities;

- Conducting research and development, training and extension work, and consultancy services on agricultural and biosystems engineering facilities/services, system and technologies;
- Testing, evaluation and inspection of agricultural and biosystems, fishery and forest product machinery and other related agricultural and biosystems engineering facilities and equipment.
- Management, manufacturing and/or marketing of agricultural and biosystems machinery and other related agricultural and biosystems engineering facilities and equipment;
- Teaching, agricultural and biosystems engineering subjects in institution of learning in the Philippines;
- Employment with the government provided such item or position requires the knowledge and expertise of an agricultural and biosystems engineer.[5]

Economics has been defined as the study of resource allocation under scarcity. Agricultural economics, or the application of economic methods to optimize the decisions made by agricultural producers, grew to prominence around the turn of the 20th century. The field of agricultural economics can be traced back to works on land economics. Henry Charles Taylor was the greatest contributor in this period, with the establishment of the Department of Agricultural Economics at the University of Wisconsin in 1909.[5]

Another contributor, 1979 Nobel Economics Prize winner Theodore Schultz, was among the first to examine development economics as a problem related directly to agriculture.[6] Schultz was also instrumental in establishing econometrics[6] as a tool for use in analyzing agricultural economics empirically; he noted in his landmark 1956 article that agricultural supply analysis is rooted in "shifting sand", implying that it was and is simply not being done correctly.[7] Agricultural economics arose in the late 19th century, combined the theory of the firm with marketing and organization theory, and developed throughout the 20th century largely as an empirical branch of general economics. The discipline was closely linked to empirical applications of mathematical statistics and made early and significant contributions to econometric methods.[7] In the 1960s and afterwards, as agricultural sectors in the OECD countries contracted, agricultural economists were drawn to the development problems of poor countries, to the trade and macroeconomic policy implications of agriculture in rich countries, and to a variety of production, consumption, and environmental and resource problems.[8]

Agricultural economists have made many well-known contributions to the economics field with such models as the cobweb model,[9] hedonic regression pricing models,[10] new technology and diffusion models (Zvi Griliches),[11] multifactor productivity and efficiency theory and measurement,[12][13] and the random coefficients regression.[14] The farm sector is frequently cited as a prime example of the perfect competition economic paradigm.[9]

In Asia, the Faculty of Agricultural Economics was established in September 1919 in Hokkaido Imperial University, Japan, as Tokyo Imperial University's School of Agriculture started a faculty on agricultural economics in its second department of agricultural science.[10]

In the Philippines, agricultural economics was offered first by the University of the Philippines Los Baños Department of Agricultural Economics in 1919. Today, the field of agricultural economics has transformed into a more integrative discipline which covers farm management and production economics, rural finance and institutions, agricultural marketing and prices, agricultural policy and development, food and nutrition economics, and environmental and natural resource economics.[11]

Since the 1970s, agricultural economics has primarily focused on seven main topics, according to Ford Runge: agricultural environment and resources; risk and uncertainty; food and consumer economics; prices and incomes; market structures; trade and development; and technical change and human capital.[15] The American Society of Agricultural Engineers, now known as the American Society of Agricultural and Biological Engineers (ASABE), was founded in 1907.[10] It is a leading organization in the agricultural engineering field. The ASABE provides safety and regulatory standards for the agricultural industry. These standards and regulations are developed on an international scale for fertilizers, soil conditions, fisheries, biofuels, biogas, feed machinery, tractors, and machinery.[1] In the field of environmental economics,[12] agricultural economists have contributed in three main areas: designing incentives to control environmental externalities (such as water pollution due to agricultural production), estimating the value of non-market benefits from natural resources and environmental amenities (such as an appealing rural landscape), and the complex interrelationship between economic

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activities and environmental consequences.[16] With regard to natural resources, agricultural economists have developed quantitative tools for improving land management,[13] preventing erosion, managing pests, protecting biodiversity, and preventing livestock diseases.[17] While at one time, the field of agricultural economics was focused primarily on farm-level issues, in recent years agricultural economists have studied diverse topics related to the economics of food consumption. In addition to economists' long-standing emphasis on the effects of prices and incomes, researchers in this field have studied how information and quality attributes influence consumer behavior. [14] Agricultural economists have contributed to understanding how households make choices between purchasing food or preparing it at home, how food prices are determined, definitions of poverty thresholds, how consumers respond to price and income changes in a consistent way, and survey and experimental tools for understanding consumer preferences.[18] Agricultural economics research has addressed diminishing returns in agricultural production, as well as farmers' costs and supply responses. Much research has applied economic theory to farm-level decisions. Studies of risk and decision-making under uncertainty have real-world applications to crop insurance policies[15] and to understanding how farmers in developing countries make choices about technology adoption. These topics are important for understanding prospects for producing sufficient food for a growing world population, subject to new resource and environmental challenges such as water scarcity and global climate change.[19] Development economics is broadly concerned with the improvement of living conditions in low-income countries, and the improvement of economic performance in low-income settings. Because agriculture is a large part of most developing economies,[16] both in terms of employment and share of GDP, agricultural economists have been at the forefront of empirical research on development economics, contributing to our understanding of agriculture's role in economic development, economic growth and structural transformation. Many agricultural economists are interested in the food systems of developing economies, the linkages between agriculture and nutrition, and the ways in which agriculture interact with other domains,[17] such as the natural environment.[20][21]

II.DISCUSSION

The International Association of Agricultural Economists (IAAE) is a worldwide professional association, which holds its major conference every three years. The association publishes the journal Agricultural Economics.[22] There also is a European Association of Agricultural Economists (EAAE), an African Association of Agricultural Economists (AAAE) and an Australian Agricultural and Resource Economics Society. Substantial work in agricultural economics internationally is conducted by the International Food Policy Research Institute.[18]

In the United States, the primary professional association is the Agricultural & Applied Economics Association (AAEA), which holds its own annual conference and also co-sponsors the annual meetings of the Allied Social Sciences Association (ASSA). The AAEA publishes the American Journal of Agricultural Economics and Applied Economic Perspectives and Policy.[19] Graduates from agricultural and applied economics departments find jobs in many sectors of the economy: agricultural management, agribusiness, commodities markets, education, financial sector, government, natural resource and environmental management, real estate, and public relations.[20] Careers in agricultural economics require at least a bachelor's degree, and research careers in the field require graduate-level training;[23] see Masters in Agricultural Economics. A 2011 study by the Georgetown Center on Education and the Workforce rated agricultural economics tied for 8th out of 171 fields in terms of employability.[24][25] Bioresource engineering is similar to biological engineering, except that it is based on biological and/or agricultural feedstocks. Bioresource engineering is more general and encompasses a wider range of technologies and various elements such as biomass, biological waste treatment, bioenergy, biotransformations, bioresource systems analysis, bioremediation and technologies associated with Thermochemical conversion technologies such as combustion, pyrolysis, gasification, catalysis, etc.[21]

Bioresource engineering also contains biochemical conversion technologies such as aerobic methods, anaerobic digestion, microbial growth processes, enzymatic methods, and composting. Products include fibre, fuels, feedstocks, fertilisers, building materials, polymers and other industrial products, and management products e.g. modelling, systems analysis, decisions, and support systems. Bioresource engineering is a discipline that is usually very similar to environmental engineering.[22]

The impact of urbanization and increasing demand for food, water and land presents bioresource engineers with the task of bridging the gap between the biological world and traditional engineering.[1] Agricultural and bioresource engineers attempt to develop efficient and environmentally sensitive methods of producing food, fiber, timber, bio-based products and renewable energy sources for an ever-increasing world population. Some of the research in bioresource engineering

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include machine vision, vehicle modification, wastewater irrigation, irrigation water management, stormwater management, inside natural environment for animals and plants, sensors, non-point source pollution and animal manure management.[2] Biological systems engineering or Biosystems engineering is a broad-based engineering discipline with particular emphasis on non-medical biology.[23] It can be thought of as a subset of the broader notion of biological engineering or bio-technology though not in the respects that pertain to biomedical engineering as biosystems engineering tends to focus less on medical applications than on agriculture, ecosystems, and food science. The discipline focuses broadly on environmentally sound and sustainable engineering solutions to meet societies' ecologically-related needs. Biosystems engineering integrates the expertise of fundamental engineering fields with expertise from non-engineering disciplines.[24] Many college and university biological engineering departments have a history of being grounded in agricultural engineering and have only in the past two decades or so changed their names to reflect the movement towards more diverse biological based engineering programs.[1][2] This major is sometimes called agricultural and biological engineering, biological and environmental engineering, etc., in different universities, generally reflecting interests of local employment opportunities.[25]

Since biological engineering covers a wide spectrum, many departments now offer specialization options. Depending on the department and the specialization options offered within each program, curricula may overlap with other related fields. [26]There are a number of different titles for BSE-related departments at various universities. The professional societies commonly associated with many Biological Engineering programs include the American Society of Agricultural and Biological Engineers (ASABE)[3] and the Institute of Biological Engineering (IBE),[4] which generally encompasses BSE. Some program also participate in the Biomedical Engineering Society (BMES) [5] and the American Institute of Chemical Engineers (AIChE).[6]

A biological systems engineer has a background in what both environmental engineers and biologists do, thus bridging the gap between engineering and the (non-medical) biological sciences – although this is variable across academic institutions. For this reason, biological systems engineers are becoming integral parts of many environmental engineering firms, federal agencies, [27] and biotechnology industries. A biological systems engineer will often address the solution to a problem from the perspective of employing living systems to enact change. For example, biological treatment methodologies can be applied to provide access to clean drinking water [7] or for sequestration of carbon dioxide.[8] In economics, land comprises all naturally occurring resources as well as geographic land. Examples include particular geographical locations, mineral deposits, forests, fish stocks, atmospheric quality, geostationary orbits, and portions of the electromagnetic spectrum.[28] Supply of these resources is fixed.[1] Land is considered one of the three factors of production (also sometimes called the three producer goods) along with capital, and labor. Natural resources are fundamental to the production of all goods, including capital goods.[2] While the particular role of land in the economy was extensively debated in classical economics it played a minor role in the neoclassical economics dominant in the 20th century.[3] Income derived from ownership or control of natural resources is referred to as rent.[2]

III.RESULTS

Mechanised agriculture or agricultural mechanization is the use of machinery and equipment, ranging from simple and basic hand tools to more sophisticated, motorized equipment and machinery, to perform agricultural operations.[1] In modern times, powered machinery has replaced many farm task formerly carried out by manual labour or by working animals such as oxen, horses and mules.The entire history of agriculture contains many examples of the use of tools, such as the hoe and the plough.[29] The ongoing integration of machines since the Industrial Revolution has allowed farming to become much less labour-intensive.Agricultural mechanization is part of this technological evolution of agricultural automation.[2] It can be summarized as a progressive move from manual tools to animal traction, to motorized mechanization, to digital equipment and finally, to robotics with artificial intelligence (AI).[3] These advances can raise productivity and allow for more careful crop, livestock, aquaculture and forestry management; provide better working conditions; improve incomes; reduce the workload of farming; and generate new rural entrepreneurial opportunities.[3]Current mechanised agriculture includes the use of tractors, trucks, combine harvesters, countless types of farm implements, aeroplanes and helicopters (for aerial application), and other vehicles. Precision agriculture even uses computers in conjunction with satellite imagery and satellite navigation (GPS guidance) to increase yields. New digital equipment is increasingly complementing, or even superseding, motorized machines to make diagnosis and decision-making automatic.[2]Mechanisation was one of the large factors responsible for urbanisation and industrial economies. Besides improving production efficiency, mechanisation encourages large scale production and sometimes can improve the

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quality of farm produce. On the other hand, it can cause environmental degradation (such as pollution, deforestation, and soil erosion), especially if it is applied shortsightedly rather than holistically.[30]

Motorized mechanization has substantially expanded at global level, although it has been unevenly and inadequately adopted particularly in sub-Saharan Africa.[2] Mechanization is limited to a range of operations including harvesting and weeding and is rarely used for fruit and vegetable production across the globe.[13]Extensive adoption started in the United States of America, where tractors replaced about 24 million draught animals between 1910 and 1960 and become the main source of farm power.[14] United Kingdom first started using tractors in the 1930s, but agricultural transformation in Japan and some European countries (Denmark, France, Germany, Spain and former Yugoslavia) did not take place until about 1955[31]. Thereafter, the adoption of motorized mechanization took place very quickly, completely superseding animal traction.[15] Using tractors as farm power enabled, and even triggered, innovations in other agricultural machinery and equipment that greatly eased the toil associated with agriculture and allowed farmers to carry out tasks more quckly.[16] At a later stage, motorized machinery also increased in many Asian and Latin American countries.[13]

Sub-Saharan Africa is the only region where adoption of motorized mechanization has not progressed over the past decades.[17][18] A study in 11 countries proves this low level of mechanization in the region, finding that only 18 percent of the sampled households have access to tractor-powered appliances. The remaining ones make use of either simple hand-held tools (48 percent) or animal-powered equipment (33 percent).[18] Agribusiness is the industry, enterprises, and the field of study[1] of value chains in agriculture[2] and in the bio-economy,[3] in which case it is also called bio-business[4][5] or bio-enterprise. The primary goal of agribusiness is to maximize profit while satisfying the needs of consumers for products related to natural resources such as biotechnology, farms, food, forestry, fisheries, fuel, and fiber.Studies of business growth and performance in farming have found successful agricultural businesses are cost-efficient internally and operate in favorable economic, political, and physical-organic environments. They are able to expand and make profits, improve the productivity of land, labor, and capital, and keep their costs down to ensure market price competitiveness.[6]Agribusiness is not limited to farming. It encompasses a broader spectrum through the agribusiness system which includes input supplies, value-addition, marketing, entrepreneurship, microfinancing, and agricultural extension.In some countries like the Philippines, creation and management of agribusiness enterprises require consultation with registered agriculturists above a certain level of operations, capitalization, land area, or number of animals in the farm[32]. An agriculturist, agriculturalist, agrologist, or agronomist (abbreviated as agr.), is a professional in the science, practice, and management of agriculture and agribusiness. It is a regulated profession in Canada, India, the Philippines, the United States, and the European Union. Other names used to designate the profession include agricultural scientist, agricultural manager, agricultural planner, agriculture researcher, or agriculture policy maker.The primary role of agriculturists are in leading agricultural projects and programs, usually in agribusiness planning or research for the benefit of farms, food, and agribusiness related organizations. Agriculturists usually are designated in the government as public agriculturists serving as agriculture policy makers or technical advisors for policy making. Agriculturists can also provide technical advice for farmers and farm workers such as in making crop calendars and work flows to optimize farm production, tracing agricultural market channels, [33] prescribing fertilizers and pesticides to avoid misuse, and in aligning for organic accreditation or the national agricultural quality standards.Preparation of technical engineering designs and construction for agriculture meanwhile are reserved for agricultural engineers. Agriculturists may pursue environmental planning and focus on agricultural and rural planning.[34]

IV.CONCLUSIONS

Studies of agribusiness often come from the academic fields of agricultural economics and management studies, sometimes called agribusiness management.[2] To promote more development of food economies, many government agencies support the research and publication of economic studies and reports exploring agribusiness and agribusiness practices. Some of these studies are on foods produced for export and are derived from agencies focused on food exports. These agencies include the Foreign Agricultural Service (FAS) of the U.S. Department of Agriculture, Agriculture and Agri-Food Canada (AAFC), Austrade, and New Zealand Trade and Enterprise (NZTE).The Federation of International Trade Associations publishes studies and reports by FAS and AAFC, as well as other non-governmental organizations on its website.In their book A Concept of Agribusiness,[8] Ray Goldberg and John Davis provided a rigorous economic framework for the field. They traced a complex value-added chain that begins with the farmer's purchase of seed and livestock and ends with a product fit for the consumer's table. Agribusiness boundary expansion is driven by a variety of transaction costs.[35] As concern over global warming intensifies, biofuels derived from crops are gaining increased public

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and scientific attention. This is driven by factors such as oil price spikes, the need for increased energy security, concern over greenhouse gas emissions from fossil fuels, and support from government subsidies. In Europe and in the US,[36] increased research and production of biofuels have been mandated by law. Industrial agriculture is a form of modern farming that refers to the industrialized production of crops and animals and animal products like eggs or milk. The methods of industrial agriculture include innovation in agricultural machinery and farming methods,[38] genetic technology, techniques for achieving economies of scale in production, the creation of new markets for consumption, the application of patent protection to genetic information, and global trade.[37] These methods are widespread in developed nations and increasingly prevalent worldwide. Most of the meat, dairy, eggs, fruits and vegetables available in supermarkets are produced in this way.[39]

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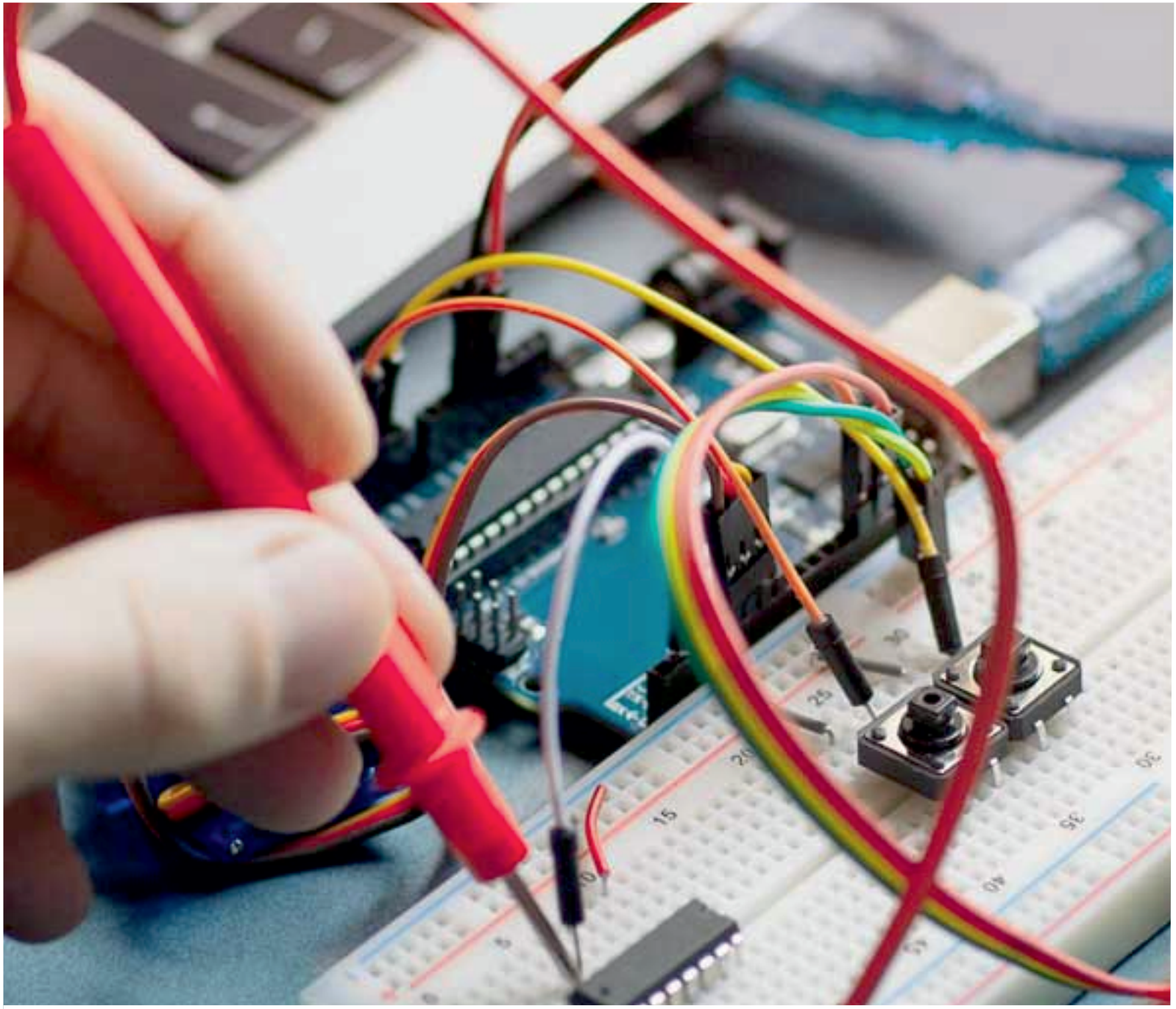

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