CHAPTER 9

IMPERIALISM AND THE TRANSFER
OF AGRICULTURAL TECHNIQUES

by

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At the beginning of the period covered by this essay (1850–1960), most of the inhabitants of sub-Saharan Africa were living outside the money economy. Apart from the cities of the savannah belt in the Western Sudan, the towns of the West African forest zone, and the maritime entrepôts along the east coast and some comparable settlements, Africans largely depended on agricultural economies of the household type. There was little specialization of production. Producers relied, above all, on a plentiful supply of land to provide for their subsistence. Methods of production varied in accordance with the dictates of nature. Over the centuries, moreover, African farmers had managed to adapt a considerable number of foreign crops, such as maize, to local conditions. Nevertheless, methods of production generally remained rudimentary. There was rarely any population pressure to force an intensification of land use. The volume of trade was so limited that it was usually insufficient to induce tillers to increase their output beyond the immediate needs of the tribe or family.

By the end of the colonial era, however, the colonial impact had created conditions that had a substantial bearing on raising agricultural output and trade. The establishment of 'law and order' and the advent of the administrator, teacher, missionary, tax collector and trader all contributed to the need to produce a surplus to meet money obligations. The development of transport systems, especially railroads and low-cost shipping, facilitated such a rapid expansion of external trade that during the period under review a marketable surplus was produced above and beyond subsistence. The surplus was large enough to meet the demands of the expanding urban centres in Africa, as well as to provide the major exports to earn foreign exchange with which to finance imports needed to foster economic development.

Sub-Saharan Africa is still the least-developed region in the world in terms of the proportion of total resources used to maintain the population; for instance, agricultural productivity is still extremely low by international standards. Nonetheless, there has been a considerable increase in agricultural output since the middle of the nineteenth century, and most notably since the first decade of the twentieth century. Part of this increase has come from extending age-old methods of cultivation to new lands, and part from exploiting natural resources, such as wild rubber or oil-palms, when a market has opened for these products. The introduction of new, higher-value crops has undoubtedly contributed most to the expansion of output, but there have also been increases in productivity that have come from technological changes in the agricultural sector. Technological changes in agriculture, which may be defined as the introduction of new or improved inputs in the production process, are changes that take
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considers the efforts made under colonial administrations to promote agricultural development and technological change, especially by promoting research. The conclusion gives a brief review of the scientific and technological legacy related to agriculture left by the colonial powers on the eve of independence in Africa.

Technological change and the transfer of technology in agriculture

In theory, technological change in agriculture is the same as that in any other sector of an economy: it involves the introduction of a new or improved input in the production process. Emphasis is laid on this approach because technological change extends beyond the concept of more skilful management or better organization of existing resources—namely, there is a shift in the production function rather than a more efficient use of existing inputs. Examples in agriculture in contemporary Africa can illustrate this difference: farmers in many countries are advised to change from broadcasting seed to planting in straight rows so as to increase yields per acre. Where no new factors of production are used, then, this will represent a change in technique whereby the farmer expects yields to rise because of the benefits from improved spacing of his plants. However, if, as is the more usual case—as with cotton in Uganda—farmers introduce row planters or new seeds and chemical fertilizers at the same time as they shift to planting in straight rows, this represents a technological change. Technological changes involve the introduction of some form of additional capital in the production process. This, in turn, usually requires some change in the management and techniques of production if the capital is to be combined efficiently with other factors of production. The international transfer of technology involves the transfer of a new input developed and used in one country to another. If this item is to be used efficiently, the transfer usually requires a transfer of techniques as well.

Although the principles of technological change and the international transfer of technology tend to be applicable to all sectors of an economy, several aspects of this process are peculiar to agriculture, especially as they relate to transfers from Europe to Africa. The distinctive aspect of agricultural technology, for instance, is that it deals with inputs and end-products that have a lifecycle of their own. For analytical convenience, inputs used to produce agricultural products may be described as reproducible and non-reproducible. The reproducible, such as seed and animal breeding-stock, are those that have inherent qualities of their own, that are influenced by the physical environment and that reproduce themselves. These qualities can be modified by breeding programmes that change the genetic base of a specific plant or animal. Thus it is possible for plants or animals to evolve through a process of natural selection or to be bred in such a way as to flourish within a given physical environment. However, since all reproducible inputs are sensitive to their environment, a plant or animal that flourishes in one physical environment will not necessarily flourish in another. A reproducible input suited for conditions in temperate

1 See Montague Yudelman, Gavan Butler and Ranadev Bunerji, Technological change in agriculture and employment in developing countries (Paris, Organization for Economic Co-operation and Development, 1971), passim.
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...Africa and for most export crops by the 1940s, but that for most food crops was only getting under way in tropical Africa by the 1960s.

An important aspect of the final stages of the international transfer of technology is that research must be applied in situ within the host country. Basic research in plant classification, genetics, biology and physiology may be universal in character and may be undertaken in any location, provided that there are suitable facilities to simulate different physical conditions. In addition, the initial import of new inputs may be undertaken without localized research. Many tropical products, for example, have been transferred from Latin America to Africa or the Far East by way of the Herbarium at Kew Gardens. Transfers such as the importation of rubber seeds from Brazil (*Hevea brasiliensis*) into Ceylon and Singapore were facilitated by the classification and multiplication of seed in Kew Gardens and by the subsequent transfer of this seed to botanical gardens in the Far East, where there was further multiplication. However, once the stage is reached when it is necessary to adapt both inputs and techniques of production to local circumstances, this can be done only within the area where the commodities are to be produced. It is only there that it is possible to test, systematically, how an input or a package of inputs will perform in circumstances under which they may be used for production. Thus, in the final analysis, the creation of facilities for research, together with the creation of a capacity to undertake research—including the human capacity—is necessary if any region wishes to adapt imported technologies to a given physical environment. Research of this kind, intended to benefit producers in sub-tropical Africa, cannot be undertaken in Europe, for, unlike research related to other sectors of the economy, agricultural research and product development tend to be both product specific and location specific.

Thus far, my discussion has concerned itself with the problem of transferring biological inputs, but in agricultural production farmers the world over use a wide variety of manufactured goods. The non-reproducible goods that are used are associated with the level of development of the agricultural economy. In isolated, underdeveloped and primitive economies, these items are usually made within the family household, and might include tools such as digging sticks, simple hoes and sleds for transport. With the growth of trade there will be increased specialization of production and division of labour. An increasing proportion of the inputs purchased by farmers will be manufactured off the farm. These might be developed and produced by local artisans and small workshops or they might be imported. An increase in trade between the agricultural and non-agricultural sectors will give rise to a larger-scale, domestic manufacture of these goods. Alternatively, they will continue to be imported. These articles may well be manufactured by extremely large-scale, capital-intensive, high technology industries, such as the chemical fertilizer and pesticide industry or the tractor-manufacturing industry.

Unlike reproducible inputs, there are no physical constraints on the transfer throughout the world of such capital inputs as machines. Certain economic considerations do have a bearing on the appropriateness of the manufactured inputs that are transferred among nations. Because the largest markets for capital goods used in agriculture (such as tractors and heavy implements) are to be found in the high-income countries, these goods are largely designed for the...
conditions existing in these markets. Such conditions usually include a relative scarcity of labour and an abundance of capital. In the low-income countries, in contrast, there is a relative abundance of labour and a scarcity of capital. Thus the transfer of technology that is capital-absorbing and labour-displacing may be undesirable from the point of view of increasing returns to society. Such a transfer might be encouraged by economic policies in the importing countries that undervalue capital and foreign exchange while overvaluing the price of labour. In addition, some importing countries may be forced to fall back on capital-intensive technologies because no alternative intermediate system is available to them. The manufacturers of these capital-intensive technologies, for their part, may have very little interest in developing less sophisticated systems because of the low rate of return.

The availability of complementary skills is a necessary condition for the successful introduction of new technology. The more complex the technological change, the greater the skill component in effecting the change. The most successful technological changes in agriculture in colonial Africa tended to be those that were the least demanding in terms of additional skills. The successful introduction of new crops such as maize was due partly to the ease with which these crops were cultivated and harvested. Similarly, the ease of cultivation is largely responsible for the spread of some tree-crops such as cocoa.

The least successful attempts to foster technological change in colonial Africa were made in the post-World War II years when there were several schemes to encourage the use of machine technology, such as tractors. The costs of operation and maintenance of these machines tended to make the schemes impracticable. Part of the reason for these high costs was a shortage of trained and skilled personnel. This did not apply in areas such as those parts of southern and Central Africa settled by Europeans. Here the settlers brought with them skills acquired by education and experience that were transferred when they migrated. The pattern was similar to that in North America and Australasia; but, of course, the number of European migrants to Africa were a minute fraction of those who went to the temperate zone regions of North America and Australasia.

A further aspect of the transfer of technology relates to the diffusion of new inputs among farmers. In this regard it is axiomatic that producers must have appropriate incentives if there is to be widespread technological change. Because the number of individual decision-makers in agriculture is substantial, any widespread technological change must appeal to a large number of producers. In some instances changes might be enforced, as in the early 1900s when compulsion was used to force producers in Uganda or the Congo to grow cotton or food-crops. In the main, though, producers will adopt changes only when they consider it to be to their advantage.

During the colonial era it was not always appreciated that all indigenous producers might not see the desirability of change in the same light. Nor did policy-makers appreciate that there might be differences in outlook within the same societies and between societies. In some societies, for example, innovators might be highly motivated to increase output, even though the adoption of a technological change might require added inputs of labour. Others, who did not adopt the change, might have preferred added leisure to added output, especially if there was little opportunity to trade the increased output. In some
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societies—especially in poor subsistence economies—producers might not be interested in change because they might consider the inherent risks too great. Subsistence producers might have evolved methods of production by trial and error to maximize risk aversion, as the risk of crop failure might mean hunger and starvation. In the eyes of such a group the potential benefits from change might not be equal to the premium they placed on risk aversion. In other instances, the value that the local populace attached to a commodity—such as cattle in parts of South and East Africa—might far exceed the apparent market value because of the special role that cattle play in these societies. In very broad terms, though, as a society becomes monetized, so producers tend to adopt those changes that will add to their real incomes and so costs and prices per unit of output tend to become important determinants of the direction of technological change.

Once it is recognized that costs and prices influence the direction of technological change, then it may be seen that technological change in agriculture is not a phenomenon that is isolated from events outside the agricultural sector. The interdependence of agriculture and the other sectors of the economy and the subsequent inter-sectoral linkages influence both costs and prices in agriculture, and so the adoption of new inputs. The opening of railways, which were so important in African development, for example, may be a prime factor in encouraging technological change. Costs of transporting bulky crops may be sharply reduced, thus making it profitable for farmers to introduce new export crops into an area where formerly the marketing costs had been too high. The development of the mining industry, as happened in South Africa, can encourage technological change in agriculture; an expansion of a labour-intensive mining industry might result in a rising cost of labour, thus encouraging farmers to substitute animal or machine-drawn equipment for labour at the farm level. The development of a new low-cost method of producing chemical fertilizer, as occurred in the 1920s in Europe, may shift the cost-price ratio between chemical fertilizer and the price of a product to favour the use of fertilizer. Indeed, because agricultural progress in tropical Africa was closely linked to the development of world markets, the major impulses for introducing technological changes in African agriculture came in response to development outside Africa.

The transfer of technology and the spread of technological change in agriculture depend on a host of factors, cultural, social, economic and physical. Whatever the origins of a new input in a specific area, this input usually requires some adaptation in a given environment. This means there has to be localized research, which must frequently be financed out of public revenues. The allocation of public expenditures thus becomes an important factor influencing the transfer of technology and techniques of production. The diffusion of the new technology requires the spread of knowledge that makes it readily accessible to farmers. In the final analysis, though, the rate of adoption of the new input will depend on the extent to which farmers believe their best interests can be served. In the early pre-colonial period in Africa, the absence of an internal market of appreciable size limited the demand for agricultural output. It was the opening of the export markets that provided the major stimulus for both technological change and agricultural development.
Africa is a vast continent that covers a multiplicity of climatically diverse regions, many of them isolated from one another by deserts, mountains or forests. Some nine-tenths of sub-Saharan Africa is situated within the tropics, with the temperate zones being primarily in the Republic of South Africa. The interior of tropical Africa remained for the most part isolated from the world, partly because of the effects of the tropical environment on Europeans and partly because of the inaccessibility of the African hinterland. With the exception of the salubrious areas, such as those in the Republic of South Africa and, to a much lesser extent, in Rhodesia and Kenya, there was very little permanent immigration from outside Africa. Thus the problems attendant on encouraging technological change in agriculture in Africa, unlike those in North America and Australasia, were related to encouraging change among an unlettered and unschooled indigenous population inhabiting an area about which very little was known even as late as the mid-nineteenth century.

Early African agriculture was based on a system of shifting cultivation that was rational from a technical and economic point of view in the circumstances that prevailed. Technically, it was a concession to the nature of the soil and the climate, especially the erratic rainfall. The soil is poor in many parts of tropical Africa, particularly in the semi-arid regions of Central and East Africa; and shifting cultivation has in the past prevented depletion of the soil in the absence of an appropriate technology to meet the requirements of sedentary cultivation. A relatively sparse population using primitive techniques of production was in ecological balance with its environment. Economically, within the limit of his horizons, the African producer was rational in his production methods. Land was plentiful, labour was relatively scarce and capital almost nonexistent. The plentiful and free land supply was substituted for any intensive labour effort that might have required extra energy-inputs (which undoubtedly had a cost). Thus land was used extensively to produce a limited output; output per acre and per man must have been low. Some of the larger centres, cities like Timbuktu, Kano and Ibadan, drew for their provisions on imports from the countryside. But in most parts of the subcontinent, the bulk of the crops was produced for consumption within the span of the season before the new harvest was brought in. There was little diversion of effort for ‘round-about’ production. Irrigation works, such as those built by the ancients in parts of East Africa, were few and far between. Capital formation consisted mainly of land clearance, the building of simple storage facilities and the production of uncomplicated tools. Economically, these were backward societies. The range of choice, both for producers and for consumers, was limited. Surpluses were limited; and even though there was usually some form of trade in salt, iron and other valuable commodities, producers had to live mainly on what they grew themselves or on what they could take away from others by force.

The first changes in African agriculture that followed on the expansion of European interest in the region were not so much changes in techniques of production as in the introduction of new crops. Before the advent of the Europeans the more important indigenous food-crops included sorghums, millets, yams, native rice, teff and certain wheats. A few crops, such as teff, had, and still have, a limited geographical range, whereas others, such as sorghum and
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Millet, provide the staple diet throughout the semi-arid areas of the continent—namely, from Senegal to the Sudan and southern Africa. As well as the indigenous crops came others, primarily by means of Arab traders from the East, and they included cloves and spices. Later, the Portuguese brought into the region major crops from the New World, such as cassava, sweet potatoes, ground-nuts and tobacco.

Perhaps one of the more important food-crops introduced into Africa in the sixteenth century was maize, which is now a staple food throughout much of the continent south of the Sahara. The introduction and the spread of this crop were not systematic, but seem rather to have taken place because the qualities of maize made it culturally and economically acceptable. It was introduced at first on the east and west coasts in order to supply a suitable foodstuff for ships’ crews. Later, the demand increased because maize seemed suitable for feeding to slaves on the long voyages to the New World. Thereafter, it penetrated the hinterland very rapidly. In Uganda, for instance, maize growing spread through much of the territory between 1840 and 1900. Here again, though the reasons are subject to speculation, the physical attributes of the crop seem to have encouraged its acceptance and diffusion. It is easy to plant and to harvest, and it can be stored and transported and converted into edible food without too much difficulty. Thus it was an ideal commodity for provisioning travellers, for trading and for use by marauding parties.

In contrast to maize, other commodities, such as Asiatic rice and cassava, spread much more slowly through the regions in which they could be cultivated. Asiatic rice is labour-intensive, and labour was scarce in Africa; and because the rice grew in the areas infested by tsetse-fly, it was not possible to substitute animal labour for human labour. Consequently, producers tended to prefer to grow the less labour-intensive crops that were less demanding. Cassava, for example, grows very readily in tropical Africa, but technology for converting it into an edible food-crop requires the removal of the prussic acid in this root crop. The difficulty in adopting this technology slowed down the spread of this crop. It was only when former slaves from Brazil returned to West Africa that a suitable technology for the preparation of manioc meal was diffused. Thereafter its production increased very rapidly.

There were attempts before 1880 also to introduce new commodities and inputs into regions suited for European settlement. The major efforts in this direction were made in South Africa, where the earliest settlers grew maize and wheat. In addition, though, new crops introduced into South Africa included grapes brought into the Cape by the Huguenots, sugar cane introduced into Natal and merino sheep imported into the Cape. The settlers introduced horses as well, which provided mobility for the Voortrekkers.

During the period 1880–1950, the colonial powers gradually assumed increasing responsibility for the development of agriculture in sub-Saharan Africa. Before the Berlin Act and the subsequent scramble for Africa, they tended to follow a policy favouring the expansion of markets rather than developing new regions through government intervention. A variety of pressures—

1 See Marvin P. Miracle, *Maize in tropical Africa* (Madison, University of Wisconsin Press, 1966), passim.
2 Thomas R. De Gregori, *Technology and the economic development of the tropical African frontier* (Cleveland, Press of Case Western Reserve University, 1969), passim.
humanitarian, economic, financial, commercial and political—led the colonial powers to intervene in the economic development of these territories. Initially, though, in the absence of direct government intervention in agriculture, it was the private corporations or individuals, missionaries and traders who assumed important roles in developing agriculture.  

The humanitarian impulse of the missionaries was directed largely at the abolition of the slave-trade. However, slave porterage was essential for the ivory and rubber trades, so that if the slave-trade was to be ended, it was necessary to develop alternative exports and a supporting transport system. Traditional commercial activity fitted comfortably into this general scheme of expanding trade, so that mission societies soon became involved in promoting trade as well as agricultural development.  

Successful evangelization often began with the establishment of a plantation, or else economic necessity required that the mission station develop a plantation. Consequently, some missionaries imperceptibly became settlers (though early attempts to found self-supporting Methodist missions failed). The dual in-

6 EDITORS’ NOTE: The notion of planned economic development was becoming widely current by the beginning of the twentieth century. In Germany, Bernhard Dernburg (in charge of colonial affairs 1906-10) had very clear ideas on how to develop the colonies through the creation of a logistic infrastructure and of specialist services. The Germans founded African agricultural schools, such as Nuajja in Togo, and research centres, such as Amani in East Africa. The Kolonial-Wirtschaftliches Komitee promoted the cultivation of cotton. The British under Joseph Chamberlain, colonial secretary 1895-1903, had both planners and a plan. Pressure from shipping and merchant interests, cotton manufacturers and others pushed government into providing some infrastructure to develop West Africa. Railways and roads and ports were built. Humanitarian interests dictated health measures. The official plans called for the development of trade, and governors were appointed who had qualifications in port and railway construction and public health. For example, in South Nigeria, Governor William MacGregor and Sir Ralph Moor stressed agricultural development by experimentation, testing of plants for their economic value and supplying farmers with seed, seedlings and saplings from the government botanical gardens. The seedlings for coffee, kola, cocoa, maize, oil-palm and citrus and other fruits produced at the Royal Botanical Gardens at Kew helped to improve the people’s diet and led to the development of economic crops. Farmers were given instruction in cultivation, and gardeners and demonstrators were provided. The new steel matchetes made it easier to clear the bush, and new crops were planted for food and export. Economic plants were brought from the West Indies, and American experts in cotton-growing and stock-raising came to Lagos. These people not only tried to develop new export crops, but planted new trees to conserve and develop forest resources as well. The Southern Protectorate of Nigeria also encouraged agriculture and market gardening. It introduced new crops and experimented in agriculture. It had botanical gardens and an experimental cotton plantation, and brought in cattle from Barbados. Although many ideas failed, some succeeded, notably those involving mangoes, tobacco, firewood plantations, cocoa, kapok, cinnamon, raffia and kola. The protectorate experimented also with jute, castor oil, bananas, maize, and ground-nuts. (See I. F. Nicolson, The administration of Nigeria, 1900-1961 [Oxford, Clarendon Press, 1969], for details.) Similar work was done in Kenya, Uganda and Southern Rhodesia.  

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Interest in evangelization and agriculture also inspired some crop experimentation and agricultural education. Missionaries were responsible for the introduction and dissemination of many important export crops in Africa.

Missionaries helped to lay the foundations of the cotton industry in Uganda. In 1903, the industrial mission of the Church Mission Society imported from the United States sixty-two bags of cotton-seed of five varieties. This seed, along with some imported from Egypt by the government, was distributed among the chiefs. It soon became apparent that the long-staple, American upland variety flourished in the environment of Uganda. From this seed, which in 1904 was given to about thirty growers of the Ugandan Trading Company, established by the mission, some forty-five tons were harvested. The crop was so successful, in fact, that whereas in 1904 there were 500 applicants for seed and more than 240 bales of cotton were exported, by 1914 some 27,000 bales were exported. Missionaries also introduced coffee into East Africa. The White Fathers’ mission in Kenya brought arabica coffee to that country where, after many technical difficulties were resolved by the agricultural department, it became an important export crop. Missionaries introduced other minor crops, too, varying from cinnamon and ginger to potatoes and onions. They also helped with the dissemination of improved seed, playing an important part in fostering the rapid growth of the cocoa industry in the Gold Coast, tea and coffee in Malawi, and fruit and vegetables in Zambia.

In addition to these contributions, the missionaries helped to spread improved techniques of production. The Jesuits and Seventh-Day Adventists helped to introduce the ox-drawn plough to the Tonga of Northern Rhodesia. The London Missionary Society in north-eastern Zambia introduced the use of manure and the practice of laying out gardens in beds. In Malawi, missionaries and missionary workers played an important role in the introduction of cotton culture and dairy farming. Individual missionaries made lasting contributions to agricultural development. Among the most successful of the missionary teachers were two American agriculturists, George Arthur Roberts and Emory Alvord, both of whom worked in Southern Rhodesia. Roberts taught agriculture to Africans from 1908 to the 1960s. He introduced the plough and taught Africans to train and to use their cattle as draught animals to till soil that had previously been left idle. In 1914 he added dairy cows to his training programme, and soon after, the proper care and feeding of poultry. His innovations were numerous. He practised the first contour-ploughing to stop the erosion that accompanied tropical rains; he organized agricultural shows to stimulate improved farming and animal husbandry; he taught Africans to irrigate; and he tried new crops, vegetables, trees, pest controls and improved stock-breeding, ditching and draining. Significant as Roberts’s contributions were, his influence was largely confined to the vicinity of his mission, whereas Alvord, in his efforts to improve African agriculture, covered the entire colony of Southern Rhodesia.

Alvord, who had a master of science degree in agriculture, came to Southern Rhodesia in 1919 to work with the Congregational Church Mission. For seven years he ran an agricultural course in the mission school and worked out a comprehensive scheme for demonstration and extensive work. In 1920, when he had been in Southern Rhodesia only a year, he was asked to assist in drawing up plans for a new government agricultural school at Domboshawa that had
been authorized recently. He spent some time at Domboshawa instructing the staff and the African students in subjects such as crop rotation, proper ploughing, manuring, the use of legumes and row planting. Alvord was appointed agriculturist for the instruction of Africans in 1925, and spent the next thirty years training Africans in his demonstration techniques. Successful demonstrations of improved farming and animal-husbandry techniques required that Alvord-trained Africans live in the villages and actually plant and raise cattle. They were equipped with new knowledge, seeds, fertilizers and tools. Alvord also taught the use of the plough and introduced manuring, new crops and so forth. He taught Africans how to conserve and maintain their soil, how to plant and tend their crops, to care properly for their cattle and to maintain proper pasturage and to increase the amount of arable land; in addition, he introduced irrigation. He taught Africans to live in planned and well-constructed villages, rather than to scatter at will, planting their crops haphazardly wherever there seemed to be space. In this way it was possible to improve their water supplies, to achieve better sanitary conditions and to keep pastures and cultivated fields separate.

In general, missions performed a valuable task in helping to create some of the conditions necessary for technological change in agriculture. They introduced new inputs such as the plough and seed and encouraged their diffusion; and they taught some of the complementary skills needed to utilize the new inputs. Through the spread of literacy, they paved the way to a better understanding of the scientific basis for agricultural production. Nonetheless, despite these efforts most missionaries were after all not agricultural scientists; their primary interests lay in other directions. Their main contribution to agricultural development and technological change in agriculture lay in their educational programmes and the spread of literacy. These programmes provided the first cadres of Africans who were to exert an influence on the development of their own educational systems, including those related to agriculture.

In the metropolitan powers there were commercial interests eager to exploit the resources of the colonies. Among the more successful of these was the British Cotton Growing Association (BCGA), financed largely by the cotton manufacturers of Liverpool, formed in 1902 to encourage cotton production in the hope of finding an alternative source of supply to the southern states of the United States. The association itself financed research trials, distributed seed, guaranteed the price of cotton, assisted in arranging transport for cotton and established ginneries in parts of Africa. In co-operation with the missionaries and with some local governments, the association undoubtedly played an important part in creating the cotton-growing industry in sub-Saharan Africa—an industry

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*Editors' note: Another example of a missionary who revolutionized African agriculture was Sam Coles, an Alabama Negro who went to Angola in 1923 as an agricultural missionary and served for thirty years in southern Angola among the Ovimbundu. Coles had been trained in agriculture and industrial arts at Talladega College. He introduced the plough, taught Africans to train their cattle to pull the ploughs, to carry water, to stomp trees and to transport logs and crops. He introduced new crops such as wheat and fruit and showed people in a 300-mile area around his mission station how to improve their crops and to farm previously unused land. See Samuel B. Coles, *Preacher with a plow* (Boston, 1957).

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dominated by small-scale African producers. In 1921 the association was superseded by the Empire Cotton Growing Corporation, which was supported by the British government. The corporation focused its research on improving the genetic quality of cotton plants and worked closely with the Shirley Institute in England to enhance the ginning characteristics of African cotton. It operated a series of research stations in sub-Saharan Africa, including stations in South Africa, Sudan and Uganda. As the number of cotton growers expanded, the corporation’s work shifted more towards resolving practical problems of cotton production, such as improving practices and techniques of production and protecting crops. There is no doubt that between 1902 and 1920 the BCGA assisted substantially in the founding of the cotton industry in Africa; nor can there be any question that the corporation made a major contribution towards the expansion of that industry over the years 1920-60. The dramatic impact of its contribution may be gauged from the record of one country, Uganda, which in 1904 exported no cotton, exported 1.5 million 100-pound bales of cotton in 1959.

Other commercial interests that fostered technological change in African agriculture included processors of raw material, such as the manufacturers of tobacco. Tobacco companies, such as the Nigerian Tobacco Company and the East African Tobacco Company, assisted African producers to provide the raw material needed for their cigarette and tobacco factories. To this end, the companies sponsored research and production of seedlings and of high-quality tobacco. The seedlings were then distributed to farmers who were given technical advice, credit and supplies, including help in building small curing barns. The companies purchased this tobacco at a guaranteed price. In Nigeria, where the programme started in 1934, 400,000 pounds of tobacco was sold by the farmers by 1938. In East Africa, the tobacco companies started somewhat later; but by 1960 both Nigeria and the three countries of East Africa—Uganda, Kenya and Tanzania, formerly known as Tanganyika—had a self-sufficient tobacco industry. In addition, large numbers of hitherto subsistence producers, such as those in the West Nile region of Uganda, were able to enter the money economy and to enjoy a much higher level of living than hitherto.

The trading companies were still another element in the private sector that contributed towards agricultural development and technological change in sub-Saharan Africa. These companies appeared to provide a means of resolving the dilemma of expanding colonial hegemony while limiting government enterprise and extending government administrative expenses. The chartered company became an important vehicle for this purpose and was used in the British, German and Portuguese colonies.

The three British chartered companies—the Royal Niger Company, the Imperial British East Africa Company and the British South Africa Company—were founded in 1886, 1888 and 1889, respectively. Of the three, only one was a financial success, the Royal Niger Company, operating in the Niger basin. This may be partly explained by a sequence of technological changes outside


11 EDITORS' NOTE: Over the succeeding years the Nigerian Tobacco Company encouraged and taught Africans to grow and to cure better varieties of tobacco and to form co-operatives and producer groups. They also gave technical advice and lent Africans money.
Africa that provided the stimulus for an expansion of trade in palm-oil products. The first of these changes was the invention and the increased use of the steamship, which reduced substantially the costs of ocean transport. This lowered the price of palm-oil and thereby increased demand until the expansion of this trade was limited by the substitution of petroleum for palm-oil. The decline in value of palm-oil exports, however, was offset by a further technological innovation that increased the use of palm-kernels. This innovation, called the Loder process, led to the manufacture of margarine and permitted palm-kernels to be used as a low-cost substitute for animal oleo. It was not long before palm-kernels, previously unused, surpassed palm-oil as an export.

The company’s main interests were in trading in products already produced in the region rather than in developing new products or new techniques of production. Nonetheless, the company did undertake some experimental work in agriculture through the establishment of botanical stations manned by officers trained at Kew in London. At Abutshi, attempts were made to cultivate cocoa, coffee, fruit trees, cotton and indigo; and there was a small experimental rubber plantation at Koonini as well as an experimental garden at Asaba. Except for the Asaba garden, which was totally unfit for cultivation because of its unfortunate location on the sand-banks of the Niger river, little is known about the operation of these stations.

The Imperial British East Africa Company, whose contribution to agricultural development was limited, was short-lived. The company established its own plantations for the production of coffee, undertook surveys and explored the possibilities of improving transport to the interior. The British South Africa Company looked to the exploitation of minerals in Central Africa for its main source of revenue. When its expectations were not realized, the company decided to capitalize on its very large concessions of land. Land was sold to companies, syndicates and individuals. In addition, the company hoped to attract European settlers and to exploit its own holdings for productive purposes. Although programmes for recruiting settlers never succeeded, the company made a major contribution to the development of the region by using its lands for investigating every branch of agriculture that might have held promise, especially the production and processing of tobacco, the growing of citrus under irrigation and the improvement of beef and dairy herds. However, these advances were confined to the European sector of the agricultural community, which in 1920 numbered some 20,000, compared with the 900,000 or so Africans who depended on the land for their livelihood. The research work initiated by the company laid the basis for one of the most successful programmes of research undertaken in Africa, which followed when Rhodesia became a self-governing colony in 1923.

Perhaps the most determined efforts were those of certain German Kolonialgesellschaften, which undertook the major task of agricultural development of the German territories in Africa between 1870 and 1915. These companies, backed by the German government, approached the development of agriculture in their colonies with a thoroughness that belittled the European country with the most advanced system for developing technological change in Europe. The Kolonial-Wirtschaftliches Komitee (KWK), founded in 1896, came to play an

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THE TRANSFER OF AGRICULTURAL TECHNIQUES

important role in promoting technological change in the German territories. It concentrated on introducing rational methods of production in the German colonies: Kamerun, German East Africa, Togo and German South-West Africa. It mounted scientific expeditions to various tropical regions, established nursery gardens in the colonies and undertook the chemical testing of tropical agricultural products and seeds. The chartered companies and plantation interests established a private colonial training school in 1898 to train European staff. Pressure from German industries led to the creation of special institutions to undertake research into seed production and the production of implements for colonial use, and to the establishment of a cotton board and a rubber board.

The chartered companies and the KWK assisted in introducing new inputs into their colonies. In 1893, a botanist working for the German East Africa Company introduced sisal agave from Florida into East Africa. Ten years later, East Africa exported 422,000 kg of sisal. The companies also introduced coffee, cotton and potatoes into German East Africa. The KWK was instrumental in promoting cotton production in the German territories. Cotton plantations, on which the first steam ploughing-engines and fertilizers were used on irrigated lands, were established in East Africa. In Togo, the KWK attempted to encourage the Africans to grow cotton; and, as part of this effort to transfer technology and techniques of production, six Negro farmers were brought over from the Tuskegee Institute in North America to introduce the crops to the Africans. 14

In other parts of Africa, notably in the French and Belgian territories, the private sector’s contribution to agriculture was through the concessionaire system, which was also part of the effort to reduce administrative expenses. Large-scale concessions granted to European enterprises enabled them to exploit the natural resources through the establishment of plantations. The exploitation frequently consisted of using forced labour to harvest the products already growing in a region rather than the promotion of a new product or the introduction of new techniques of management. The extent of exploitation of the local


14 EDITORS’ NOTE: The party of six Tuskegees arrived in Togo in 1901 and established an experimental farm. Among other things, they planted cotton, maize and ground-nuts. They had to overcome locusts, ants and chiggers, African indifference to cash-cropping, and seed failures. A hybrid was finally developed, and an agricultural school for over 200 students was in operation by 1907. Cotton production went from almost zero to 530,763 kilograms in 1911. Before 1914, Tuskegee also sent instructors to teach agricultural and industrial skills to Africans in the Sudan, Nigeria and the Belgian Congo.

The Tuskegee approach, as formulated by Booker T. Washington, emphasized practical education in agricultural and industrial skills (carpentry, blacksmithing, etc.). From 1900 on, hundreds of missionaries and colonial officials came to visit Tuskegee and Hampton institutes to learn how to offer practical education to Africans. The example and the lessons of Tuskegee were followed closely by many schools established in Africa. Included among these were the Zulu Christian Industrial School of Natal, the South African Native College, Fort Hare, the Lumbwa Industrial Mission of Kenya, the Mittel und Gehilfen Schule of German East Africa and Achimota College in the Gold Coast. After the First World War the Phelps-Stokes Fund carried forward the idea of practical agricultural education for Negroes in Africa and the United States. By supporting investigating teams and visits from Africa by missionaries and colonial officials, the Hampton-Tuskegee techniques of agricultural training were introduced into African schools.
populations led to a public outcry against the system, which, together with the lack of profitability of many concessions, resulted in the system's being abandoned or considerably modified.

By the turn of the century it was becoming increasingly accepted that the administration of the colonies was a public responsibility—a responsibility that the colonial powers gradually assumed along with the task of helping to develop the resources of the colonies. In this connection there was much disagreement as to how great a role private interests could play in agricultural development, especially as to whether large-scale European plantations were preferable to African smallholdings. In West Africa, climatic conditions more or less determined that development would rest in native hands and secure it there. European plantations were not allowed. In 1907 Lever Brothers failed to win plantation rights in Nigeria, and shortly thereafter, when a world shortage of vegetable oil and oil-seed increased the pressure for more efficient exploitation, the government promised its support for ground-nut cultivation. The government accepted responsibility for improving techniques of production. To this end, research was initiated into the improvement of the processing of oil so as to reduce the high wastage under peasant systems. In contrast to Nigeria, the Belgian authorities permitted Lever Brothers to have large-scale concessions in the Congo. These were administered so effectively by the local operatives that exports of oil-palm products from the Congo rose very rapidly. However, for many years there was no research into improving the technology of production, and the plantations were enclaves of development that had a minimal spread-effect regarding technological change among peasant producers of African oil-palm. It was only in 1936 that research was initiated into commodity problems and problems of establishing productive African farming systems.

In other regions, where the climate was more salubrious, governments encouraged policies of European settlement. The European settlers in South Africa, Southern Rhodesia and Kenya were pioneers and innovators. In areas such as South Africa, the immigrants brought European techniques with them to the Cape and Natal. In Southern Rhodesia they developed the tobacco industry, the main source of that country's agricultural income; and in Kenya, the coffee and dairy industries. In each instance, the largest proportion of the resources to develop new inputs and new techniques of agricultural production was allocated to the European settlers. Nonetheless, there was considerable progress among African producers in these regions, as evidenced by the acceptance of new means of production, such as ploughs, wagons, the use of farm manure and the growing of cash-crops.

As the notion of imperial responsibility developed, the public sector of the various governments assumed an increasing role in encouraging agricultural development and technological change in agriculture. Perhaps the most concerted effort was Germany's 'scientific colonialism'. Apart from the major efforts by


17 *Editors' note:* The Southern Rhodesian government also sought to improve the African reserves. They built bore-holes, wells and cattle-dips, and they introduced ploughs, seed and new
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the private sector, the government established what was probably the most advanced research station in Africa at Amani in East Africa. The government also introduced cocoa, rubber and coffee, promoted the cultivation of cotton, expanded palm-oil and coconut production, undertook reafforestation and planted trees. This programme yielded dramatic results in the increase in exports. A special feature of German development was the attention given to subsistence agriculture, with agricultural advisers being sent to each district to give instruction on a local level.  

French and British efforts at research differed from German mainly in that they were less concerted. The French followed a policy of specialized monoculture rather than attempting to diversify, taking the path of least resistance indicated by the resources of their colonies. Rubber seemed a promising prospect for a long while until, with the exhaustion of forests and the rise of eastern competition, the industry declined rapidly. Efforts to retrieve it by fostering plantation cultivation and by reafforestation were ineffectual. Palm-oil products then became the mainstay of the economies of Dahomey and timber of the Ivory Coast. The ground-nut was always the staple in Senegal, its production booming with the construction of railways into the interior and bringing in its wake a serious problem of soil depletion.

As in other areas, cotton cultivation was encouraged for a while, especially breeds of cattle. From the early 1900s onward, there was, in fact, an astounding increase in African production of maize, beef, ground-nuts, etc.

<table>
<thead>
<tr>
<th></th>
<th>1904</th>
<th>1914</th>
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<tr>
<td>Area cultivated by Africans (in acres)</td>
<td>159,000</td>
<td>936,173</td>
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<tr>
<td></td>
<td>1902</td>
<td>1913</td>
</tr>
<tr>
<td>African-owned cattle</td>
<td>55,155</td>
<td>377,000</td>
</tr>
<tr>
<td></td>
<td>1902</td>
<td>1913</td>
</tr>
<tr>
<td>African-owned sheep and goats</td>
<td>237,000</td>
<td>893,000</td>
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</tbody>
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Data are from Gann, History of Southern Rhodesia, pp. 185, 323.

The Southern Rhodesian government began to give more active support to African agriculture soon after responsible government was achieved. In 1924, government industrial and agricultural schools were set up at Domboshowa and Tjolotjo, where farming instructors were trained. In 1929, Alvord came under the newly organized Department of Native Education; and from the late 1920s, agricultural demonstrators began to work in the reserves. Southern Rhodesia was actually ahead in the provision of agricultural services for Africans in comparison with Colonial Office-administered territories like Northern Rhodesia and Nyasaland.

In Kenya, white farming did not prevent the emergence of African production for the market. Hickman notes: 'The year 1913 was prosperous for Africans as well as for the whites. The opportunity to export was beginning to make itself felt, and the shortage of land in the reserves would not reveal itself until after the war. Grain and pulses, mostly maize, beans and peas, headed the list of exports for the year ending March 31. 1913, with a value of £131,258, more than four times the amount exported just three years before.' ('Kenya and Uganda', p. 187.) In German East Africa, the development of German plantations producing commodities such as sisal did not prevent the rapid expansion of such African-grown crops as coffee and cotton.

after palm production in Malaya began to undermine the profitability of African palm production, but with little success. As the vicissitudes of monoculture trade became apparent, attempts were increasingly made to vary production again with little success. The full extent of these efforts may be appreciated from an examination of the Inspector of Agriculture’s report, with its flower-bed by flower-bed account of the various plants grown in government research stations. Under the control of the Fédération d’Afrique Occidentale Française was a Station Centrale Agronomique at Hann (founded 1903): which had a small laboratory and experimented with all types of soils and plants. Smaller, more specialized, stations existed at Koulikoro (1902) and at Banfofo (1904), the former experimenting with cotton and ostrich farming, among other things, and the latter dedicated largely to rubber-tree cultivation. By 1907, four other experimental gardens, specializing in cotton, rubber, fruits and sheep rearing, were established in Senegal and Guinea. A ground-nut research station at M’Bambey, founded in 1913, set the model for later specialized research stations. The work of such stations was often hampered by inadequate staffing and by a lack of knowledge about tropical conditions, knowledge that had to be acquired by trial and error.

Yves Henry, in his 1906 report on agriculture in French West Africa, emphasizes the limited role of these stations, announcing important departures in French agricultural policy. His criticisms are similar to those found in many recent reports on agricultural development throughout the tropical world. He took issue with the old policy that gave every experimental garden the research capacity for independent existence—a garden, a collection of plant specimens, a laboratory and an experimental farm—assuring it independence and continuity in information services. Not only was this system expensive, but it was suitable only for areas of monoculture because individual research stations could not diversify their experiments widely.

Further flaws in the old system were a fondness for showy foreign plants and sensational novelities, experimented with on a small scale and not yielding anything but speculative results—itself a symptom of a narrowness of interest on the part of the directors ‘qui s’hypnotisaient sur leurs carrés de cultures et, le plus souvent, ignoraient presque tout de la région dans laquelle ils se trouvaient placés’. This was accompanied by a tendency to implant European methods of cultivation in regions that were not ready for them, a tendency which forced the early closure of two stations which had over-ambitious plans involving full-scale European-style farms to teach Africans sophisticated agricultural techniques. In Senegal, large numbers of agricultural tools were given to stations for distribution to the Africans, but remained unused because it was not realized that success depended not simply on offering better tools, but on significant cultural changes to inculcate the concepts of individual property and industrialized production. Experimental gardens, which were of limited usefulness to African agriculturalists, were likely to fail when created with insufficient resources. They were dependent on a higher administrative bureau for their direction, and thus abrupt budget cuts and policy changes were often handed down.

Modest sums for crop experimentation were likely to be withheld in favour of grants for *culture maraîchère* for the direct support of the towns in which administration was centered. Henry embodied his administrative recommendations in a decree making agricultural services an independent branch of the federal administration.

The principle that each British colony should have a department of agriculture managing botanical gardens was endorsed by many governors before it was translated into action. Although government resources were scarce, the colonial governments did expand research efforts. This pattern of expansion may be illustrated by the experience of British West Africa. In the Gold Coast the first research station, the Aburi Agricultural Station, was established in 1890. Thereafter, the following stations were established: the Christianborg Coconut Plantation, 1901; the Aburi Rubber and Kola Plantation, 1902; the Tarkwa Agricultural Station, 1903; the Lalolobo Cotton Farm, 1904; the Kumasi Agricultural Station, 1906; the Assuantes Agricultural Station, 1907; and the Tamali Agricultural Station, 1909. Although the results of the early work of these stations is difficult to assess, experience was gained in developing plant types, and knowledge was gained about pests and plant diseases. The experience proved valuable in subsequent breeding of improved plant types grown for distribution and in evolving methods of plant and disease control. In addition, the researchers discovered improved methods of rubber tapping, so making the rubber tree more productive as well as discovering methods of improving cocoa fermentation.

In Nigeria, developments were somewhat slower. Despite sporadic attempts to establish botanical gardens, little was done until the agricultural department was founded in 1910. Before that time, there was a forestry department, of which agriculture had been a part during the first decade of the twentieth century. Northern Nigeria had no agricultural department until 1912 and no veterinary services until 1914. Thus, because of the slow start in establishing work in agricultural crops, the most interesting and useful experimental results pertained to tree-crops, especially rubber. Little, though, was done until 1907 on oil-palm trees and on diseases affecting them. This, together with the exclusion of plantations, was one of the factors that led to the decline of the Nigerian domination of the world market for palm-oil. After a late start, there was some work on cotton and, after years of research, the Department of Agriculture was able to introduce the exotic American Allen type of cotton that gave higher yields so that cotton became an attractive crop for farmers. These higher yields and the opening of the railway to the coast soon resulted in a substantial upsurge of cotton production in Northern Nigeria. In addition, there was some research work on ground-nuts through the very rapid expansion of ground-nut production; and exports of this crop are attributable, in large measure, to the opening of the railway that provided access to world markets.

In the British colonies, agricultural development always had a grass-roots

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13 EDITORS’ NOTE: See Pedler’s essay in this volume, pp. 95–126, for the reasoning behind the rejection of plantations. The British excluded plantations in order to protect African land rights.
14 EDITORS’ NOTE: For a different view, see note 6.
orientation because responsibilities in this department, particularly in the initial stages of colonization, usually devolved on the individual district officer. Lord Lugard's directives to his district officers underlined their duty to encourage native farmers to grow export crops and to collect information on the necessary conditions for production, including transport requirements. Although the principle of economic self-determination was inconsistent with applying pressures to produce any particular crops, officers were to make polite suggestions and to forward samples of promising crops to the Imperial Institute (created to assist in the marketing of tropical products). As enforcers of anti-adulteration and forest preservation laws, they were generally to try to maintain high levels of production by patient explanation that inferior produce fetched lower prices. It was considered desirable also for the heads of provinces and, if possible, for local officers to maintain gardens at their stations (for which purpose they could use prison labour if available), where vegetables, seedling trees of economic value and fruit should be planted as well as samples of improved crops.

A personal account of the practical problems of administration in newly opened tropical territories written in 1914 reiterates the fact that the development of a district is very much a matter of how committed the individual officer is to his 'civilizing mission'. After considering the various advantages and disadvantages of native cultivation as the basis for agricultural development, the account offers two rules of thumb as guidelines in such matters: 'Encourage development of the slow but sure type,' not becoming discouraged by a failure to achieve quick results, and 'trust the bulk of the administration to the European', giving the African little say in policy matters. It considers a certain amount of coercion useful in the introduction of new methods to native farmers, proposing that the pressures of taxation be supplemented by compulsory (paid) labour on government plantations established solely for training purposes. After an initial period, this system could be altered, for example, the plantations could be run on a smaller scale as youth training colleges and for the growth of local seed supplies. This system would release agricultural superintendents for advice-giving tours of the region. More and better practical education is seen as the main hope for development. Examining attempts to develop various crops for export and local use, it is stressed that it is worse than useless to introduce new crops or improvements in techniques of cultivation that have not been thoroughly tested because governments thereby can easily destroy the whole credibility of their policy.

Although closer co-operation between government agencies, private enterprise and missions was developing, African initiatives were seldom encouraged. Some Gold Coast cocoa plantations were managed by Africans.
with full government support, and the services of trained native agriculturists were used by the Fédération d’Afrique Occidentale Française in its 'cadre local d’agents indigènes du Service de l’Agriculture' (created in 1913); but there was no systematic organization of the indigenous cultivator into co-operatives. The French launched the first experiment in native co-operatives with the creation in 1910 of the Sociétés Indigènes de Prévoyance. These were semi-official agencies, in which membership was later made compulsory. Dues were collected and were meant to provide the basis for insurance, marketing and loan schemes, as well as finance for members of the co-operative farms. These ambitious schemes certainly did not begin to realize themselves in the early years of the Société’s existence, when co-operative activities were limited to seed lending and tool sharing.

By 1914, tropical agriculture was being developed along several fronts. Every British colony except the Gambia had a botanical garden for localized research. Research and information services on all levels were beginning to be integrated with native welfare programmes, both medical (to alleviate chronic labour shortages) and educational public-works projects and commercial development plans. A few important successes in crop introduction—cotton in Uganda, coffee in Kenya, cocoa in the Gold Coast, ginger in Sierra Leone, cloves in Zanzibar—had been achieved along with the distilled experience of many failures. The introduction of certain fruits and food-crops helped raise national productivity; there was a start on conservation and on experimentation with minor crops such as mangoes, raffia, and kapok in Nigeria. Cattle were imported from Barbados and work was initiated in combating sleeping-sickness. Simple ploughs, steel machetes and oil-expressing devices were being used to advantage, although, on the whole, new methods of production were much more difficult to introduce than new crops. The basis was established, though, for the expansion of exports, which was to be so important for the development of the region as a whole. If the agents of colonial policy in the years before the First World War did not have dramatic success in developing African agriculture, it is hardly surprising. The lack of funds available for development made it difficult enough, but added to this was the tremendous lack of knowledge about the physical, social and economic conditions that prevailed in Africa.

Research and development after World War I

The years after World War I up to the beginning of the 1960s were years during which there was a determined effort to learn more about African agriculture. It was a period in which it was recognized that a greatly expanded research effort in the region was a necessary prerequisite for introducing technological changes and 1913 the export of cocoa went up from 536 tons valued at £7,300 to 50,600 tons valued at £2,489,000. 'The Gold Coast', says Holmes, 'had become the world’s foremost cocoa producer.'

Editors' note: To the list of successes, add cotton in Togo and in German East Africa, ground-nuts in Senegal.

Editors' note: The needs of the industrialized West stimulated tropical exports of cocoa, coffee, tobacco, palm-oil, palm-kernels and oil, ground-nuts, cotton, sisal and rubber. Charles C. Slover, 'Tropical exports', in Tropical development (p. 53), estimates that the period from 1880 to 1913 was one of spectacular growth in export crops.
into tropical Africa and that new approaches would be needed to organize, execute and finance such an effort. In this period, though, there occurred a time of great financial stringency—during the depression of the 1930s—and many of the programmes and projects for expanding research and inquiry in the colonies were curtailed. By the late 1940s and early 1950s, however, the financial situation had changed. The colonies themselves had surplus funds arising from the expansion of exports during the post-war boom, and the colonial powers made substantial allocations for agricultural development in the colonies. The last years of the colonial era culminated with a substantial effort to promote agricultural research and development in Africa along with the adjustment of many of the institutions in keeping with the change from colonial to independent status.

The nature and pace of change that did occur may be illustrated by the British experience with promotion of colonial research during this period. The British war-time experience with government-supported research on developing substitutes for scarce raw materials led to the firm establishment of the principle that the government should accept responsibility for research. This principle, which was extended to the Colonial Office, resulted in the creation of the Colonial Research Committee. This committee, which remained in operation until 1933, disbursed a very modest amount during its existence. In 1925, the separation of the Colonial Office from the Dominions provided an opportunity for reorganizing certain aspects of direction of colonial agriculture. A series of advisory committees was established and an agricultural adviser for the colonies was appointed in 1929. The Empire Marketing Board, which was created in 1926 and was in operation until 1933, was set up to give preference to colonial food products. Because this policy could not be implemented without contradicting Britain's 'cheap food policy', it was decided to allocate £1 million a year for promoting schemes to encourage the sale of Empire produce in the United Kingdom. These schemes included research on projects of direct benefit to the colonies, such as assisting the Imperial College of Tropical Agriculture in Trinidad, which was to become a centre for training of colonial officers interested in tropical agriculture. In 1929, with the onslaught of the industrial recession, the government of the day introduced the Colonial Development Act, which established the principle of unilateral aid to colonial territories for development purposes. The Act, though, was acceptable only because it was seen as a means of reducing unemployment in Great Britain by promoting commerce and industry between the United Kingdom and the colonies.

By the late 1930s there was an increase in the interest in agricultural development in the colonies. However, there was still no overall policy—nor much in the way of financial resources—for agricultural research and agricultural development.

Nevertheless, some significant progress was made in the British territories during the inter-war years. Some of the work in cotton has already been mentioned. Additional progress was made at the Gezira Research Station in the Sudan, which was subsequently to become the Agricultural Research Institute. In Nigeria, the Northern Region Experiment Station was established at Samaru.

The transfer of agricultural techniques in 1922 to work on cotton and ground-nuts. A breeding station for wheat was opened in 1930 in Njoro in Kenya. Some forty minor stations were developed to conduct research in the Rhodesias and Nyasaland. Four main research stations were developed in Tanganyika: two government-sponsored research stations were formed in Uganda and nine in Kenya.

The work that was undertaken covered a wide range. In broad terms, however, the research effort became more diverse, for as old problems were resolved new ones emerged. One of the principles of agricultural development is that each success generates a new set of problems, thus making it essential that there be a sustained research effort to maintain whatever gains are made. This may be well illustrated in the case of the Agricultural Research Institute in the Sudan, which made an important contribution to the success of the Gezira Scheme. The initial research at the institute made possible the control of two important diseases of cotton: blackworm and leaf curl. Strains were developed that were resistant to these diseases, thus enabling producers to get higher yields. Thereafter, the researchers turned their attention to developing varieties of higher ginning quality.

In the late 1930s, following excellent crops of high-quality cotton, a new pest, 'leaf-sucking' jassid insects, invaded the cotton fields. Experimental work resulted in the discovery of an appropriate application of insecticide that controlled the jassids and so saved the crop. Thereafter, with these diseases and pests under control, the research workers turned to examine a phenomenon that influenced the size of the harvest. This was a consideration of why yields fluctuated from season to season and from area to area. Careful research indicated that heavy rains increased yields but resulted in a high growth of weeds after harvest, and this depressed subsequent yields of cotton. The weeds, it was found, removed both moisture and nutrients from the soil. As a result of further experimentation, irrigation of fallow and the use of nitrogenous fertilizers were introduced to offset this effect and to give farmers sustained high yields. Irrigation out of season, however, encouraged the growth of unwanted seed grass. On the other hand, removal of this grass and weeds would deprive the farmers of Gezira of their main source of animal fodder and so cut down their production of high-protein meat and milk so necessary for good nutrition. The nutritional problem could be overcome by mechanization and fodder conservation, but its resolution was still perplexing the scientists at Gezira in the late 1950s and early 1960s.

Other research in the inter-war years included a sophisticated programme of corn-breeding in Southern Rhodesia. This programme began in Salisbury in 1932. Seventeen years later, Southern Rhodesia released its first hybrid maize, thus becoming the first country outside the United States to produce hybrid corn commercially. By the early 1960s most of the European-grown corn in the Rhodesias consisted of hybrids, which gave much higher yields than did the traditional varieties. In 1930, research was started on improving wheat at the wheat-breeding station at Njoro in Kenya. The scientists at this station developed a range of varieties of wheat. Their research in this direction saved the Kenya wheat crop in the post-war years when an outbreak of plant disease caused a breakdown of resistance of one of the most dependable high-altitude varieties of wheat. Fortunately, as a result of earlier research efforts, alternative
disease-resistant varieties were made available for distribution to farmers, so
cornering the wheat crop of Kenya.31

The tempo of research and promotion of agricultural development was stimu-
lated in the years following the Second World War. General Smuts pointed out
in his Rhodes Memorial Lecture delivered at Oxford in 1929 that there was
need for a comprehensive survey of what was taking place in Africa so that a
research programme could be formulated. In response to this suggestion, the
Royal Institute of International Affairs sponsored such a survey under the direc-
tion of Lord Hailey. The major recommendation of the Hailey Report, which
was accepted by the British government, was that the British government
should provide substantial funds for research into African problems and that the
funds should be administered by a central managing body that included repre-
sentatives from scientific and academic institutions involved in the problems.
Despite the outbreak of the Second World War, the British government created
a new Colonial Development and Welfare Fund and a Colonial Research
Fund—the latter being directly linked to the Hailey proposals. A Colonial
Research Committee was appointed to administer the fund; and the committee
recommended, *inter alia*, that centres of research and development should be
established to help with the research programmes.

For the first time, substantial funds were available for research and develop-
ment on problems of special interest in the colonies. In addition, there was a
network of advisory boards covering most of the relevant areas of research.
Regional research institutes were established in East and West Africa. In 1959,
the Colonial Research Council was dissolved and its functions were transferred
to a new Overseas Research Council. With the increasing independence of the
colonies, a new Department of Technical Co-operation was established, which
assumed some of the functions formerly carried out by the Colonial Office.
Among its functions was the financing of research.

Between 1940 and 1960, through the Colonial Development and Welfare
Acts, some £24 million was made available by Parliament for 'colonial re-
search'.32 About 6.5 per cent was earmarked for research into agriculture and
related activities, with most of the funds being allocated for expenditure in East
and West Africa. At the same time, the governments of countries such as the

31 Editors' note: Italy and Portugal, too, sponsored agricultural research for their colonies. The
Italians founded the Istituto Agricolo Coloniale Italiano in Florence in 1903. The institute
published an important journal, *L’Agricoltura Coloniale*. In the colonies themselves the Italians
built a number of research centres. There were veterinary institutions at Asmara, Mercera and
Addis Ababa. In the 1930s the Italians created also a network of agricultural offices and experi-
mental farms. Agricultural experts provided advice both to Italian settlers and to indigenous
farmers. Specialized commissions from Italy also investigated particular products, such as wool,
olive, seeds, bananas, etc.

In 1906 the Portuguese opened the Jardim e Museu Agrícola do Ultramar, which made impor-
tant contributions to the study of colonial plants and agricultural products. Then in 1930 the Por-
tuguese reorganized their system of colonial studies into a central body, the Junta das Missões
Geográficas e de Investigação do Ultramar. Special institutes dealt with plant and animal dis-
eases. Also in the 1930s the Portuguese maintained a central laboratory for veterinary pathology
as well as experimental farms in Angola and Moçambique. Their work on the breeding of cattle
and sheep for export was of practical value for Angola. After the Second World War the Por-
tuguese founded such groups as the Centro de Investigação Científica Algodeira (for cotton) and
the Instituto de Investigação Agronómica de Angola. Similar bodies were opened in Moçam-
bique as well.

The transfer of agricultural techniques

Gold Coast, Nigeria and Uganda had accumulated substantial reserves through state trading in export crops by statutory marketing boards. These boards were able to finance commodity research such as that undertaken on cocoa, coffee and cotton. The policy for the grants from the Colonial Development and Welfare Fund was to encourage regional research efforts so as to avoid duplication and to encourage regional and national institutions to become self-supporting. This was to be done by providing a part of the total resources needed, while the governments were to assume an increasing share of total costs. The research funds provided by the British government helped to finance a number of existing and new regional research stations: the West Africa Cocoa Research Institute, the West African Oil Palm Research Institute, the West African Institute for Trypanosomiasis Research, the East African Veterinary Research Organization. Unfortunately, though, even in 1960, the strains of nationalism were already making it apparent that the idea of a regional approach was premature.

In the post-war years, substantial progress was made also in the French and Belgian territories. The French system was reorganized in 1943, when the central direction of research in the French colonies became the responsibility of the Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM), which is attached to the Ministry for Overseas France. The role of ORSTOM was to organize fundamental research or to provide 'orientated basic research', whereas a series of eight specialized institutions was to undertake applied research. These eight institutions included a group of development agencies, such as the Bureau pour le Développement de la Production, that helped in the execution of development projects. The French system had its headquarters in France and was supported by a central scientific service based near Paris. By 1960 ORSTOM had thirty research centres of a permanent nature distributed throughout the different ecological zones. ORSTOM's budget was directly paid for by French tax-payers, and the organization deployed a permanent staff far larger than that in most research organizations—more than five hundred research scientists complemented by nearly two thousand assistants and technicians.

The eight specialized institutions differed slightly according to the circumstances of their establishment. Some were government-controlled companies, some non-profit-making private associations. But each had a central headquarters and laboratories in France to provide logistical and technical information and support for the stations abroad. In most cases, however, they were national stations managed by the institute on behalf of the host state. In 1960 there were seventy such stations. The French research programme has been notably successful in gathering basic information, in improving varieties and production of ground-nuts and cocoa, in developing new farming methods and in promoting agricultural development in general.

The French system differed from the British approach in that it was a tightly controlled system operated by French expatriates and financed largely by French tax-payers. It was assumed that the concentration of effort along functional lines made sense in a situation where many of the countries concerned

were too small to afford their own research efforts. In addition, the shortage of indigenous skills and finance made it appear highly advantageous for the former colonies to participate in this programme. Unlike the British approach, it was accepted in the French plan that there would be a continuing commitment. No special provision or consideration was given to creating an independent research capacity in each of the colonies or in the colonies when grouped on a regional basis.

The Belgian system was somewhat similar to that of the French, with the central organization for agricultural research in the Belgian Congo being the Institut National pour l’Etude Agronomique du Congo Belge (INEAC). This institute was financed primarily from Belgian sources and was administered by a committee representing the Ministry of the Colonies and the Belgian universities. INEAC became ‘one of the finest tropical research centers in the world.’ The station was notably successful in breeding oil-palms, which increased yields considerably. INEAC contributed also to one of the few successful technical and social programmes to establish sedentary ‘agriculture’: the Paysannats settlement schemes. These schemes moulded the system of shifting cultivation into the pattern whereby the benefits could be maximized and the harmful effects minimized. Before the independence of the Congo, INEAC employed approximately 450 Belgian scientists and technicians. Following independence, as the administrative system collapsed, there was nearly complete disintegration of INEAC, and much of the best and most painstaking research on tropical agriculture was lost.

In the early post-war years, despite the increase in research, there was still an assumption that it was possible to transfer new technology into the region without constant investigation and sustained research in the field. The consequences of this assumption were highlighted by the failure of two important projects of agricultural development, both of which ignored this principle. The first scheme was the Ground-nut Scheme undertaken in Tanganyika in 1946. Some 20,000 acres were to be planted to ground-nuts so as to provide vegetable oils for the housewives of Britain. The operation was to constitute the largest single mechanized-farming operation in the world. The capital, management and expertise were to be provided from Britain. The scheme was a complete and costly failure. Undoubtedly the wash-out would have been mitigated had there been some experimentation that showed the true nature of the physical environment—the lack of rainfall, the difficult properties of the soil and the high cost of mechanized bush clearance. The second scheme, though it too involved mechanization, was to encourage settlement in unoccupied but fertile land in Northern Nigeria and to lead to a substantial increase in the production


EDITORS’ NOTE: The Ecole de Médecine Vétérinaire de l’Etat was also important for veterinary research in the Belgian Congo. Agricultural problems were investigated at the State Botanical Gardens, at the Botanical Department of the Musée du Congo Belge at Tervuren, and at the University of Louvain. In 1931, Louvain initiated its own research centres in the Congo for the purpose of improving African agriculture. The new organization became known as CADULAC (Centres Agronomiques de l’Université de Louvain au Congo). INEAC also played a role in improving the cultivation of rubber and indigenous foods crops and worked on veterinary problems and the upgrading of African-bred cattle.

The transfer of agricultural techniques of ground-nuts and sorghums. The scheme was initiated in 1954. Many African peasants refused to be drawn into it, and it was effectively terminated in 1959. The scheme itself was uneconomic partly because there had been no research on the technical aspects of the programme; nor had there been any research on the economics of increased production.\(^3\)

The lesson of these colonial failures, in so far as they relied on large-scale capital imports, appears to have been well learned. Most of the schemes initiated towards the end of the colonial era (and in the subsequent period of independence)—such as the Swynnerton Plan in Kenya—were based on technological changes that had been proved successful in the area in which they were to be adopted. This could be done only when there was investigation and research within the region in question and an appreciation of the social and economic factors involved. By 1960, the accumulated experience of the colonial era indicated that there were no short cuts in agricultural development and that there could be no wholesale transfer of technology from Europe to Africa. The lessons learned were that African agriculture would have to develop along its own lines and that a sound economic and technical base for development could emanate only from research and investigation in the tropical regions of Africa.

**Conclusion**

Technological change in agriculture is part of the dynamics of agricultural development; change takes place at the farm level when farmers use new inputs in the production process. If there is no indigenous capacity to produce those inputs, then they have to be imported. There are, however, physical constraints on the successful transfer of seeds and breeding-stock and techniques of production from one ecological zone to another. Historically, the first imports of new agricultural inputs are usually from countries with similar physical environments, and, over time, the importing country develops its own capacity to generate its own inputs—inputs adapted for use in local social, economic and physical circumstances.

At the outset of the period 1850–1960, the new inputs were introduced into tropical Africa by the private sector—missionaries, traders and private research groups. There was little desire for public involvement in the development of the colonies, much less any desire to allocate public resources for the development of a technology exclusively for the use of peoples living in tropical Africa. By the 1880s, though, there was a shift of attitudes. Over the next seventy years there was an increasing involvement of both the metropolitan powers and the administrations in tropical Africa in developing suitable inputs and technologies for localized use.

Nonetheless, it was only in the late 1940s that substantial public resources were made available for research and agricultural development. These resources included the first substantial grants made by the colonial powers for this purpose, and were in many respects the forerunner of the subsequent programmes of external aid for development of less-developed countries. By the 1960s there was publicly financed research in all the colonies or former colonies in tropical Africa. The pattern of research in Francophone Africa differed

\(^3\)Ibid., p. 334.

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from that in Anglophone Africa in that research in the Francophone region was tightly controlled from France, whereas the emphasis in Anglophone Africa was to devolve responsibility onto local administrations.

During this period there were successes and failures in the spread of new inputs and the introduction of new technologies. The greatest success in agriculture in the colonial era was undoubtedly the rapid expansion of production for export. Part of this may be attributed to improved transport crops, but some credit should be given to the introduction and adaptation of new crops during the colonial era. In addition, the sustained increase in exports was made possible also by research and development on methods of disease and pest control and by research on the most suitable techniques of production. The failures, on the other hand, generally involved attempts to introduce advanced techniques of production, such as mechanization, imported from the colonial powers. One reason for the failures was the lack of adequate research and investigation into the social, economic and physical conditions in the areas in which the machine technology was to be used. Another explanation, especially outside of areas of European settlement, lay in the shortage of complementary skills.

Whatever the successes—and they were considerable—there was at least one great weakness in the colonial approach. This was the failure to develop institutions that could produce the skilled, indigenous manpower to undertake research and to participate in the management and direction of agricultural growth. At various times during the colonial era attempts were made to establish vocational and agricultural schools or to introduce agricultural training, but there was no sustained effort to provide the skilled elite of agriculture. By the time of independence there was only one agricultural faculty in sub-Saharan Francophone Africa; it was founded in the mid-1950s in the Belgian Congo. There were five institutions of higher learning in the British territories established in the early 1950s that provided an advanced degree in agriculture. Between 1952 and 1963 only four university graduates were trained in Francophone Africa and around 150 in Anglophone Africa.38

In 1960, in terms of overall economic development, the former colonial areas of tropical Africa included some of the least productive and most technologically backward economies in the world. By international standards, then, the colonial experience in economic and agricultural development might appear to have provided a limited base for future development. However, the real achievements during the period under consideration have to be seen in a perspective that incorporates some notion of the backwardness of the region as little as fifty to sixty years before 1960. This backwardness is well illustrated by Sir Philip Mitchell, a former governor of Kenya. He described the indigenous population at the turn of the century as follows:

Inland of the narrow coastal strip they had no units of government of any size or stability: indeed, with a few exceptions such as Buganda, nothing beyond local chiefs or patriarchs. They had no wheeled transport and, apart from the camels and donkeys of the pastoral nomads, no animal transport either; they had no roads nor towns; no tools except small hand hoes, axes, wooden digging sticks, and the like; no manufactures and no commerce as we understand it, and no currency, although in some places barter of produce was facilitated by the use of small shells; they had never heard of working for wages. They went stark naked or clad in the bark of trees or the skins of animals, and

38 Ibid., pp. 348–9.
they had no means of writing, even by hieroglyphics, notches on a stock or knots in a piece of grass or fibre; they had no weights and measures of general use.\textsuperscript{39}

The transformation of the agricultural economy of the region between 1880 and 1960, when considered against the above background and with full account taken of the shortage of trained agricultural elites, has been remarkable indeed. By the end of the colonial era the agricultural economy was ‘monetized’, a transport system facilitated the movement of crops, and an expanding education system and expanding medical services were paid for out of an agricultural surplus. The indigenous producers of the region were using new inputs, including new seeds developed within the region as well as new implements and a few machine-powered inputs. The region had become an important exporter of agricultural surpluses, with the indigenous producers exporting a wide range of crops that were competitive in world markets. This could not have been accomplished without the importation of technology and a recognition of the importance of adapting this technology to local needs.\textsuperscript{40}

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\textsuperscript{39} As quoted in Yudelman, \textit{Africans on the land}.

\textsuperscript{40} \textit{Editors’ note:} See also, in this volume, both Hogendorn’s essay and the relevant section in the Introduction, which gives a somewhat different interpretation.


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