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研究成果報告(精簡版)

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中文關鍵詞： 二十世紀初德國發明新的合成氮製造技術刺激了全球化學肥料的生產，日本則是亞洲地區率先引進並大力採用此技術的國家，並隨其帝國版圖擴張而影響殖民地農業生產型態。本文乃探究戰前臺灣朝鮮密集施肥農業的源頭，追溯其與日本化肥工業間的連動關係，以究明此種仰賴化肥農業型態的多重歷史社會因素。

英文摘要： n 1910, Ftitz Harber and Carl Bosch invented the industrial process for producing ammonia synthesis. This magnificent invention is indeed a product of longing for resolution of overpopulation and grain deficient around the world. The so-called Harber-Bosch process was thus gradually and wide spread through out the globe. In East Asia, Japan was one of the leading countries on developing the nitrogen technology. Noguchi Jun and his colleagues learned the Frank-Caro method from Germany and founded Japan Nitrogenous Fertilizer, Inc. in August 1908. In the following decades, Japanese nitrogenous fertilizer was extensively circulated throughout East Asia concurrently with the expansion of Japan Empire. The outcome is a great transformation of the idea and habitus of farmers in this region. An investigation from UN shows that Japan, Taiwan and South Korea are the top-three countries for heavy-use of fertilizer in Asia. This figure indicates that chemical fertilizer seems to be a Japanese colonial legacy of agricultural activity. But how could it be? In what condition and process do the colonized farmers abandon their manure and adopt the chemical fertilizer? What is the environmental impact for the adoption of chemical fertilizer in this region? These are the problematic which I will try to resolve in this article.

英文關鍵詞： chemical fertilizer, nitrogen technology, Noguchi Jun, Japanese formal empire, Japan Nitrogenous Fertilizer Inc.

The Production, Distribution and Impact of Chemical Fertilizer in East Asia

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For a long time, human knew various fertilizer to improve agricultural productivity. However, the function and mechanism of fertilizer was a secret of nature, waiting to be unfolded until nineteenth century. Justus von Liebig published *Chemistry in Its Application to Agriculture and Physiology* in 1842? was an epoch-making contribution. At the same time, scientists in various countries explored the nature and function of nitrogen, sulfate, and calcium to the plain in the subsequent decades. By the end of nineteenth century, scientists and engineers developed various methods to fix nitrogen from the air. The Norwegian Arc Process, the Cyanamide process, and most important, the so called Harber-Bosch process (1908), all make contribution for the great leap of the production of ammonium synthesis.[1] Suffered from grain deficient after Meiji Restoration, Japanese scientists inspired European innovation and eagerly collected all the information, dispatched experts to England, France and Germany to learn new invention, tried to buy the patent, or even hired the scientists to Japan to help them for constructing the fertilizer plants.

Japan has its long tradition of rice production and developed its own knowledge on fertilization. Green manure, dried fish, night soil was well-known nutritive additives to farm. The economic structure changed rapidly after the Sino-Japanese war. Industrialization and urbanization diminished farm labour supply and decreased the agricultural productivity. Grain deficient became a crucial problem. To obtain more stable food supply from without, Japan fire to China and Russia, annex Taiwan and Korea for grasping more resources; and sought resources from within to increase food production. Although agro-engineer and officials advocated and urged their people to raise the productivity by using chemical fertilizer, and some

1 Despite Haber-Bosch process, there are various rival processes of ammonium synthesis, for example, Georges Claude process mainly applied in France, Luigi Casale process widely applied in Italy, Belgium and Japan, and Mont Cenis-Uhde process also found in Japan's plant. Vaclav Smil, Enriching the Earth: Fritz Haber, Carl Bosch, and the Transformation of World Food Production, (Cambridge Mass.: The MIT Press, 2001, pp. 111-114.

inorganic fertilizers, such as superphosphate, was imported and could be accessed at that time, it did not really win great popularity until the outbreak of Sino-Japanese War. Before the war, Japanese could only accept compound fertilizers, mixing superphosphate with traditional manure. But once farmer overcome their un-acceptance of non-traditional substances, and experience a high-yield profit offered by chemical fertilizers, the situation changed rapidly.

According to Watanabe Tokuji and his colleagues, Japan experience three stages of transformation in their application of chemical fertilizers. Traditionally, self-sufficient fertilizer from farmland, or using dried fishes, was the main type of fertility before 1895. After the Sino-Japanese war, Japan could obtain more soybean via her control on Korea and Manchuria, nitrogenous soybean and imported superphosphate became the main elements in the second phase, say from 1895-1910s. the third stage is from 1910s to 1940s. In this period, superphosphate and sulfuric acid became the favour of farmer due to the rapid growth of the relevant industry. During the third stage, Japan experienced the worst social unrest and conflict. The Rice Riot (Kome Soudou) outbreak in 1918 was just a tip of the iceberg of severe food problem that existed decades long. Increase rice supply from its colonies seems to be an instant and effective strategy to pacify the entanglement in Japan society.

Korea

Korea became the second colony of Japan Empire in 1910. The Colonial government vigorously promoted the agriculture reform after their annexation. The first phase was variety improvement between 1910 and 1920, underlined the importance of land reform from 1920 to 1930, and emphasize the cultivation improvement after 1930s. In the first decade of colonization, government general try to refine the variety of rice, improve the irrigation system, increase the access of fertilizer and perfect the dry method. The result of variety improvement was high concentration on specific varieties. Joushinriki (早神力，Zaoshenri), Kokuryoumiyako (穀良都) and Tamahashiki (多摩錦) were the three main varieties occupied almost 42.3 percent of total cultivated land in 1920, and was replaced by Ginbouzu (銀坊主), Kokuryoumiyako and Rikuu (陸羽) no. 132, which occupied 67.4 percent in 1930s.[2] As Kan Jeon suggested that such high concentration of variety

[2] Kan Jeon (姜在彥)ed., Chosen ni okeru Nitchitsu Kontsurun (Tokyo: Fuji shuppanshia, 1985) pp.

bring the Korean agriculture to more fertilizer-intensive from two dimensions. Those refining varieties were all fertilizer-responsive, and together with the effect of colonial land policy, which suppress the landlord and peasant to more market oriented and more intensive cultivation and eventually led to ever-growing access of fertilizer in order to increase their unit productivity.

Under these circumstances, the artificial fertilizer demand indeed increase in a very short period. In the first eight years of Japan's colonial rule, the governor emphasize the self-sufficient of manure, but the policy shift into "commercial fertilizer" which foster peasant to use soybean meal imported from Manchuria during 1918 and 1926. In order to increase the mission of rice supply from Korea, the colonial government announced a "program of increasing rice yield" between 1926 and 1935 in which persuading farmer to access the straight inorganic chemical fertilizer instead of organic one. Colonial government invest 360 million Yen from the Fund of Agriculture Improvement to be the capital for purchasing chemical fertilizer, which led to the proliferation of the demand of ammonium sulfate.

Coincidentally, the new Zaibatsu, or" Konzern", such as Nichitsu (Nippon CHisso Hiryou, or Japan Nitrogenous Fertilizers) just expand their industrial empire into Korea, found "Chousen Chisso Hiryou KK in August 1925, constructed two hydroelectric plants in cooperation with Germany's I. G. Farben at Pujon and Changjin River respectively, and with this cheap supply of electricity, Nichitsu built a fertilizer plant at Hungnam to produce synthesis ammonium sulfate.[3] This expansion not only bring great profit to Noguchi Jun, founder of the Nichitsu, but also increase the supply of synthesis ammonium sulfate both for Japan and Korea. According to Barbara Molony's estimate, the output of synthesis ammonium sulfate of Nitchitsu was 12,500 tons in 1923 and became 399,900 tons in 1935, increase almost thirty times in only twelve years, in which 85 percent or 341,400 tons, was contributed from Korea's plants, and Korean farmers consumed about 68 percent or 274,000 tons. It goes without saying that the practice of "Program of Increasing Rice Yield" was benefit from the sufficient supply of commercial fertilizers from Nitchitsu, in paraphrase, however, the program also benefit Nitchitsu to tightly control the fertilizer market in Korea.

Taiwan

[3] Barbara Molony, *Technology and Investment: The Prewar Japanese Chemical Industry*, (Cambridge Mass.: Council on East Asian Studies, Harvard University, 1990) pp. 156-173.

Taiwan was the first colony of Japan after the Sino-Japanese war in 1895. The Taiwanese have the same experience of agriculture reform as its Korean counterpart. But the agriculture policy in Korea described hitherto was, in a sense, a replica of Taiwan model. Before Japanese occupation, Taiwanese already developed mature agricultural skill, including the utility of various nutrients, such as green manure, compost, night soil and ashes to improve the soil. The colonial government in Taiwan made great effort on land reform for the purpose of inducing Japanese capitalists to invest sugarcane industry during the first two decades of their colonial control. Artificial fertilizer was first introduced to sugarcane farmers in around 1910. A portion of soybean meal, peanut and sesames oil were imported at the same time as well, but superphosphate and ammonium sulfate was trivial. A small amount of Zailai rice was exported to Japan but with bad market response. In order to increase the rice supply for Japan, agricultural specialists developed two different strategies on variety improvement. The first is to refine Zailai rice to fit the market need of Japanese, the other is to improve the Japonica rice to adapt Taiwan environment and fit the taste of Japanese by sophisticated cross breeding experiment. In the beginning, colonial government support the former strategy from around 1900 to 1920s, highlighted the works of varieties purification, salt screening of seed, rice inspection, co-breeding and unified fertilizer purchasing system. About thirty out of 1679 strains of Zailai varieties was selected as purified and superior ones between 1903 and 1923, and thus increased three-fold of production in twenty years. However, the market response in Japan was not improved concomitantly by these painstaking efforts. According to Li Liyong's observation, the improvement project on Zailai variety face some bottleneck around 1920s, owing that the project was a highly manpower-cost and consuming too many administrative investment. The ever-growing free will of the peasant who frequently blamed the seed-screening policy was another obstacle. There was another faction in the agro-lab who insisted to introduce the Japonica varieties into Taiwan and had done various research and experiment to select the suitable strains. The obstacle and downturn of the market price of Zailai rice eventually gave the counter-faction good reason to replace Zailai rice with Ponglai rice. The colonial government eventually supports to promote the cultivation of Ponglai rice.[4] The Japonica rice had already been cultivated at the tableland of northern Taiwan and then gradually expanded into

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[4] Li Liyong, *Riji shiqi taizong dicu di nonghuei yu mizuo, 1902-1945*, Taipei: Daoxiang, pp. 108-112. 李力庸，《日治時期臺中地區的農會與米作（1902-1945）》，頁 108– 112。

middle plain of Taiwan between 1898 and 1917. However, Taiwanese farmers initially dislike the Japonica due to its precocity, few tiller, short stem and low production. After repeatedly seed-screening and crossbreeding to improve the varieties, the Ponglai rice gradually gain the trust from farmers. The governor general Izawa Takio thus announces the success of the experiment and gave the Nakamura strain a new name: "Ponglai rice" in 1926. Although the Nakamura strain was severely attack by rice blast in the same year, specialists Iso Eikichi and Suenaga Megumu successfully resolve the problem by finding a stronger strain, Taichung N. 65, which was crossbred of Shinryouku with Kameji to replace Nakamura strain. Under the encouragement of the kind market response from Japan, the cultivated acreage of Taichung N. 65 and other Ponglai rice grew rapidly in the subsequent decades. As Table 1 shown, the Taichung N. 65 became the dominant strain which cultivated acreage rose dramatically from 220 chia to 264,846 chia between 1929 and 1938, almost tenfold within one decade.[5] Taichung N. 65 was next to Asahi strain as the second dominance within Japan Empire.

Table 1

Year	The cultivated acreage of Taichung N. 65（*chia*）（A）	The cultivated acreage of Ponglai rice（*chia*）（B）	A／B（%）
1929	220	102310	2.0
1930	15515	135237	11.5
1931	44162	147448	30.0
1932	104323	193942	53.0
1933	164532	237429	69.3
1934	205782	269527	76.3
1935	245079	304985	80.1
1936	246349	299018	82.4
1937	259711	312870	83.0
1938	264846	310721	85.2

Source: Kawano Shigeto, Lin Yingyen tr. Riju shidai Taiwan migu jingjirung, p.33

The issue

5 Li Liyong, pp. 112-118; Kawano, p.

After briefly describe of the story of agricultural improvement within Japan Empire, we may point out several similar character between Japan, Korea and Taiwan. All of them experienced the same path of improvement: refine seed and breeding, refine the irrigation system, land reform, cooperative marketing, and fertilizer-intensive. Historians who study the agricultural modernization would have the same observations. Ramon Myers and Yamada Saburo compiled a table to compare the change and effectiveness of seed improvement, fertilizer input and rice yield in this three countries and suggested that there are “two important elements of [this] modern technology transmission: new rice-seed varieties that germinated earlier than traditional varieties, resisted disease, and responded to fertilizers of a high nitrogen content, …”[6]

All these statements emphasize the dependent relationship between seed improvement, fertilizer-responded and productivity. But I would make more articulate statement that in many goal of seed improvement, fertilizer-responsive would be the major, or even decisive one.

Two reports from Iso Eikichi and Suenaga Megumu, the main figures of the creator of Taichung, N.65, arouse my attention. Suenaga recalled that there existed different opinion on the policy of improving the rice productivity in Taiwan between colonial governor and local officials in the initial stage of the colonial rule in Taiwan. Fujine Yoshiharu, the engineer of Taipei Agro-lab station and Fujihara Ginjiro, the Chief Staff of the Taipei Branch of Mitsui Busan, advocated that the colonial government should promote to transplant Japonica rice to Taiwan for the purpose of increasing rice supply for Japan and fertilizer consumption in Taiwan. Although the project of improving Japonica rice was not the dominant experimental project between 1910 and 1925, the fertilizer-responsive strain of rice eventually gained its dominant role after 1926. Iso Eikichi asserted that increasing tiller, heavier spike, fertilizer responsive were the main point of rice improvement in terms of productivity.[7] Iso and Suenaga’s reports indicate a gleamingly relation between varieties improvement and encouragement of fertilizer consumption in favor of Japanese fertilizer manufacture or supplier. To explicit this relationship, we need to examine the development of Japan’s fertilizer industry.

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6 Ramon H. Myers and Yamada Saburo, “Agricultural Development in the Empire,” in R. H. Myers and Mark Peattie ed., *The Japanese Colonial Empire, 1895-1945*, Princeton: Princeton University Press, 1984, p. 436.

7 Iso Eikichi, Taiwan Ine no ikushyukaku kenkyu Study on the improvement of rice varieties in Taiwan, p.

Taki Fertilizers Co., founded in 1885, was said to be the first artificial fertilizer company. [8]Three years later Tokyo Artificial Fertilizers was created by Takamine Jokichi (1854-1922), , which produced superphosphate from phosphate rock and sulfuric acid. This two pilot factories was benefit by the Sino-Japanese War in 1895 owing that the war interrupt the importation of soy meal from Manchuria, and stimulate the high demand of artificial fertilizer made by them. additionally, two other major company emerged and made great advance on the productivity of chemical fertilizer after the Russo-Japan War. The one is Japan Nitrogenous Fertilizers (Nitchitsu hereafter), founded by Nokuchi Jun and Fujiyama Tsuneichi in 1908 with the combination of Sogi Electric and Nihon Carbide; the other is Japan Electric Chemical Company supported by Mitsui Konzern. The emergence of this two company also marked the breakthrough of the technology of chemical fertilizer from gas by-product to electrochemistry process. [9]

The outbreak of World War I was a benchmark for Japanese chemical fertilizer industry. The blockage of importation of European chemical fertilizer during the wartime stimulates Japan government and industrialists to develop their own production line to meet the domestic need. [10] The use of ammonia synthesis on munitions industry also stimulates countries involved in war to improve their technology and product, the so-called Casale process in 1916 and Claude process in 1917 respectively.[11] On the other hand, German was forced to release their patent or license of chemical fertilizer, which gave the chance for France, United Kingdom and United States, and Japan to obtain the advanced Haber-Bosch process. Japan obtained the patent of Haber-Bosch process during the war, and the exclusive right of patent licensed to Toyo Chisso Kumiai (Oriental Nitrogen Association), but unfortunately, Japanese chemical firms had no idea about transferring this process commercially. Various substitutive process were thus introduced into Japan before 1930, the Casale process, for example, by Nitchitsu in 1923, and a succession of processes for

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8 Iijima Takashi, Nippon no kagaku jijutsu: kigyoushi ni miru sono kouzou, (Japan's Chemical Technology: A Business history perspective) Tokyo: Kougyou chousakai, 1981, pp. 31-33.

9 Iijima, pp. 46-48; Barbara Molony, p. 174

10 The wholesale price of ammonium sulfate was 150 Yen per ton before the war, sharply rose to 300 Yen in 1917, and exceeded 410 Yen next year. Kan, p. 91

11 Vaclav Smil, *Enriching the Earth: Fritz Haber, Carl Bosch, and the Transformation of World Food Production*, Cambridge Mass.: The MIT Press, 2001, pp.113-115; G. J. Leigh, *The World's Greatest Fix: A History of Nitrogen and Agriculture*, Oxford: Oxford University Press, 2004, pp.142-154.

ammonia synthesis, including Claude, Fauser, Mont Cenis (Uhde), and NEC process, were launched during the inter-war period.[12] At the same time, Nitchitsu began to expand its territory into Korea, founded the Chosen Nitrogenous Fertilizers (Chosen Chisso Hiryo) in 1927, with the superior resources, especially plentiful and cheap electricity, Nitchitsu became the largest nitrogenous fertilizer company in the Japan empire.[13]

The ever-booming development of the chemical fertilizer industry sharply increased the supply of chemical fertilizer. As Table 2 and Chart 1 shown, the production of four major chemical fertilizers, namely ammonium sulfate, superphosphate, lime nitrogen and compound fertilizer, were all growing rapidly after World War I. With the benefit of introducing various synthetic processes, the production of ammonium sulfate was especially growing rapidly, from 52.8 to 232.4 between 1918 and 1928, and from 234.6 to 1108.2 between 1929 and 1938, almost twenty-one times of growth within only two decades. But unfortunately, this booming production also led to an overproduction with a more severe situation of market fluctuation after the 1929 depression. Japanese felt being dumped by British and German's syndicates due to lacking of tariffs protection for fertilizer since 1899. However, the responses from various interest groups had different priorities regarding fertilizer and eventually became a political issue and international confrontation. Eleven European countries organized "Convention Internationale de 'Azote", or CIA, a cartel involved 80 percent of the world's nitrogen producer. The exclusion of Japan's membership had an immediate impact on its own market.[14] In reaction to the threat of this European cartel, three of Japan's four largest producers of ammonium sulfate formed the Nitrogen Deliberative Associaton (Chisso Kyogikai). The Association urged the Finance Ministry to apply the Unfair Dumping Law of 1910 against the CIA agreement. After two years negotiation, Japan stipulated the so-called "Noguchi-Bosch proposals", and the manufacturers formed a distribution cartel, the Ammonium Sulfate Distribution Association (Ryuan Haikyu Kumiai, ASDA). ASDA signed with CIA three separate agreements between 1934 and 1936, which made

12 Akira Kudo, "Dominance through cooperation: I.G. Farben's Japan strategy," in John E. Lesch ed., *The German Chemical Industry in the Twentieth Century*, Dordrecht: Kluwer Academic Publishers, 2000, p. 271.
13 Barbara Molony, *Technology and Investment: The Prewar Japanese Chemical Industry*, Cambridge Mass.: Council on East Asian Studies, Harvard University Press, 1990, pp. 156-174.
14 Akira Kudo, *Japanese-German Business Relations: Cooperation and rivalry in the inter-war period*, London: Routledge, 1998, p. 113.

Japanese manufacturer a windfall.[15]

Table 2 The Production, Import and Export of Chemical Fertilizer, Japan, 1912-1945

Unit: 1,000 ton

Year	Ammonium Sulfate			Ammonium Nitrate		Super-phosphate		lime nitrogen		Synthesis Fertilizer	Compound Fertilizer
	P	E	I	P	E	P	E	P	E	P	P
1912	7.3	−	84.6	−	−	443.1	−	5.0	−	−	237.1
1913	7.5	−	111.5	−	−	548.6	−	6.7	−	−	286.4
1914	16.1	−	106.5	−	−	513.9	−	11.2	−	−	253.6
1915	31.8	−	20.1	−	−	363.1	−	15.2	−	−	176.5
1916	37.4	−	7.2	−	−	420.5	−	33.2	−	−	179.0
1917	40.7	−	15.2	−	−	445.5	−	39.7	−	−	208.3
1918	52.8	−	1.1	−	−	467.9	−	53.7	−	−	236.3
1919	79.0	−	119.0	−	−	607.8	−	90.5	−	−	376.6
1920	80.1	−	72.7	−	−	508.6	−	86.6	−	−	238.6
1921	94.8	−	79.9	−	−	554.1	−	99.1	−	−	257.8
1922	93.0	−	93.8	−	−	594.5	−	101.7	−	−	293.3
1923	104.2	−	146.9	−	−	507.0	−	111.0	−	−	316.5
1924	108.7	−	169.7	−	−	593.3	−	121.7	−	−	413.1
1925	131.1	−	205.2	−	−	673.8	−	125.3	−	−	480.8
1926	147.0	−	269.0	−	−	786.3	−	140.7	−	−	493.5
1927	176.5	−	250.0	−	−	934.8	−	120.4	−	−	532.7
1928	232.4	−	284.5	−	−	926.2	−	159.9	−	64.4	680.8
1929	234.6	−	380.7	−	−	947.2	−	161.2	−	121.3	777.3
1930	265.8	−	302.9	−	−	957.2	−	228.4	−	82.0	627.1
1931	393.2	−	224.1	0.6	−	862.4	−	168.0	−	56.0	546.6
1932	459.7	−	118.7	1.5	−	1041.5	−	180.6	−	104.3	616.8
1933	471.4	−	108.4	2.7	−	1116.6	−	223.4	−	151.1	710.1
1934	494.4	1.4	160.9	3.4	−	1126.1	−	197.3	−	237.3	722.5
1935	611.8	6.0	238.6	2.4	−	1331.6	29.3	260.6	1.7	398.0	815.8
1936	880.3	17.7	314.1	3.5	−	1437.2	26.4	290.4	1.3	358.2	845.9

15 Barbara Molony, pp. 174-185.

1937	931.2	7.2	224.2	3.7	–	1583.0	32.8	323.5	0.7	581.0	952.0
1938	1108.2	–	295.8	7.4	–	1234.1	8.1	306.8	2.1	477.4	1215.6
1939	1008.9	–	82.3	8.7	–	1460.4	7.1	215.3	–	249.6	1051.6
1940	1109.5	–	139.0	9.9	–	1639.1	41.7	224.4	–	171.5	682.1
1941	1241.7	–	48.2	15.4	–	1251.1	11.7	260.8	–	147.0	440.3
1942	1146.1	0.1	46.7	16.6	–	570.3	9.1	203.1	–	298.9	315.8
1943	966.5	0.5	3.7	19.7	–	560.7	2.4	161.7	–	257.0	198.0
1944	712.3	0.5	0.9	20.9	–	112.3	2.0	164.6	–	174.6	51.0
1945	243.0	–	–	7.7	0.1	12.7	–	77.8	–	45.3	–

Source: Watanabe Tokuji ed., Gandai Nihon Sangyou Hadatsu shi XIII: Kagaku Kougyou, Appendix 10, p. 48. P=production, I=import and E=export

Chart 1

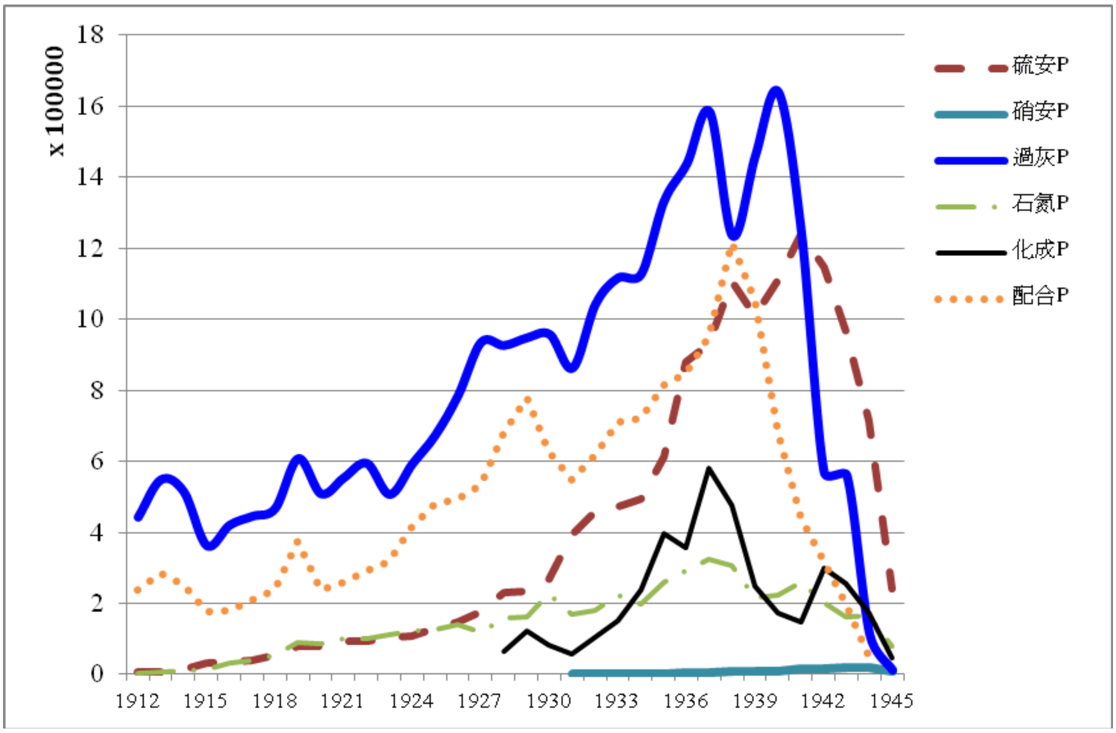

Table 3 Japanese fertilizer exported to Korea and Taiwan, 1912-1941

	Export to Korea					Export to Taiwan					
Year	Ammonium sulfate	calcium nitride	calcium super-phosphate	Other Artificial Fertilizers	Soybean	Soybean	calcium Super-phosphate	Ammonium Sulfate	Soda nitrate	Potassium Sulfate	Compound Fertilizer
1912					136	5629	25599				
1913					192	1301	26364				
1914				877	24	4532	25070				
1915				518	15	3030	39094				

1916				437	36	6717	50277				
1917				523	75	12411	60226				
1918				1232	170	988	37751				
1919				8790	745	3749	18757				16742
1920				2093	92	1289	18405				23575
1921				3487	39	469	12733	4429	1059		22421
1922				6224	468	26	12938	6838	87		19471
1923	614			5750	726	12	14716	8884	511		11940
1924	6208			7802	584	467	27255	16685	245		20745
1925	14945			14859	294	7	34054	15576	612		15639
1926	29797			19579	519	26	33776	9481	349		9976
1927	32364			34895	876	390	39948	8107	303		6941
1928	50129			50144	1237	2028	41993	7792	289	1456	10986
1929	78615			69391	871	881	38965	14873	144	845	9674
1930	62631			94524	167	1136	35095	21241	152	789	12058
1931	22538		22177	53744	1498		32115	18857		581	18448
1932	17949		39197	83225	1750		41803	49491		877	22892
1933	21893		56743	113859	1182		50108	40351		940	35444
1934	37132	31333	62145	74763	1408	800	59414	50926		392	35005
1935	33570	35786	93156	95069	1449	368	58248	69719		729	37196
1936	67425	46779	113232	121765	979	848	55211	114599		122	44128
1937	43509	35133	120134	29919	1511	584	50120	137331		3851	71176
1938	53656	18185	142328	36813	2266	432	46840	155903		3732	103002
1939	29634	2	134154	16763	1712	362	57070	101698		1008	58377
1940	41447	23	112515	3950	41	37	64403	72414		3093	54160
1941	31173	246	68349	2334	2		50539	51980		1311	58644

Source: Kondo Suo ed., Ryuan: Nippon Shihon Shugi to Hiryou Kogyo (Ammonium Sulfate: The Japanese Capitalism and the Fertilizer Industry), Tokyo: Nippon Hyoronsya, 1950

The blockage between CIA and ASDA may have impact on the agricultural production of Japanese colonies. As Table 3 shown, the amount of ammonium sulfate exported to Taiwan increase sharply from 14,873 to 155903 between 1929 and 1938, almost tenfold of growth within only ten years, and import volume steadily occupied around 10 percent of total production of Japan’s Ammonium sulfate in this period.

This growth ratio is almost the same scale as the growth of cultivated acreage of Taichung N. 65, or roughly speaking, Ponglai rice. However, Taiwanese peasant and was not in favor of the increasing import amount of chemical fertilizer. As Ramon Myers and Yamada Saburo pointed out that "farmers in Japan were encouraged to apply more fertilizer to their rice land because fertilizer prices declined as the rice price rose. This price incentive operated more weakly in the two colonies, because fertilizer-rice price ratio remained fairly constant between 1920 and 1935. Even so, by producing and marketing more rice, farmers still increased their farm income."[16] Their observation and conclusion is right, but they didn't answer why the fertilizer price is so high in Taiwan? This a good question deserves another paper to resolve.

Year[a]	Seed Improvement[b]			Fertilizer input per ha[c]			Fertilizer-rice price ratio[d]			Rice yield per ha[e]		
	JP	TW	KO	JP	TW	KO	JP	TW	KO	JP	TW	KO
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1895	– 4			13			7.0			2.06		
1905	0.30			24			5.2			2.46		
1915	0.40			49			4.4			2.79	1.47	
1920	0.42		0.22	63	12	1.3	3.5		3.3	2.91	1.47	1.43
1925	0.42	0.13	0.57	79	20	3.4	3.0	4.5	3.0	2.84	1.63	1.50
1930	0.56	0.23	0.72	96	33	12	3.0	4.5	3.5	2.89	1.75	1.48
1935	0.56	0.46	0.84	104	55	28	2.2	4.2	2.5	3.04	1.97	1.82

a. Five-year averages centering on the years shown.

b. Ratio of area planted in improved varieties to total paddy area planted in rice.

c. Kg. of $N+P_2O_5+K_2O$

d. Metric tons of brown rice purchasable with a ton of $N+P_2O_5+K_2O$

e. Metric tons of brown rice

Source: Yujiro Hayami and Vernon W. Ruttan, *Agricultural Development, An International Perspective*, Baltimore and London: The Johns Hopkins Press, 1971, p. 202, cited from Ramon H. Myers and Yamada Saburo, "Agricultural Development in the Empire," in Ramon H. Myers and Mark Peattie ed., *The Japanese Colonial Empire, 1895-1945*, Princeton: Princeton University Press, 1984, p. 436.

16 Ramon H. Myers and Yamada Saburo, "Agricultural Development in the Empire," in R. H. Myers and Mark Peattie ed., *The Japanese Colonial Empire, 1895-1945*, Princeton: Princeton University Press, 1984, p. 436.

Conclusion

The creation of Ponglai rice variety is a influential innovation and contribution of grain supply for Taiwan and Japan which manifest the progress of biological and chemical technology of Japan agriculture studies before the Second World War. However, the fertilizer-responsive character induces the grain production to a more fertilizer-intensive type, which became severe environmental problem after the war. My article is a preliminary observation on the relationship between seed screening and fertilizer industry. I do not have any intention to accuse that the creation of Ponglai rice is collusion between agro-engineer and fertilizer-capitalists. The agro-engineer should wholeheartedly do their research by every scientific means to resolve the food problem in their homeland. Chemical fertilizer would be one of the best resolutions in the aura of applying science and technology to strengthen the power of nation-state in the first two decades of twentieth century. The Japanese agro-engineer might follow the “selective affinity” to choose what they thought to be the most scientific method to improve their live. However, they also honestly find out that ammonium sulfate might be harmful to soil. But by what extent could this information be obtained by farmers in Japanese Empire would be another theme deserve to explore in another study.

國科會補助專題研究計畫移地研究心得報告

日期：101 年 5 月 4 日

計畫編號	NSC 100－2410－H－004－102－		
計畫名稱	酸與鹼：近代東亞肥料、肥皂的製造與消費		
出國人員姓名	呂紹理	服務機構及職稱	國立政治大學歷史系教授
出國時間	101 年 4 月 3 日至 101 年 4 月 12 日	出國地點	上海

一、移地研究過程

本計畫名為「近代東亞肥料、肥皂的製造與消費」，其中「東亞」一詞主要指涉中國、日本與臺灣。有關日本方面的資料，在前一期國科會專題計畫中，已先有初步的收集，獨缺中國大陸的資料。是以申請計畫時，乃鎖定上海為目標，收集相關資料。2012 年 4 月有幸受華東師範大學人文學院之邀，於該院「思勉人文講座」報告，計有 4 月 5 日上午之演講及 4 月 10 日下午之座談，並趁便於演講座談之餘，赴上海圖書館收集相關資料。上海圖書館資料極為豐富，尤以一樓之「近現代文獻閱覽室」及二樓之「古籍閱覽室」與本計畫所需最為相關。其中「近代文獻閱覽室」收有「舊平裝圖書」33 萬餘冊；1949 年前出版之近現代報紙 3543 種；1949 年前出版之雜誌 18733 種，以及 50 餘萬冊英法德荷西葡等外文書籍。此外另有「上海地方文獻閱覽室」，收錄上海相關文獻近九千種、地圖 2 萬餘張。「古籍閱覽室」則有 170 餘萬冊線裝或善本書，史料收藏極為豐富。我於該室收集 24 種善本，主要以化學、肥料、肥皂相關，另有農學農業農務之書亦極夥，然時間有限，無法全收。這 24 種善本的出版時間集中在光緒宣統至民

國 20 年間，多為譯著，除傅蘭雅外，亦可見新渡戶稻造及日本、德國化學公司出版之產品解說，頗可見當時外國化學肥料產品對中國的行銷。

唯此行時間極為有限，而我對上圖相關規定亦需時間熟悉。據云現在上圖調閱複印資料已較以前快速方便許多，古籍室亦然。唯古籍室若與其他藏書室相比，仍有許多限制，館員調書速度緩慢，複印限制頗多，這些都限制了此行收集資料的成效，只能待來日再找機會。

書名	著輯譯者	出版年	出版者	索書號
各國政治藝學簡要錄 12 卷	杭州圖書公司輯	光 29	杭州編輯局鉛印	479775
化學大成	上海璣衡堂輯	光 22	上海璣衡堂	長 648230-49
爆藥記要 6 卷	美國水雷局撰，清慈谿舒高第譯	光 1	江南製造局	長 270946
化學闡原 15 卷	法畢利幹口譯，王鍾祥筆述	光 8	同文館	長 270654-72/441486-50
化學表 1 卷	上海製造局繙譯館輯	光 10	江南製造局	長 64990/長 64991
化學材料中西名目表	江南製造局	光 10	江南製造局	長 270774/長 18960
化學須知 1 卷	英傅蘭雅	光 12		長 464830
化學衛生論 4 卷	英真司騰撰，傅蘭雅譯	光 16	上海格致書院	長 018962/482718-21
造肥皂新書 11 章（2 冊）	佚名	民國刊本		500157-58
淡氣爆藥新書下編 5 卷	英山福得撰，舒高第	光 30	江南製造局	528857-58

	譯			
化學名詞草案 1 卷	醫藥學會輯		民國京華印書局	長 104355/長 104356
化學鑑原 6 卷續編 24 卷補編 6 卷附 1 卷	英韋而司撰，續編英蒲陸山撰	光 22	上海璣衡堂	547699
化學求數 15 卷附表 1 卷	德富里西尼烏司撰，傅蘭雅譯	光 23	娛萊小築石印	長 663955-60
最新格致肥料改良農務種植全書	上海禮和洋行輯	光 34	中國圖書公司鉛印	441505
肥料學講義 1 卷	福建農林學校輯		民間抽印本	527157/527104
農務化學問答 2 卷	英仲斯敦撰，英秀耀春口譯，上海范熙庸筆述	光 25	江南製造局	405482-3
肥料學第 3 編（3 冊）	國立北京農業大學輯			527449
農務化學簡法 3 卷	美固來納撰，傅蘭雅譯上海王樹善筆述	光 29	刻本	長 024379
農務土質論 3 卷	美金福蘭格令希蘭撰，美衛理譯，范熙庸筆述	光 26	江南製造局	438789-91
肥料效用篇 1 卷	日梅原寬重口述，伊東貞元譯	光緒間石印本		長 014014 子

農業汎論卷肥料講義 1 卷	民間佚名輯		鉛印	485881-2
農業本論 2 卷	新渡戶稻造	光緒間石印本		長 014014 丙
農務全書上編 16 卷中編 16 卷下編 16 卷	美施妥縷撰，舒高第譯		江南製造局	長 65724-27

國科會補助計畫衍生研發成果推廣資料表

日期:2012/07/23

國科會補助計畫	計畫名稱: 酸與鹼：近代東亞肥料、肥皂的製造與消費
	計畫主持人: 呂紹理
	計畫編號: 100-2410-H-004-102- 學門領域: 台灣史
無研發成果推廣資料	

100 年度專題研究計畫研究成果彙整表

<table>
<tr><td colspan="3">計畫主持人：呂紹理</td><td colspan="5">計畫編號：100-2410-H-004-102-</td></tr>
<tr><td colspan="8">計畫名稱：酸與鹼：近代東亞肥料、肥皂的製造與消費</td></tr>
<tr><td colspan="3" rowspan="2">成果項目</td><td colspan="3">量化</td><td rowspan="2">單位</td><td rowspan="2">備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）</td></tr>
<tr><td>實際已達成數（被接受或已發表）</td><td>預期總達成數(含實際已達成數)</td><td>本計畫實際貢獻百分比</td></tr>
<tr><td rowspan="14">國內</td><td rowspan="4">論文著作</td><td>期刊論文</td><td>0</td><td>0</td><td>100%</td><td rowspan="3">篇</td><td></td></tr>
<tr><td>研究報告/技術報告</td><td>0</td><td>0</td><td>100%</td><td></td></tr>
<tr><td>研討會論文</td><td>1</td><td>1</td><td>100%</td><td>完成一篇英文初稿’’’’’’’’ The Production, Distribution and Impact of Chemical Fertilizer in East Asia’’’’’’’’’，發表於第一居亞洲環境史國際研討會（The First Conference of East Asian Environmental History）。目前改寫為中文，擬投稿學術期刊。</td></tr>
<tr><td>專書</td><td>0</td><td>0</td><td>100%</td><td></td><td></td></tr>
<tr><td rowspan="2">專利</td><td>申請中件數</td><td>0</td><td>0</td><td>100%</td><td rowspan="2">件</td><td></td></tr>
<tr><td>已獲得件數</td><td>0</td><td>0</td><td>100%</td><td></td></tr>
<tr><td rowspan="2">技術移轉</td><td>件數</td><td>0</td><td>0</td><td>100%</td><td>件</td><td></td></tr>
<tr><td>權利金</td><td>0</td><td>0</td><td>100%</td><td>千元</td><td></td></tr>
<tr><td rowspan="4">參與計畫人力（本國籍）</td><td>碩士生</td><td>0</td><td>0</td><td>100%</td><td rowspan="4">人次</td><td></td></tr>
<tr><td>博士生</td><td>0</td><td>0</td><td>100%</td><td></td></tr>
<tr><td>博士後研究員</td><td>0</td><td>0</td><td>100%</td><td></td></tr>
<tr><td>專任助理</td><td>0</td><td>0</td><td>100%</td><td></td></tr>
<tr><td rowspan="9">國外</td><td rowspan="4">論文著作</td><td>期刊論文</td><td>0</td><td>0</td><td>100%</td><td rowspan="3">篇</td><td></td></tr>
<tr><td>研究報告/技術報告</td><td>0</td><td>0</td><td>100%</td><td></td></tr>
<tr><td>研討會論文</td><td>0</td><td>0</td><td>100%</td><td></td></tr>
<tr><td>專書</td><td>0</td><td>0</td><td>100%</td><td>章/本</td><td></td></tr>
<tr><td rowspan="2">專利</td><td>申請中件數</td><td>0</td><td>0</td><td>100%</td><td rowspan="2">件</td><td></td></tr>
<tr><td>已獲得件數</td><td>0</td><td>0</td><td>100%</td><td></td></tr>
<tr><td rowspan="2">技術移轉</td><td>件數</td><td>0</td><td>0</td><td>100%</td><td>件</td><td></td></tr>
<tr><td>權利金</td><td>0</td><td>0</td><td>100%</td><td>千元</td><td></td></tr>
<tr><td>參與計畫人力</td><td>碩士生</td><td>0</td><td>0</td><td>100%</td><td>人次</td><td></td></tr>
</table>

	（外國籍）	博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)	無						

	成果項目	量化	名稱或內容性質簡述
科教處計畫加填項目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與（閱聽）人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

■達成目標

□未達成目標（請說明，以 100 字為限）

□實驗失敗

□因故實驗中斷

□其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文：□已發表 ■未發表之文稿 □撰寫中 □無

專利：□已獲得 □申請中 ■無

技轉：□已技轉 □洽談中 ■無

其他：（以 100 字為限）

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）（以 500 字為限）

計畫期間已完成一篇英文初稿，發表於第一屆亞洲環境史國際研討會（The First Conference of East Asian Environmental History）。本文主要論點，有二：一是臺灣農民習用化肥與殖民政府推廣耐肥作物品種有關；然為了解臺灣日本帝國圈域內其他殖民地在化肥使用上的相互關係，本計畫將觀察焦點擴大到同受殖民統治的朝鮮。透過閱讀朝鮮農業史及化學肥料史二手研究成果，我發現朝鮮與臺灣有著既相似又相異的經驗。就相似面而言，1910 年代以後，朝鮮半島的稻作農業也同樣經歷了與臺灣相似的品種改良、土地改良與耕作法改良的過程，以達到日本增加米產的需求。品種改良的目標，亦在與日本水稻雜交，以育成耐肥的水稻品種。然而，朝鮮與臺灣經驗相異者，為日本新興財閥「日窒」（日本窒素肥料株式會社）在朝鮮投入大量資金，開發水力發電，而其目的則為製造氮肥提供廉價的電力，從而使得朝鮮也成為提供自身及日本氮肥極為重要的產地。本文另一個重要觀察，為國際化學肥料市場變動對日本對殖民地供給化肥的影響。初步的觀察發現：就在日窒大力在朝鮮投資的同時，國際化學肥料市場產生了不小的變動，致使日本在 1920 年代末期發生化肥生產過剩現象，同一時間卻也是臺灣農技官僚大力尋找耐化肥水稻品種的時期。兩者之間未必純屬時間巧合，對於臺灣總督府及日本農技官僚而言，使用化肥是一種時代的「選擇性親近」，但是否此一選擇也與日本化工業者的政商力量有關？則還需要求證。