ABACA (MANILA HEMP): THE FIBER MONOPOLY OF THE PHILIPPINE ISLANDS[1]

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THE variety of plants that yield fibers of greater or less value, in various parts of the world, is very large. Living conditions in the temperate zones are comparatively little modified by these plants, but in the tropical countries they are of enormous importance, being used in countless ways. Thus in the Philippines, plants yielding fiber used for different purposes by the natives include varieties of ferns, pandans, grasses, bamboos, sedges, palms, battans, vines, other plants with leaf or petiole fibers and miscellaneous growths. However, only two Philippine fibers are of notable commercial importance for rope and bag manufacture—abaca and maguey. Minor species that have possibilities of future development and significance in world commerce are the sisal, hennequen, kapok and ramie. Abaca so dwarfs all the others as a Philippine product and is so definitely the monopoly of the Islands that this discussion will deal with it at length, and with the others only as their relative importance warrants. In any event there is so much of similarity in the growth and utilization of these plants that a detailed account of one covers the major points that apply to all of them.

The abaca plant is closely related to the banana and the plantain, resembling them in appearance and habits of growth. The banana plant produces a fiber which lacks the strength of the abaca, and the abaca produces a banana-like fruit filled with large black seeds and economically unimportant. The term Manila hemp usually applied to the abaca fiber is very misleading. Properly speaking hemp is the bast fiber extracted from the inner bark of the *Cannabis sativa*. The so-called Manila hemp is the structural fiber obtained from the leaf sheath of the *Musa textilis*. The term abaca designates both the plant and the fiber under consideration.

Abaca enjoys the distinction of being strictly a Philippine product. As many as fourteen varieties are under cultiva-

[1] The paper is supplemented by one discussing the general regional geography of the Philippines published in the *Bulletin* of the Geographical Society of Philadelphia.

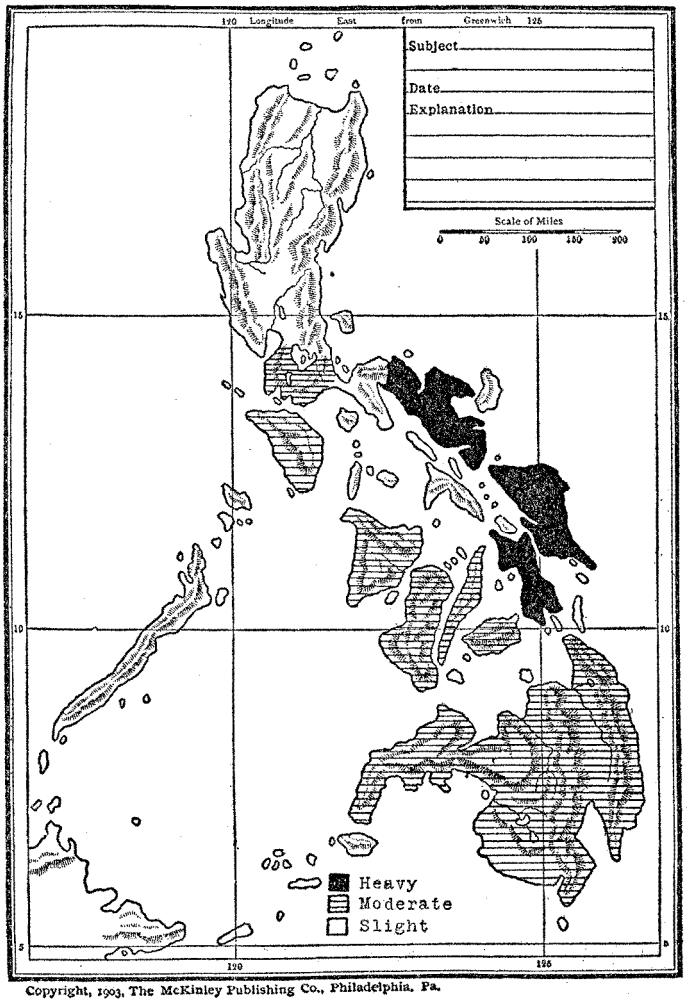

FIG. 1. AREAS OF HEMP PRODUCTION.

tion in the Islands, differing in color and shape of stalk, color and size of leaves, greater or less tendency to produce suckers, and in quality, abundance of strength of fiber produced, and in hardiness. The most desirable qualities are hardiness, rapid growth, ability to withstand drought, and abundant yield of fiber, of good quality and easily extracted.[2]

Abaca is distributed throughout the greater part of the Philippines, but is most successfully cultivated in a district comprising roughly the southern two thirds of the Archipelago. It may be cultivated as high as 3,000 feet above sea level if varieties adapted to the higher altitudes are used.

[2] H. J. Edwards, Philippine Farmers' Bulletin, No. 12, "Abaca," 1910.

The adaptability of any particular soil for the production of the abaca plant depends on the conditions of climate and exposure of a particular location, but if those are favorable it does best on alluvial plains subject to the overflow of rivers and on the moist mellow loams formed by the disintegration of volcanic rock.[3] Dry sandy soils, stiff clays or limestone soils are avoided. Since the bed-rock structure of the Philippines is mainly composed of basic lavas which have been decomposed by weathering generally to notable depths, it will be seen that soil difficulties are not great, and there is ample suitable area for any reasonable development of the industry.[4]

Climate is probably more important than soil in the selection of lands suitable for abaca plantations. The four climatic factors are, rainfall, humidity, winds, and temperature. A heavy and evenly distributed rainfall is most essential unless irrigation water is available. Relatively high humidity is desirable and this nearly always occurs in regions subject to heavy rainfall. The abaca plant is especially unsuited for cultivation in regions swept by heavy winds. Its leaves are heavy and broad and the plant stiff, so that a wind storm may do untold damage. So also are the banana plantations in the West Indies ruined by tropical cyclones. Temperature is relatively unimportant, as it is subject to but slight variations throughout the year in the Philippines and maintains a mean of 75° to 80° F., according to altitudes.

Reproduction of the abaca is usually by suckers, though possible by seed, and the planter may use considerable judgment in selecting varieties high in natural quality and especially adapted to his own conditions. Certain varieties do much better in alluvial soil, while others are more fitted to be planted in loam. The insular agricultural advisers are doing much to spread the doctrine of suitable seed, but before that it was the usual practise to call on the aid of a neighboring successful planter.

In preparing the land, underbrush, weeds, and all trees are removed and burned except those trees necessary for shade or wind protection. There is rarely any plowing or other preparation of the soil. The seeds are planted at regular intervals, and beans, peas, sweet potatoes, or other vegetables are planted in alternate rows as these, by their rapid growth, will choke back the weeds and themselves yield a profitable crop. However,

[3] Edwards, *op. cit. supra*, p. 21.

[4] J. Russell Smith, "Industrial and Commercial Geography," New York, 1913, p. 523.

it is always recommended where animals and implements are available that the planter plow and harrow, and he may be certain of a crop which will yield returns for his extra effort.

Commercial fertilizers have seldom if ever been used in abaca cultivation. Much of the land is virgin and the soil is deep, fertile, and filled with decaying organic matter. Only a very small per cent. of the plant becomes the commercial fiber, the waste parts being scattered on the ground to conserve fertility. A study of the relative value of the various fertilizers has not even been made, but from the composition of the plant and the fiber it is known that potash is by far the most essential requirement.

About the only cultivation necessary is to loosen the soil around the plants and keep the weeds cleared out. This last should be done every two months during the first year. Later when the abaca shades the ground weeding is less necessary, and after three or four years once a season will suffice. Another valuable treatment after the fourth or fifth year is to dig out the decayed roots of old stalks and throw in new soil providing additional plant food.

Shade is desirable, especially where there is any pronounced dry season. The shade prevents evaporation, keeps back the weeds, draws up moisture for the plants and protects them from strong winds. Leguminous trees, with tall trunks, narrow leaves, and deep roots are selected where possible.

The abaca has few enemies, and damage from these is negligible. The larvæ of two insects attack the plant by boring a large hole in the trunk and causing the leaves to turn yellow. Much more destructive are high winds, drought, and the ravages of wild pigs, deer, and carabaos.

The first stalks are ready for harvesting twenty months to three years after planting, depending on locality and variety. After the first harvest it is usual to cut the plantation over every six or eight months. The mature plant consists of a cluster of ten to thirty stalks all growing from one root. The stalk is ready for harvest when the large violet flower bracts fall to the ground.

Harvesting is done by hand with a sharp knife which cuts the stalk a few inches above the crown of the plant. Care is necessary in felling the stalks as an unskilled laborer will allow the stalk to fall to the ground, bringing down other young shoots whose leaves are tangled with the mature stalk. For this reason it is desirable to cut the leaf of the stalk before it is allowed to fall. It is likewise important to cut the stalk on the slant so that water will not stand on the cut and cause rot.

The yield varies greatly, but 1,000 pounds of fiber per acre is considered a good crop. The average probably falls considerably below this.

The trunk or stalk of abaca ranges from 6 to 18 inches in diameter and 2 to 8 meters in length. This trunk consists of a small, central fleshy core from 6 to 10 inches in diameter at the base, to about 2 inches at the top around which a number of thick overlapping sheaths are wrapped, each sheath being the stem of petiole of a leaf. The fiber is extracted from the outer portions of these sheaths. The process of hand extraction consists of two distinct operations; first, the removal of the ribbon-like strips of fibrous material from the leaf sheath, and second, the separation of the individual fibers by pulling these ribbons under a knife.

The laborer inserts under the bark of one of the leaf stems a small sharp piece of bone and pulls off a fibrous strip about 2 inches wide and as long as the stalk. One sheath yields 2 to 4 such strips. Each consecutive sheath is thus stripped down to the central core.

These strips are taken to a shed where the stripping apparatus is kept. This consists of a log set in a horizontal position about 4 feet from the ground. On top of this is fastened a block of smooth hard wood. Over this block is placed a bolo, having a blade a foot long and a handle 15 inches long. A rattan is atached to the end of the knife handle and connected with a bamboo spring above. Another rattan passes to a foot treadle. Thus the spring holds the knife to the block and the treadle regulates the pressure.

In the process of stripping the operator holds a ribbon of fiber in his hand with the end wrapped around a block of wood. He draws it under the knife with a quick steady pull, reverses the ribbon and repeats the process. A small bunch of wet fiber is left in his hands. The work is very exhausting and the laborer can work only part time, and even then is frequently ruptured by the strain of pulling.

The quality of the fiber depends on the condition of the knife blade, the pressure exerted and whether or not serrated knives are used. The latter produce a very poor quality and their use is being discouraged by manufacturer and consumer. Unless closely watched the native labor is apt to reduce the pressure in order to make the pulling easier and this results in poorly stripped fiber.

Beginning shortly after 1900 progress in Philippine fiber production fell off to an alarming degree. The reputation of the industry suffered in the opinion of foreign manufacturers

and dissatisfaction was apparent on all sides. Even more serious was the manner in which fiber plantations were neglected and the quality of the product correspondingly lowered. Defects of organization and lack of control of the industry were felt to be the heart of the difficulty. Before 1914 the grading and inspection, buying and selling of the fiber were haphazard and inefficient. The grading and inspection had been in the hands of a large number of export firms. The grades they established varied continually and tended to increase beyond all need. Market quotations were not well understood and suspicion was aroused in the mind of the seller because of the difficulty of determining whether his fiber had been honestly graded and he had received a fair price for it. Manufacturers and consumers were complaining because the product was not well graded and the general product poorer. The defects in the method of handing the hemp were set forth in the following outline:[5] (1) The lack of fixed and accepted standard grades; (2) the inadequacy of the prevailing methods of grading the fiber and of designating the grades; (3) the lack of any authoritative control over the operation of the grading establishments; and (4) the more or less general ignorance of the producers as to their quality of their product.

To remedy these conditions the Philippine Legislature in 1914 passed a law known as Act No. 2380, "An Act Providing for the Inspection, Grading, and Baling of Abaca (Manila Hemp), Maguey (Cantala), Sisal and Other Fibers." The grading of the abaca was based on color, tensile strength, and cleaning. Four classes were created, excellent, good, fair, and coarse, and each of these was subdivided into a total of twenty-one grades of definite description. The maguey and sisal were divided into two classes, first, fiber cleaned by retting, and, second, fiber cleaned by machinery or with knives.

The fiber grading law embodies the following provisions: (1) The establishment of fixed standard grades for each of the chief commercial fibers exported from the Philippine Islands; (2) the requirement that every grading establishment shall grade and prepare for export in accordance with the established standard and with the regulations; (3) the institution of a system of inspection of all graded fiber, and supervision over all grading and baling operations to enforce compliance with the regulations, and (4) the institution of an educational campaign among the producers for the purpose of improving

[5] M. M. Saleeby, "One Year of the Fiber Grading Law," *Philippine Agricultural Review*, Vol. IX., 1916, p. 13.

the methods of production and preliminary preparation of the fiber.

Under the law 89 grading stations were established and fiber inspectors assigned to the more important stations. Stations without inspectors are required to submit their fiber for inspection on its arrival at Manila or Cebu, the leading ports for export. The law has been so successful in remedying the conditions which it was designed to meet that there are now over 100 stations in operation and a staff of about 50 inspectors.

USES OF ABACA

Abaca is the raw material for a large number of manufactured products. Most of the export trade is with American and English rope factories, and, as they are the dominating market for the fiber, so are they dependent on the Philippines for the source of their supply. Increasing amounts of abaca are being exported to Japan for the manufacture of Lagal hat braid. The growth of this industry is a factor in the large immigration of Japanese to the Philippines. They have settled in Mindanao and Cebu, where the better grades of fiber are grown, and make it their business to see that the Japanese market is supplied with the necessary quantity of high-grade abaca for the manufacture of textiles and braid. The braid is made up in Japan and sent to the United States chiefly where it is used for women's hats. Among a large number of products whose market is local, abaca is consumed in the production of slippers, baskets, bags, matting, lace, furniture, and a coarse cloth.

POSSIBILITIES OF THE ABACA INDUSTRY

New uses and new applications of old uses of abaca and allied fibers are being constantly proposed. The extent to which this fiber may be used in the manufacture of paper is significant in view of the present scarcity. The utilization of waste abaca for this purpose was first suggested in 1905. Manufacturers of Manila paper had previously been dependent upon old rope for their raw product. Large shipments of waste abaca began moving toward American paper mills and continued until 1911, when the experiment failed. The reasons stated were that the waste had a relatively low percentage of paper pulp, the quality of the waste was too variable, and freight charges were prohibitive.

Further investigation was made with results stated by the consular service as follows:[6]

[6] Daily Commerce Reports, May 16, 1912, p. 632.

In 1912 twelve large paper manufacturers in eastern United States formed a Philippine corporation to handle and develop the use of abaca and its by-products in the paper industry. The enterprise rests upon the demand for certain classes of paper of an especially strong and tough grade. Experts report that a one inch strip of hemp paper will support 100 lbs. For a number of years there has been a growing demand among manufacturers for the waste products of hemp and old rope to supply this grade of paper, especially as the business of making paper bags for cement, flour, and similar commodities was being extended. The organization backing this industry has spent over half a million dollars in experiments but reports as yet no substitute for hemp. The peculiarity of Manila hemp is that it is practically all fiber in composition, and that no matter how finely the hemp is divided it is still capable of division as fiber, while a fiber of cotton, for example, is only a tiny tube, a fiber of sisal is merely non-fibrous wood, and similar objections are had to other products.

The result has been the conclusion that, all things considered, the use of the whole of the original hemp stalk will be the most economical way out of the situation. By present methods about one third of the ordinary plant is lost in stripping and about one third of the remainder is not used for the reason that the fibers are too small and too weak to be of commercial use. The new plan is to take the entire hemp plant as cut on the plantation and merely crush, dry and clean it in especially designed machinery.

Even at the lower price per pound for the whole plant than he receives per pound for about half of the original plant at the present time, after expensive handling, the planter will actually receive greater returns from his product than by present methods. The enterprise is intended to afford a new and additional supply of raw materials of the sort needed in the manufacture of special varieties of paper—a supply capable of almost indefinite extension.

At the same time the corporation described above organized a company to manufacture paper, cotton and other textile bags of all descriptions. These new industries have prospered and opened the way for further development in a new field.

Another proposition often heard is that there be more manufacturing of cordage in the Philippines and less dependence on foreign manufacturers. The consular service reports this plan as follows:[7]

One of the largest American mail order houses recently endeavored to secure the entire output of Philippine rope. The establishment of an additional factory would not involve the taking of markets away from existing factories. On the contrary a greater supply of Philippine rope would aid the existing factories by establishing Manila as a more important source of supply of cordage. Cebu is believed to be the best site for development of the cordage industry. It has an abundance of cheap labor and is the shipping and transshipping point for a large part of the hemp produced on the island.

[7] *Daily Commerce Reports*, Aug. 16, 1918, p. 634.

Government action to secure this benefit is reported in the following article:[8]

Government officials identified with the organization of the National Development Company, authorized a few months ago by the Philippine legislature, have been gathering data which may lead to the establishment of a rope factory, which will free the Philippine hemp industry from the mercy of the rope factory interests of the United States. Proposals for the organization of such an institution here result from the hemp market depression. Under present conditions hemp men of the Philippines are helpless when rope factories in the States show no disposition to buy the raw material. The National Development Company, which, when finally organized will have a capital stock of $25,000,000, 51 per cent. of which will be government owned, is intended to safeguard Philippine industries when possible, as well as to foster important industries and to offer a helping hand to any industry which has a chance of becoming important, but is not yet developed to the point of being able to walk alone.

EXPORTS OF ABACA

The accompanying figures show very clearly the growth of hemp as an export product. It was formerly equal in value to about two thirds of the total exports of the Philippines, but the rapidly developed importance of copra and sugar in international commerce has reduced this figure to about one half. The average prices received for hemp have varied from year to year according to the success of the crop and world market conditions. Since 1914 the war has so influenced the market that the figures stand for little. The total weight of the crop

HEMP EXPORTS[9]

Year	Weight Long Tons	Value (Millions)	Average Price	Per Cent. Total Exports
1899	70,152	8	$113.99	53.8
1900	90,869	13	146.81	57.8
1901	126,245	16	126.55	65.2
1902	113,284	19	170.29	67.3
1903	139,956	22	157.19	67.9
1904	123,583	22	169.48	71.9
1905	130,437	22	166.80	65.
1906	104,078	20	188.44	60.1
1907	117,241	20	167.94	59.5
1908	131,382	17	125.61	50.6
1909	167,953	17	100.60	48.4
1910	163,173	16	100.97	40.6
1911	148,202	14	97.74	32.4
1912	175,137	22	126.05	40.2
1913	119,821	22	176.27	44.2
1914	116,386	19	164.93	39.4
1915	142,010	21	150.27	39.7
1916	137,326	27	194.35	38.1
1917	169,435	47	276.26	48.9

[8] *Transpacific Magazine,* Vol. I., p. 64, 1919.

[9] U. S. Bureau of Customs and Foreign Commerce, "Commerce of the Philippine Islands," 1918, p. 16.

is the clearest indication of steady growth. The bulk of the export trade is with the United States, England, Japan, France, and Switzerland.

MAGUEY AND SISAL

Agave is the family name for a group of important fibrous plants including maguey, sisal, henequen, and zapupe. The first two, only, are of economic importance in the Philippines. While closely related, they have had only a short history in the Philippines and were introduced there from widely separated points. Maguey was introduced from tropical America by the Spaniards, while sisal came from Hawaii in 1905 as a product for experiment. It has been successful, but not to the same degree that maguey has.

The henequen member of the agave family is produced in much larger quantities for world consumption than either maguey or sisal, constituting about 80 per cent. of the world's production of "sisal" fibers as they are known commercially. Maguey and sisal however have points in their favor which should make them of increasing importance compared to henequen, which is grown almost exclusively in Mexico. Their fiber is equally, if not slightly superior to henequen, and their soil and climatic requirements are slight, for they will flourish in rocky limestone soil under conditions of long drought. Their cultivation is simple and inexpensive, not requiring skilled labor, work animals, or agricultural machinery, and they are not seriously attacked by pests.

Reproduction and planting is by suckers and not by seed. The suckers appear (about the second or third year from planting) around the mother plant, springing up from the rhizomes. If to be used in starting new plantations the suckers are set out from two to three yards apart each way, with little preliminary preparation of the soil beyond clearing it of underbrush and weeds. The only attention usually given until the third or fourth year is a periodical weeding out of suckers.

Both maguey and sisal closely resemble our common century plant. The fiber is derived from the essential element of the leaves, but the best and fully developed fiber is found only in leaves from three to four years old, so it is customary to harvest only the two outer rows of leaves from each plant, usually 20 to 30 leaves. The leaf is cut off just above the stem and the spines trimmed to facilitate handling and in this shape they are ready for extraction of the fiber.

The method of extraction commonly employed is "retting," in which the leaves are slit in strips, tied in bundles, and immersed in salt water (tidewater) for 6 or 8 days so that de-

composition takes place sufficiently for the pulp to be scraped off and the fiber left. Retting is being gradually superseded by the machinery invented for the extraction of henequen fiber, especially where the maguey and sisal are grown on a really commercial scale. The machines are composed of a 54-inch wheel revolving inside a heavy wooden or metal case. Across the surface of this wheel are placed blunt brass knives, about eight inches apart. In front of the wheel is adjusted a concave block, or brass shoe, against which the leaves are scraped by the blades of the former.

In 1917 $17,500 was appropriated by the Philippine legislature for the purchase of two Prieto maguey extracting machines in the United States. These were installed at the Singalong experiment station and since that time have given such satisfaction that Hernandez, the Director of Agriculture, believes they will[10] "greatly increase the maguey industry throughout the Philippine Islands and put it on a more stable basis." Some such machinery has long been needed for the extraction of abaca. A number have been tried, but have failed because of low capacity, complexity of construction, and high cost of operation.

After extraction of the fiber it is washed and carefully dried to prevent deterioration. When dry the fiber is tied in bundles four inches in diameter and baled. Subsequent operations are similar to those described in our discussion of hemp.

The sisal fibers are peculiarly immune to disease, two fungous diseases and one insect pest being the only known sources of danger, and these are being carefully watched to prevent any widespread damage. Damage is more likely to occur from cattle when the plantations are not properly fenced in.

The introduction of sisal fibers to the areas of the Philippines offering suitable conditions will result in the use of lands otherwise economically unimportant. The establishment of this industry demands three lines of improvement over the present methods; (1) the practise of systematic planting and cultivation, (2) the development of large plantations, or small ones close together, and (3) the introduction of fiber extracting machinery which will follow naturally after the second condition has been fulfilled.

Growth of Maguey Industry

Production of maguey for export commenced in 1904, when 690 long tons were shipped valued at $78,121. Between 1905 and 1915 the quantity exported varied between 2,000 long

[10] *Philippine Agricultural Review*, Vol. XII., 1919, p. 98.

tons, valued at $163,273 to 7,000 long tons, valued at $590,951, the highest figures being in 1913. In 1916 production rose to 15,686 tons, whose value was $1,746,511.

The future promises much, for experts are entirely agreed that the Philippines offer every opportunity to the new industry. The consular correspondent reports:[11]

> Maguey does well in the islands and there is much land adapted to its culture. The acreage is rapidly increasing.

Maguey is used almost exclusively for binder twine. For this reason exportation is confined in general to the United States and Europe. During the war a specialist in fiber plant production was assigned to the Philippines by the U. S. Department of Agriculture with a view of promoting interest in the binder twine fiber industry. Appropriations were made for experimental and extension work which are now being carried on. In a preliminary report the expert reaffirms the suitability of soil and climatic conditions for increased production of maguey.

Minor Fiber Plants

While this investigator was studying the development of the maguey industry he was authorized to carry on experiments with other fibers whose commercial importance might be developed. These experiments have not proceeded far enough to draw final conclusions but it appears that the kapok fiber will grow satisfactorily. Kapok is the mass of silky fibers investing the seed of the silk-cotton tree. Commercially it is called Java cotton and used as a filling for mattresses.

Attempts have been made to find a type of cotton which may be grown extensively. So far all efforts have failed, but more experiments are being continually tried. The Panama hat plant grows readily and may be grown commercially. Ramie or Chinese grass seems particularly well adapted to conditions. The fiber is of superior quality and is well known in all fiber markets. There is every indication that ramie will be among the fibers exported from the Philippines before many years. The fiber of the pina, pineapple tree, is used locally in making both a coarse gauzy fabric and a very fine textile. Buri raffia is the skin stripped from the leaf segments of the buri shoots before the blade has unfolded. The product is obtained from the buri palm.

[11] *Daily Commerce Reports*, Oct. 30, 1917, p. 411.