

## The Dynamics of Capitalization in Chinese Agriculture: Private Firms, the State, or Peasant Households?

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中国农业资本化的动力: 公司、国家、还是农户?

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### Abstract

Chinese agriculture has undergone a quiet transformation in the past fifteen years. The “old agriculture” of grain, cotton, and oil crops has seen a tremendous rise in uses of machinery (and also farm chemicals) to save labor. At the same time, the capital and labor dual-intensifying “new agriculture” of higher-value products—vegetables, fruit, meat, poultry, fish—has expanded greatly. These changes have been accompanied by substantial declines in the number of people working in agriculture. Together, the changes add up to a high degree of “capitalization” (i.e., increased capital inputs per unit labor) in Chinese agriculture. This article presents detailed quantitative evidence for these commonly neglected changes.

Contrary to conventional assumptions, the capitalization has been powered principally by peasant household investments, more than state or capitalist firm investments. This fact points to the need to rely more on peasant initiative in the future, by providing greater state guidance and support for peasant family farm-based endeavors, rather than strongly favoring “dragon head” enterprises as in the past decade.

### Keywords

old agriculture, new agriculture, state investment, capitalist firms, family farming

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## 摘要

过去15年间，中国农业经历了悄然但巨大的变化。“旧农业”（粮食、棉花、油料作物）大量使用机械及农药以节约劳动。与此同时，资本与劳动双密集的“新农业”（主要是高产值的蔬菜、水果、肉、禽、鱼）有着极大的发展。这些变化是伴随农业就业人员数的持续下降而来的。结果是中国农业显著的“资本化”（亦即，单位劳动力资本投入的增加）。对于这些普遍被忽视的事实，本文将给出详细的量化证据。

与通常的假设不同，中国农业资本化主要是由农户投资推动的，其总量比国家和农业企业公司的投资还要大。这一事实的重要意义在于，未来中国农业的发展，需更注重和依赖农户的能动作用。国家需对农民家庭的经营行为给予更大的服务和扶持，不应像过去十年间那样，一味将政策支持倾斜于“龙头企业”。

## 关键词

旧农业 新农业 国家投资 资本主义企业 家庭农业

While neoliberals commonly assume that agricultural development can only be driven by marketized firms (or firm-like family farms), Marxist planners often assume that it can only be driven by state investment (or subsidies). While each of the dynamics pointed out in those two perspectives has been important in Chinese agricultural change in recent decades, there is a third and even more important dynamic that has been largely overlooked. Capital investments necessary for agricultural development have in fact come mainly not just from private firms or state investment, but even more from peasant family farms, and have been drawn mainly from the wages earned by peasants working off-farm. The last is perhaps the most unexpected dimension of the recent Chinese agricultural development experience.

Along with China's general economic development, there has been a steady rise both in the opportunities for off-farm employment and in wages, causing a rise in the opportunity cost of farm labor. That in turn has caused more and more farming peasants to expect higher and higher returns from their work. Because the returns from hand plowing-planting-harvesting and hand weeding in the "old agriculture" (i.e., of "big-field" 大田 farming of mainly grain, cotton, and oil crops) have fallen well below market wages for off-farm work, there has been greater and greater resort to hiring in tractor plowing, planting, and harvesting, as well as using herbicides 除草剂 (rather than human labor) to control weeds (mainly in rice farming). At the same time, the exit of younger peasants for off-farm employment has meant the "seniorization" of the agricultural workforce—these days consisting mainly of middle aged and older men and women. That too has added to the need for mechanization to save labor. In grain farming in general, such operating capital investments have risen five-fold in the past fifteen years, according to the National Development and Reform Commis-

sion's sampling of 68,000 selected households. Similar tendencies are evident in cotton, soybeans, and oil crops, the other major crops of the "old agriculture."

The costs-benefits survey sample, however, might well be skewed toward more "advanced" households, for reasons to be examined in detail below. Nevertheless, even lower estimates, based on the 1996 and 2006 national decennial survey of all farm households, suggest impressive expansions in the use of machinery and thin plastic covers (to control temperature, moisture, and sometimes also weeds), about three-fold in the period 1996-2010.

At the same time, the decline in birth rates since the 1970s and the tide of out-migration of peasants for off-farm work have together resulted in a marked decline during recent years in the size of the rural workforce, by about 5 million each year after the turn of the century, increasing since 2006 to nearly 10 million a year. At the same time, off-farm employment within rural China itself has also increased rapidly. The combined result is that during this past decade, the number of farming persons has declined by an average of 12 million each year, dropping from 320 million in 2001 to less than 200 million in 2010.

The dimensions of the increase have been such as to propel a quiet revolution in farming methods. In contrast to the pre-1995 "revolution" in farming, which had been mainly an extension of the original "green revolution" (principally increased use of chemical fertilizers and scientific seed selection) that had driven the modernization of Chinese grain farming since the 1960s, the last fifteen years or so have seen this new change of greatly increased use of machinery and farm chemicals 农药 to save labor. Because so little has been done along these lines, the quantification we present is of necessity very detailed, perhaps even overly so. Our data show that such operating capital investments in the old agriculture might have totaled, as an upper-limit estimate, about 407.3 billion yuan in 2010. A lower, perhaps more reliable, estimate is 244.0 billion. They have brought a degree of "capitalization" (in the sense of increased use of capital per unit labor) that is surprising and has changed the "old" agriculture in fundamental ways.

The other main change has been great expansions of the "new agriculture"—of higher-value farm products that are both capital- and labor-intensifying, such as vegetables, fruits, meats, poultry, fish, eggs, and milk. Those generally require several times more investment of operating capital than grain, for fertilizers and other special modern inputs (e.g., more fertilizers for vegetables, processed feed for farm animals, and special bags 果袋 needed for growing high-value apples). The total of such increased operating capital investments in small-scale household production of eight major products (vegetables, apples, pigs, dairy cows, cattle, mutton and lamb, chickens, eggs) of the new agriculture amounted to 1218.6 billion yuan (in 2010). Since we limit ourselves

here to the new, more advanced agriculture, there is not the same problem here of possible skewing in data toward the more advanced forms.

The new agriculture also requires capital investments in fixed assets 固定资产, such as plastic tents for vegetables (commonly termed “agriculture with infrastructure” 设施农业), fruit orchards, structures for animal raising, fish ponds, and so on. The total of such investments from peasant households reached by 2010 about 230.5 billion yuan.

Peasant capital investments (fixed and liquid, old and new agriculture), at a combined total of 1,693.1 billion yuan, have come initially mainly from earnings from the peasants’ off-farm work, totaling about 5,000 billion yuan in 2010, and have been sustained partly by the higher returns from the new agriculture. That dwarfs investments by both the state and agricultural firms. In other words, peasant households have been the main force behind the vigorous capitalization of agriculture in the past fifteen years.

Needless to say, the phenomena described above have been most apparent in the more advanced east coast regions and areas adjacent to urban centers, and less so in inland, outlying or mountainous areas.

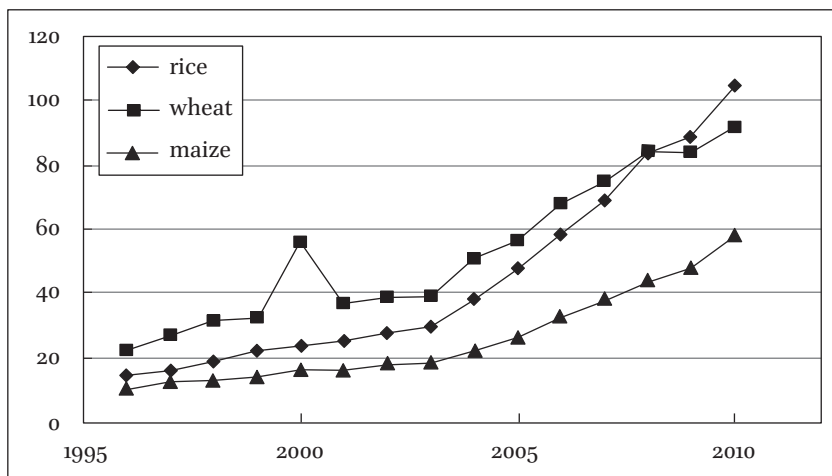
What is unmistakable is that, despite the unfair treatment as second-class citizens they have received for off-farm work in China’s second-class “informal economy” (no labor law protection, lower wages, longer hours, and little or no benefits compared to urban residents—Huang 2009), peasants have in fact made huge contributions to furthering China’s agricultural development. The record argues for policies that would facilitate and support still greater contributions from peasant family farms.

### **Increased Use of Machinery and Labor-saving Farm Chemicals in the “Old Agriculture”**

According to the National Development and Reform Commission’s sampling of 68,000 households on costs-benefits in different crops between 1995 and 2010, use of farm machinery in grain farming (using the three main grain crops—rice, wheat, maize—as a proxy for all grain) increased no less than five- to six-fold (from roughly 10-20 yuan per mu to about 60-100 yuan in “constant prices” 不变价格), as shown in Figure 1. At the same time, use of herbicides (to control weeds and save labor, mainly in rice farming) and pesticides (to control insects) increased two- to three-fold, from about 5-15 yuan per mu to about 10-45 yuan per mu, shown in Figure 2.

These changes have occurred while investments in the other two major modern inputs, chemical fertilizer and improved seeds (the main propellants

Figure 1. Machinery Inputs in Grain Farming, 1996-2010 (in yuan per mu, by constant prices)

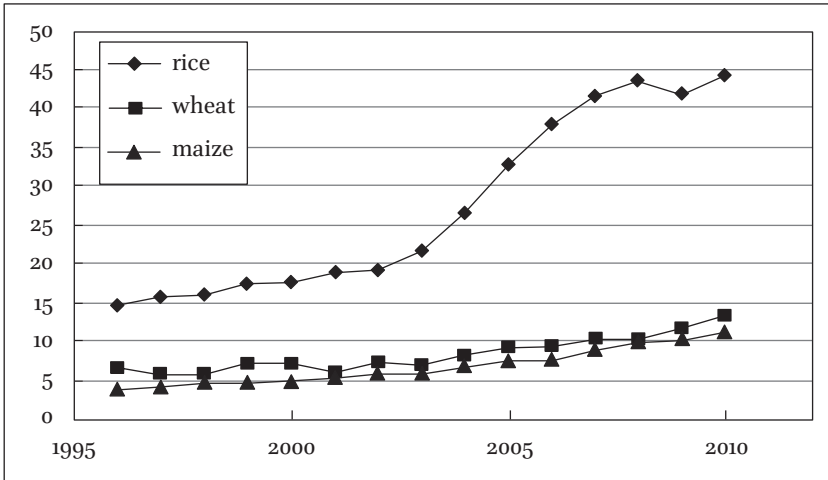


**Source.** The data in current prices come from the costs-benefits surveys in *Quanguo nongchanpin chengben shouyi ziliao huibian* (hereafter *Quanguo nongchanpin*), 2007, 2011: tables 1-2-1, 1-7-2, 1-8-2. Constant prices are obtained by using the “farm machinery” 机械化农具 price index (in the price indices for different agricultural “means of production” 生产资料) to arrive at adjusted constant prices. The data for indexed prices for different agricultural means of production come from the *Zhongguo nongcun tongji nianjian*, 1997-1999: table 7-8; 2000-2006: table 8-7; 2007-2011: table 8-4.

of the “green revolution” of the 1960s and 1970s), have increased only modestly (Figures 3 and 4). The result has been a large increase in the proportion occupied by machinery and farm chemicals inputs in all (circulating) capital inputs into farming: from about 15 percent (machinery inputs) + 11 percent (farm chemicals), or 26 percent of all “modern inputs” (farm machinery inputs + chemical fertilizer + improved seeds + farm chemicals), up to 54 percent (37 percent farm machinery and 17 percent farm chemicals).

Similar tendencies have occurred in soybeans and oil crops (8.6 percent of sown acreage in 2009) and cotton (3.1 percent), the other major components of the “old agriculture.” The tendency in machinery use in cotton, soybeans, and oil crops closely parallels that in grain. In cotton and soybeans, per mu use of machinery rose from just 5-10 yuan in 1996 to 50-60 yuan in 2010 (*Quanguo nongchanpin*, 2007, 2011: tables 1-9-2, 1-11-2, 1-12-2, 1-13-2). Farm chemicals

Figure 2. Farm Chemicals Inputs in Grain Farming, 1996-2010 (in yuan per mu, by constant prices)



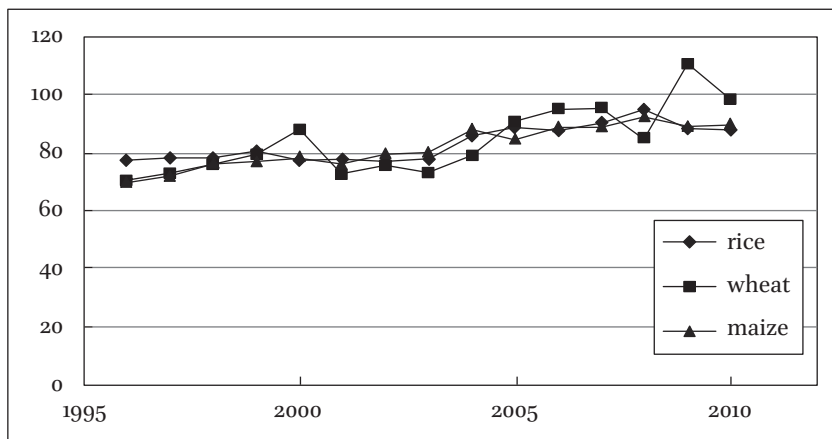
**Source.** The data for farm chemicals inputs in current prices come from the costs-benefits surveys in *Quanguo nongchanpin*, 2007, 2011: table 1-2-2, 1-7-2, 1-8-2. Constant prices are obtained by using the “farm chemicals” price index (in the price indices for different agricultural “means of production”) to arrive at adjusted constant prices. The data for indexed prices for different agricultural means of production come from the *Zhongguo nongcun tongji nianjian*, 1997-1999: table 7-8; 2000-2006: table 8-7; 2007-2011: table 8-4.

(i.e., pesticides and herbicides) use has risen substantially also, though not to the same degree as machinery use (*Quanguo nongchanpin*, 2007, 2011: tables 1-9-2, 1-11-2, 1-12-2, 1-13-2). Chemical fertilizer use too has shown considerable increase, though again not to nearly the same degree as machinery use (*Quanguo nongchanpin*, 2007, 2007: tables 1-9-2, 1-11-2, 1-12-2, 1-13-2).

According to the costs-benefits data in 2010, cotton used an average of 307 yuan per mu of modern inputs (of machinery, chemical fertilizers, pesticides-herbicides, and seeds). Soybeans, at 5 percent of sown acreage, used 146 yuan for the same four inputs; peanuts, at 2.8 percent of total sown acreage, used 289 yuan; and rapeseed, at 4.6 percent of sown acreage, used 125 yuan.

Combining all major crops of the old agriculture, Table 1 shows that the three grains (rice, wheat, maize), cotton, soybeans, and the three major oil crops accounted for a combined total of 69.6 percent of all sown acreage in 2010. They used in 2010 a combined total of 407.3 billion yuan of modern

Figure 3. Chemical Fertilizer Inputs, 1996-2010 (in yuan/mu, by constant prices)



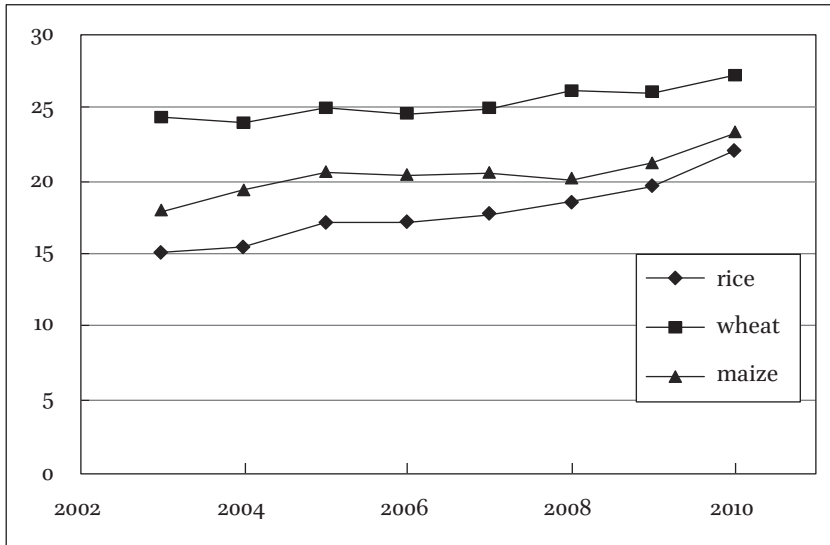
*Source.* The data for chemical fertilizer inputs in current prices come from the costs-benefits surveys in *Quanguo nongchanpin*, 2007, 2011: table 1-2-2, 1-7-2, 1-8-2. Constant prices are obtained by using the “chemical fertilizers” 化学肥料 price index (in the price indices for different agricultural “means of production”) to arrive at adjusted constant prices. The data for indexed prices for different agricultural means of production come from the *Zhongguo nongcun tongji nianjian* 1997-1999: table 7-8; 2000-2006: table 8-7; 2007-2011: table 8-4.

inputs (machinery, chemical fertilizer, farm chemicals, seeds). This figure may be taken as an approximation of total liquid capital investments in the old “big field” agriculture, according to the costs-benefits survey data.

### A Different Set of Data

However, we are inclined to think that the costs-benefits data used above need to be adjusted downward in light of the more systematic and thorough decennial survey of *all* farm households done in 1996 and 2006. As we have detailed earlier (Huang, Gao, and Peng, 2012), those two surveys required that every household be interviewed and that standardized tables be filled in on the spot by the interviewer and interviewees together. The surveys are comparable in design, scale, and detail to the decennial population surveys. We showed earlier that while the cost-benefits sampling of 68,000 households suggests that perhaps 5-10 percent of all labor in farming were hired, the decennial household-by-household surveys suggests a substantially lower figure of

Figure 4. Improved Seeds Inputs, 2003-2010 (in yuan/mu, by constant prices)



**Source.** The data for improved seeds inputs in current prices come from the costs-benefits surveys in *Quanguo nongchanpin*, 2007, 2011: table 1-2-2, 1-7-2, 1-8-2. Constant prices are obtained by using the “seeds for agricultural use” 农用种子价格指数 (in the price indices for different agricultural “means of production”) to arrive at adjusted constant prices. The data for indexed prices for different agricultural means of production come from the *Zhongguo nongcun tongji nianjian*, 2003-2006: table 8-7; 2007-2011: table 8-4. (Data on seeds are given only for the years 2003-2011.)

3 percent. And we were in the end inclined to trust in the latter figure. Indeed, the State Statistical Bureau has been adjusting the earlier figures in its *China Rural Statistical Yearbook* on the basis of the decennial surveys, in the same manner as it has adjusted population, employment, and other data to accord with the more reliable decennial population surveys.

As we suggested earlier, the sampling work has in fact been subject to the conflicting tugs of two different purposes and tendencies. One, shown for example in a speech given by the chairman of the agency conducting the survey, spoke explicitly of the purpose of the “model function of the surveyed household” to “show the peasants a visible path to becoming rich” (Zhao Xiaoping, 2004; cf. Huang, Gao and Peng, 2012: 149). The other, coming perhaps from the professional dispositions of the statisticians involved, seeks to reflect accurately the national picture—hence the efforts to adjust the data to accord with the



Table 1. Liquid Capital Inputs and Sown Acreage of Major Crops of the Old Agriculture, 2010 (in yuan)

Crops	Sown acreage (100 million mu)	Percentage	Machinery (yuan/mu)	Chemical fertilizer (yuan/mu)	Farm chemicals (yuan/mu)	Seed (yuan/mu)	Total of four items (yuan/mu)	Total liquid capital investment (100 million yuan)
Rice	4.48	18.6%	104.9	106.0	43.2	36.2	290.2	1,300.3
Wheat	3.64	15.1%	91.8	118.5	13.1	44.7	268.1	975.5
Maize	4.88	20.2%	58.1	108.4	10.9	38.3	215.8	1,051.9
Soybeans	1.28	5.3%	58.1	46.4	11.6	29.9	146.0	186.5
Peanuts	0.68	2.8%	42.4	103.2	21.8	121.9	289.3	196.5
Rapeseed	1.11	4.6%	28.4	72.8	9.5	14.7	125.5	138.7
Cotton	0.73	3.0%	53.8	152.5	56.1	44.6	307.1	223.3
Total	16.78	69.6%						4,072.9

Source. *Zhongguo nongcun tongji nianjian*, 2011: table 7-2; *Quanguo nongchanpin*, 2011: tables 1-2-2, 1-7-2, 1-8-2, 1-9-2, 1-11-2, 1-12-2, 1-13-2.

decennial national surveys. The tensions between the two tendencies seem as yet not completely resolved. We need therefore to use the decennial data as a check on the costs-benefits data, and perhaps even in preference to the latter.

However, while systematic and thorough, the decennial data are not as specific with respect to farm operations as the costs-benefits data. They do not permit a check on the same categories used by the sampling data. Rather, we have to content ourselves with suggestive indicators based on different, simpler categories. Table 2 compares trends indicated by the total number of tractors owned at year-end, divided into big-middle 大中型 and small sized 小型, given in the decennial surveys and by the machinery inputs per mu for grain given in the costs-benefits sampling data.

Clearly, the dimensions of increase suggested by the two sets of data are quite different. In one, in the ten-year period from 1996 to 2006, total farm machinery roughly doubled; in the other, in the same period, it tripled. Projecting the first trend down to 2010, machinery use might have tripled; in the latter, it went up five-fold. The average annual increase rate in the first is roughly 7 percent. In the other, it is more than 18 percent.

Another useful indicator is the amount of “thin plastic” 薄膜 used to cover crops for purposes of temperature and moisture (and sometimes also weed) control. Table 3 shows the different figures given by the decennial survey and the *China Rural Statistical Yearbook*, which has routinely incorporated the costs-benefits survey data.

Table 2. Numbers of Tractors of Different Sizes in 1996 and 2006 from the Decennial Surveys, Compared to Data on Machinery Inputs per Mu from Sampled Households (in yuan, by constant prices)

Year	Big-medium tractors	Percent increase	Small tractors	Percent increase	Machine inputs for rice and wheat (yuan/mu)	Percent increase
1996	680,000	–	11,800,000	–	20	–
2006	1,400,000	207.5%	25,500,000	216%	60	300%

*Source.* *Zhongguo di er ci quanguo nongye pucha ziliao zonghe tiyao* (hereafter *Zhongguo di er ci*), 2008: table 6-7; see also Figure 1 above.

*Note.* The 2010 *Zhongguo tongji nianjian*: table 13-5, shows 671,000 big-medium and 9,190,000 small tractors for 1996, and 1,718,000 big-small and 15,679,000 small tractors for 2006. We have opted to rely more on the decennial surveys of every household here. The former is extrapolated from sampling data; the latter is based on an actual household-by-household count.

Table 3. Cultivated Acreage Using Thin Plastic Covers, 2006

Year	Decennial survey	Costs-Benefits Sampling
1996	n.a.	97.5 million
2006	20 million	210 million

*Source.* *Zhongguo di er ci*, 2008: table 3-2-11

As can readily be seen in Table 3, the *China Rural Statistical Yearbook* possibly exaggerated the extent of such farming—most likely because of the tendency to select more advanced farms in its sampling.<sup>1</sup>

On the other hand, we should point out that the two sets of data differ little when it comes to farm chemicals and chemical fertilizer use (*Zhongguo di er ci*, 2008: table 3-2-11; compare with *Zhongguo nongcun tongji nianjian*, 2008: table 3-9). This is probably because there is not much difference between the “average” farm and the more advanced farm when it comes to those two inputs. Both kinds of farms, it may be surmised, tend to approximate the optimal levels under the same given ecological conditions and input prices.

For now, until better data become available, we might use the decennial figures as a low estimate of increases in modern inputs (of machinery and plastic covers), and the costs-benefits sampling data as the high estimate. Projecting down to 2010 from 1996-2006, the former argues for about a three-fold increase in total, while the latter argues for five-fold, as we have seen. We ourselves are once more inclined to the decennial survey data as the more reliable and accurate. Using the fraction of 3/5 to adjust our costs-benefits data downward, we would come to a figure of 244 billion yuan (407.3 bn.  $\times$  0.6) in total liquid capital investments in the old agriculture.

### Capitalization in the “New Agriculture”

The rise of the “new agriculture” of higher-value farm products and the resulting transformation in the structure of Chinese agriculture have amounted to what Philip Huang has termed a “hidden agricultural revolution” 隐性农业革命. The combination of increased capitalization of the old and the new agricul-

<sup>1</sup> Unfortunately, the *China Rural Statistical Yearbook* does not give any data for the still more important category of “agriculture with infrastructure” 设施农业, which includes tented farming of vegetables, mushrooms, some fruits and nursery farming, as does the decennial survey (*Zhongguo di er ci*, 2008: 10, table 7), to allow for a comparison of such new agriculture.

tures is the two-sided change that has wrought the basic transformation of Chinese agriculture in the past decade and a half.

Fortunately, because we are concerned here in this section only with the new and advanced segments of agriculture, we can simply rely on the costs-benefits sampling data, without having to deal with the discrepancies of data between the decennial surveys and the costs-benefits sampling.

#### *Investment in Fixed Assets*

The new agriculture involves, first of all, more fixed assets investment (e.g., tented vegetables, structures for animal raising, investments in fruit orchards, fish ponds, and so on). A good indication of such investments is the statistical category of “fixed asset investment” 固定资产投资, broken down into the “primary, secondary and tertiary sectors” 第一、二、三产业, or agriculture, industry, and services. Those investments in agriculture are further broken down by the source of fixed asset investment, from state owned 国有经济, to collective 集体经济 (divided into rural collectives 农村集体 and non-rural collectives), and individual or household investments 个体, which is further broken down to “rural individual” 农村个体, and non-rural.

As Table 4 shows, the state and rural individuals/households have been the main investors in fixed assets, the state’s total rising from just over 10 billion yuan in 1996 to more than 240 billion yuan in 2010. This reflects the state’s expanded role in investments for agricultural infrastructure, the biggest item of which is for water control 水利 (Zhongguo nongcun tongji nianjian, 2010:

Table 4. Investments in Fixed Assets, by the State, Collectives, and Individual Households (in hundred million yuan)

Year	Fixed asset investment in the primary sector	From state-owned enterprises	From collectives	From rural collectives	From individuals	From rural individuals
1996	589.09	108.39	85.09	81.15	382.5	382.5
2000	859.7	303.8	129.94	122.51	386.21	380.39
2005	2,323.66	521.43	505.68	476.11	1,115.37	1,004.37
2010	7,923.09	2,440.72	747.84	464.08	3,213.84	2,305.09

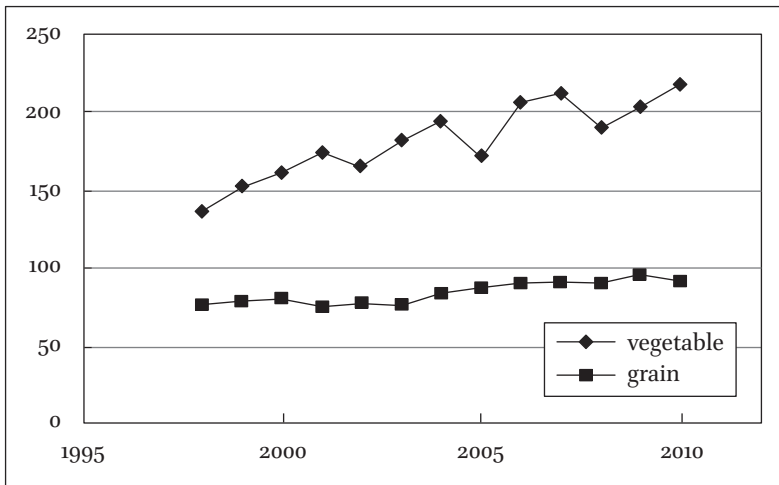
**Source.** *Zhongguo guding zichen touzi tongji nianjian*, 1997-1999, 2001, 2003-2011: table for “main categories of fixed assets investments of the entire society” 全社会固定资产投资主要指标.

table 5-2). Household investments are mainly of the type already discussed above, for a transition from the old to the new agriculture. The last has increased from less than about 38 billion yuan per year in the period 1996-2000 six-fold to 230.5 billion yuan from “rural households” 农村个体 plus another 90 billion yuan from non-rural households/individuals, to reach a total of 321.4 billion yuan in 2010. The surprise is that individual household investments in fixed assets have equaled those from the state.

### *Liquid Capital Investments*

In addition, there have been significantly more investments of liquid capital for the maintenance and capitalization of the new agriculture. Vegetables, especially the new-style tented vegetables, typically use about two times more chemical fertilizer than grain, ca. 200+ yuan in 2010 per mu, compared to less than 100 yuan for grain, as shown in Figure 5. They also use much more for

Figure 5. Chemical Fertilizer Inputs for Vegetables, Compared to Grain, 1998-2010 (in yuan/mu, by 1996 constant prices)



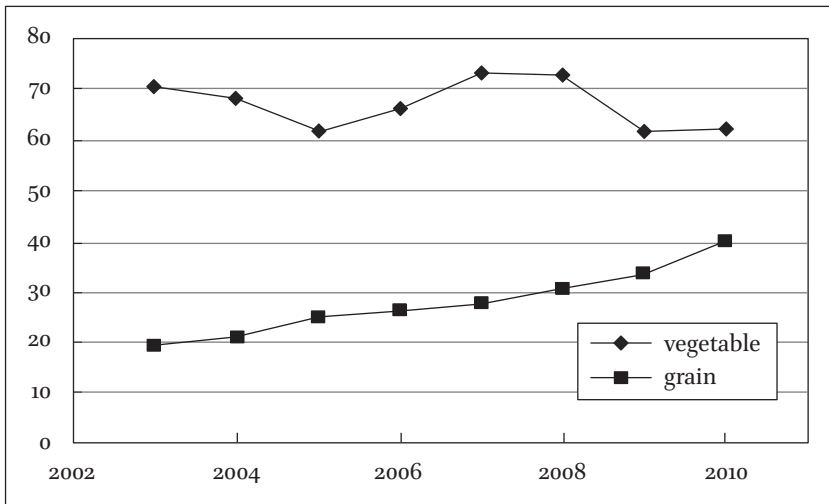
**Source.** The data for chemical fertilizer inputs in current prices come from the costs-benefits surveys in *Quanguo nongchanpin*, 2007, 2011: tables 1-1-2, 1-21-2. Constant prices are obtained by using the “chemical fertilizers” price index (in the price indices for different agricultural “means of production”) to arrive at adjusted constant prices. The data for indexed prices for different agricultural means of production come from the *Zhongguo nongcun tongji nianjian* 1997-1999: table 7-8; 2000-2006: table 8-7; 2007-2011: table 8-4.

improved seeds, about 3.5 times more before the changes of the past decade, and in 2010, about 1.5 times as much—60 yuan per mu, compared to 40 yuan per mu for grain, shown in Figure 6. And for farm chemicals too (not just to kill pests and weeds, but also to control fungi and viruses), about 100 yuan per mu in 2010 compared to 20 yuan for grain, or five times as much, shown in Figure 7.

But vegetables use less in the way of machinery inputs, as might be expected, inasmuch as tented vegetable farming occurs in a small space (as opposed to the open “big-field” old agriculture; see Figure 8). Such machinery as are used tend to be for activities such as the digging and leveling of earth required for setting up tents and the mechanized openings and closings of drapes for the more advanced tents.

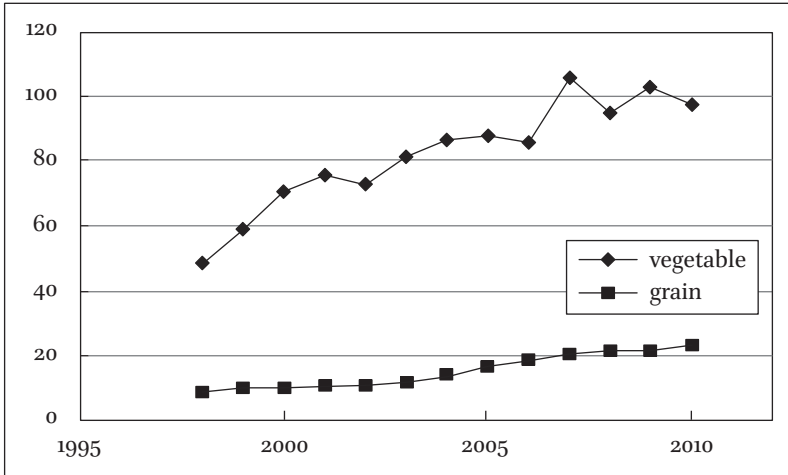
A rough summary impression of the differences between the old and the new agriculture in terms of operating capital inputs can be obtained by

Figure 6. Investments for Seeds for Vegetables, Compared to Grain, 2003-2010 (in yuan/mu, by 2003 constant prices)



**Source.** The data for improved seeds inputs in current prices come from the costs-benefits surveys in *Quanguo nongchanpin*, 2007, 2011: tables 1-1-2, 1-21-2. Constant prices are obtained by using the “seeds for agricultural use” price index (in the price indices for different agricultural “means of production”) to arrive at adjusted constant prices. The data for indexed prices for different agricultural means of production come from the *Zhongguo nongcun tongji nianjian*, 2003-2006: table 8-7; 2007-2011: table 8-4. (Data on seeds are given only for the years 2003-2011.)

Figure 7. Investments in Farm Chemicals for Vegetables, Compared to Grain, 1998-2010 (in yuan/mu, by 1996 constant prices)



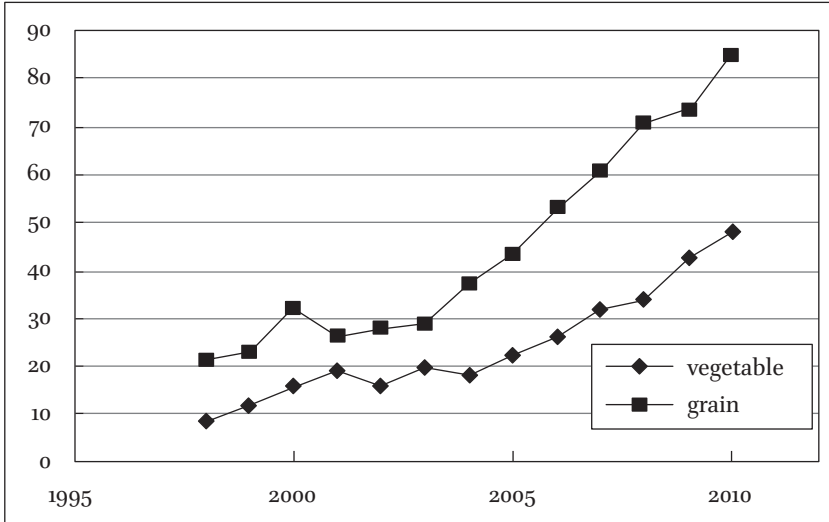
**Source.** The data for farm chemicals inputs in current prices come from the costs-benefits surveys in *Quanguo nongchanpin*, 2007, 2011: tables 1-1-2, 1-21-2. Constant prices are obtained by using the “farm chemicals” price index (in the price indices for different agricultural “means of production”) to arrive at adjusted constant prices. The data for indexed prices for different agricultural means of production come from the *Zhongguo nongcun tongji nianjian*, 1997-1999: table 7-8; 2000-2006: table 8-7; 2007-2011: table 8-4.

comparing the two in terms of the statistical category of “material and service expenses” 物质与服务费用 per mu (with the caveat that category includes not just the costs for the “modern” inputs we have been discussing above, but also older ones like water, transport, and electrical fees). As can readily be seen from Table 5, vegetables (in 2010) require more than 3 times as much as rice (3.2 times) or wheat (3.6 times), nearly 7 times more than for soybeans and rapeseed, and 2.7 times as much as cotton.

For fruits, detailed data are available only for apples. As Table 5 shows, under market demand forces, apple-growing today has become a highly capital-intensive activity, requiring in 2010 yet another 1.7 times as much liquid capital as for vegetables, and 5.2 times as much as for rice.

An approximation of total liquid capital investments in vegetables and fruits can be arrived at by multiplying the investments of “material and service

Figure 8. Machinery Inputs for Vegetables, Compared to Grain, 1998-2010 (in yuan/mu, by constant prices)



**Source.** The data for farm machinery inputs in current prices come from the costs-benefits surveys in *Quanguo nongchanpin*, 2007, 2011: tables 1-1-2, 1-21-2). Constant prices are obtained by using the “farm machinery” price index (in the price indices for different agricultural “means of production”) to arrive at adjusted constant prices. The data for indexed prices for different agricultural means of production come from the *Zhongguo nongcun tongji nianjian*, 1997-1999: table 7-8; 2000-2006: table 8-7; 2007-2011: table 8-4.

Table 5. Material and Service Inputs, Grain, Cotton, Soybeans, and Rapeseed, Compared with Vegetables and Fruit (Apples), 1996-2010 (in yuan/mu, by current prices)

Year	Rice	Wheat	Maize	Soybeans	Rapeseed	Cotton	Vegetables	Apples
1996	232.9	203.2	172.0	107.5	117.1	282.2	–	658.2
2000	199.2	229.0	158.5	96.5	116.0.	260.0	748.7	563.1
2005	242.5	216.4	176.1	113.8	107.9	295.5	877.4	559.2
2010	358.6	318.4	260.5	165.1	162.7	419.9	1,133.0	1,882.5

**Source.** *Quanguo nongchanpin*, 2007, 2011: tables 1-2-2, 1-7-2, 1-8-2, 1-9-2, 1-11-2, 1-12-2, 1-13-2, 1-18-2, 1-21-2.



expenses” 物质与服务费用 per mu by total sown acreage, as shown in Table 6. As can readily be seen, for these two major items of planted products in the new agriculture, the total liquid capital investments amounted in 2010 to 313.5 billion yuan.

As for meat production, pork of course remains the largest category of all meats. However, even pig-raising has undergone profound changes in recent years. The traditional model, of course, was the pig as a scavenger for “hog-wash” 泔水 (and its manure, converted into compost, was the principal organic fertilizer). But today pig-raising has become increasingly modernized and capitalized. The main indication of this is the much greater reliance on manufactured high-quality feed 精饲料, traditionally referring to grain feed rather than stalks and leaves and scraps, but today often high-quality manufactured feed. A second important indicator is greater and greater expenditures for the purchase of higher-value piglets 仔猪. According to the costs-benefits sampling data, today both scattered and scale raising of pigs rely mainly on manufactured feed and high-value piglets. These data show liquid capital investments totaling 900 yuan (per 100 kilograms, or about 1.5 pigs) (including both “scattered raising” 散养 and “scale raising” 规模养猪), about three times that for the “old agriculture” of grain per mu (Quanguo nongchanpin, 2007, 2011: tables 1-20-2, 1-19-2).

To get a quantitative sense of the total picture of major animal products, Table 7 tallies the amounts of total liquid capital investments (again using “material and service expenses” as an approximation) of the major products.

Table 6. Liquid Capital Investments in Vegetables and Apples Cultivation of the New Agriculture, 2010 (yuan/mu)

Crop	Sown acreage (100 million mu)	Liquid investment per mu (yuan)	Total liquid investment (100 million yuan)
Vegetables	2.85	888.0	2,530.7
Apples	0.32	1,882.5	604.2
Total			3,134.9

**Source.** Sown acreage for vegetables and apples come from *Zhongguo nongcun tongji nianjian*, 2011: table 7-12, 7-30. “Direct costs” of “materials and service inputs” come from *Quanguo nongchanpin*, 2011: tables 1-18-2, 1-21-2, 1-23-2.

**Note.** In computing liquid capital investments, only the “direct costs” 直接费用 of the “materials and service inputs” are counted, and not the “indirect costs” 间接费用 (i.e., depreciation and tax).

Table 7. Liquid Capital Investments in Animal Products in Household Small-Scale New Agriculture

Product	Scale (head)	Number for slaughter (10 thousand)	Liquid investment per head (yuan)	Total liquid investment (100 million yuan)
Pigs	1-49	34,061.0	973.7	3,316.3
	50-99	11,394.7	1,008.1	1,148.8
Dairy cows	1-4	445.6	8,395.0	374.1
	5-9	264.1	8,395.0	221.7
Beef cattle	1-9	3,409.4	4,160.7	1,418.6
	10-49	1,124.7	4,160.7	468.0
Lambs and sheep	1-29	17,277.3	359.3	620.8
	30-99	9115.0	359.3	327.5
Meat chickens	1-1,999	13,4823.2	18.4	248.0
Egg chickens	1-499	53,322.2	69.7	371.5
	500-1,999	51,292.1	104.5	536.1
Total				9,051.4

**Source.** The data on meat animals for slaughter 出栏 come from *Zhongguo xumu nianjian*, 2010; the liquid capital data are from *Quanguo nongchanpin*, 2010: tables 5-1-2, 5-5-2, 5-6-2, 5-7-2, 5-10-2, 5-13-2.

**Note.** In computing liquid capital investments, only the “direct costs” of “material and service inputs” are counted, not the indirect costs (i.e., depreciation and tax).

To separate out investments by small-scale farm households from investments by so-called big household entities 大户 and agricultural firms/enterprises 农业公司/企业, we employ the standard divisions between small and medium-to-large scale operations used in the statistical data. For pork, the line drawn is at the scale of 99 pigs. Individual households can manage easily 10 pigs, and more if production is well and efficiently organized (e.g., in new-style pig pens); raising dozens of pigs is not uncommon for a single peasant household. (With a high degree of automation at the frontier of modernization of hog raising, one labor unit can oversee as many as 200 pigs or more.) For milk cows, we use the statistical divide of 9 head as the upper limit of what a household can manage and, for beef cattle, 49 head. Similarly, for lambs and sheep, 99 head; for meat chickens, 1,999 chickens; for egg chickens, also 1,999. The result may be seen as an approximation of such products raised by small households, in which the household itself is the main source of labor (i.e., still the “family farm”), exclusive of the so-called big household 大户 entities that employ more than casual labor and the agricultural firms based principally on hired labor. (For actual examples of the different scales of production of the different products, see Yidu shi renmin zhengfu, 2012.)

As can readily be seen, the total for these major products amounted in 2010 to 905.1 billion yuan, which is obviously an incomplete count, but perhaps a good approximation of the great majority of animal products production of the new agriculture (excluding fisheries, that is, for which no data have been available after 2007).<sup>2</sup>

Adding together our tallies of liquid capital investments in the new agriculture—313.5 billion yuan + 905.1 billion yuan—we arrive at a total of 1,218.6 billion yuan. If we add to that figure the total investments in fixed assets of 230.5 billion yuan, we arrive at a total figure of 1,449.1 billion yuan of capital investments in small-scale new agriculture. This should be taken as the minimum amount of capital investments today by peasant family farms in the new agriculture.

Adding further our (revised lower) figure of 244.0 billion yuan of liquid capital investments in the old agriculture, we come to a grand total of 1,693.1 billion yuan of capital investments, both liquid and fixed, and both old and new in 2010. That amounts to 41.8 percent of the agricultural GDP (4,053.4 billion yuan) of that year, a figure that dwarfs total state investments in agriculture by a considerable margin, as will be seen below.

At the same time as the expanding capital investments detailed above, the size of the rural labor force declined markedly. As shown in Table 8, the total number of the rural employed hovered close to 500 million throughout the years 1995 to 2000, with the numbers of those exiting the countryside balancing out those added by natural increase. But then the rural workforce began to decline substantially, first by an average of about 5 million each year and then, starting in 2006, by nearly 10 million each year. The number of rural employed thereby declined from 487 million in 2001 to 410 million in 2010. Over and above that decline, the number of those employed off-farm (in township enterprises 乡镇企业 and private enterprises 私营企业) within rural China itself rose rapidly, from 143 million in 2001 to 192 million in 2010. The result was that the total number of those engaged in farming dropped rapidly, from 320 million in 2001 down to under 200 million (196 million) in 2010.

Of course, the decline by one-third of the number of people employed in agriculture, coupled with the capital investments detailed above, means considerable increases in capital inputs per unit labor (i.e., “capitalization” as used

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<sup>2</sup> Data for 2004-2007 show that in “fine farming of fresh water fish” 淡水鱼精养 an average of 26 percent of all labor input was hired labor, almost comparable to “scale meat-chicken” and “scale pig” production (Quanguo nongchanpin, 2004-2007: table 1-23-2; see also Huang, Gao and Peng, 2012: 146, figure 2; 147).

Table 8. Numbers of Rural Employed, 1980-2010 (in millions of persons)

Year	Original figure	Adjusted figure*	Subtracted	Township enterprises	Private enterprises	Self-employed	Farming
1980	318.36	–	–	30.00			
1985	370.65	–	–	69.79			
1990	477.08	–	–	92.65	1.13	14.91	368.39
1995	490.25	–	–	128.62	4.71	30.54	326.38
2000	489.34	–	–	128.20	11.39	29.34	320.41
2001	490.85	486.74	-4.11	130.86	11.87	26.29	317.72
2002	489.60	481.21	-8.39	132.88	14.11	24.74	309.48
2003	487.93	475.06	-12.87	135.73	17.54	22.60	299.19
2004	487.24	469.71	-17.53	138.66	20.24	20.66	290.15
2005	484.94	462.58	-22.36	142.72	23.66	21.23	274.97
2006	480.90	453.48	-27.42	146.80	26.32	21.47	258.89**
2007	476.40	443.68	-32.72	150.90	26.72	21.87	244.19
2008	472.70	434.61	-38.09	154.51	27.80	21.67	230.63
2009	468.75	425.06	-43.69	155.88	30.63	23.41	215.14
2010	–	414.18		158.93	33.47	25.40	196.38

*Source.* *Zhongguo tongji nianjian*, 2011: table 4-2, 2010: table 4-2.

\* The State Statistical Bureau in 2011 adjusted substantially its earlier data on the basis of the population census of 2010.

\*\* According to the 2006 decennial survey of Chinese agriculture, there were in that year 212 million who engaged in farming for six months or more during the year, and another 91 million who did so less than six months (*Zhongguo di er ci*, 2009: table 2-1-15). Thus, we can see that a large proportion of the latter group was categorized instead as employed in township or private enterprises or as self-employed.

in this article), by another 50 percent above the dimensions detailed for capital investment increases alone. Needless to say, such a change is itself a major dynamic for the rising price of rural labor.

### Wage Income Origins of Capital Investments

The chief dynamic behind the changes outlined above is rising opportunities and wages for off-farm employment, such that peasants have come to expect not 20-30 yuan per day, but rather 50-100 yuan. Those changed expectations have propelled peasants to turn to ever greater capitalization of the old agriculture, in order to save time, and to greater and greater involvement in the new agriculture, for higher returns.

Data on rural residents' incomes 农村居民收入 include figures on "wage-like income" 工资性收入, mainly of the 80 million "leave the land but not the village" 离土不离乡 peasants employed in "township enterprises" 乡镇企业 (Zhongguo nongcun tongji nianjian, 2011: table 11-5). They show a total of (2,431 yuan/rural resident  $\times$  750 million rural residents =) 1,755.7 billion yuan of such wage-like income in 2010. This figure should be distinguished from the income of the "leave both the land and the village" 离土又离乡 peasant migrant workers, who in 2010 totaled 153 million, earning a total of (2,049 yuan/month  $\times$  9.8 months worked per year  $\times$  1.53 million migrant workers =) 3,072.2 billion yuan (Zhongguo guojia tongjiju, 2011). Combining the wage incomes of those working off-farm at home and the wages incomes of those working away from home, we get a total of nearly 5,000 billion yuan in wage income for the 900 million people officially registered as peasants.

As can readily be seen, peasant wage income goes a long way toward explaining the bulk of the new capital investments peasants have made in farming. That is what has propelled, and paid for, the resort in the old agriculture to hiring more tractor plowing-planting-harvesting and using more farm chemicals, in preference to hand plowing-planting-harvesting and hand weeding. It is also what has paid for the greatly increased fixed and operating capital investments in the new agriculture.

While peasant choices are readily understandable in terms of the rising opportunity costs for farm labor, the underlying logic is perhaps not immediately apparent. What happens, in effect, is that in choosing off-farm work over the original farmwork (like hand plowing and planting, hand weeding and hand harvesting), more and more peasant households are in effect using incomes from off-farm employment to pay for the labor-saving and higher-return inputs or, in other words, for the further capitalization of farming. There are those who remain at home and contribute all or most of their earnings to the maintenance and capitalization of the family farm 经营费 for higher returns, and there are those who leave for the cities, who send part of their earnings home (to an unquantifiable extent), also to help pay for the maintenance of the family farm. Considering what peasants have had to put up with in discriminatory treatment in their off-farm employment, we might (if we were to dramatize the point) call such capital "blood and sweat capital" 血汗资本, to distinguish it from our conventional notions of capital (operating capital or capital in fixed assets) invested by private firms or the state.

### The New Age Agricultural Revolution

In the Reform era, the gross value of agricultural products has in fact increased at an average rate of about 6 percent per year (in “comparable prices” 可比价格), doubling every twelve years and quadrupling in twenty-four years. These are dimensions that dwarf the older forms of agricultural revolutions, whether the classical English agricultural revolution of the eighteenth century or the 1960s and after “green revolution.”

Most of the increase in the output value of agricultural products has of course come from the new agriculture. The increased cultivation of high-value vegetables and fruits is reflected in the quadrupling (407 percent) of the output value of “agriculture” 农业, meaning in this context planted products 种植业产品. The nearly six-fold rise (587 percent) in the output value of “big agriculture” 大农业, which includes “forestry,” “animal husbandry” and “fishery,” on the other hand, is to be accounted for mainly by the tremendous rise in meat products (1,043 percent) and in fish farming (1,904 percent), separately placed under “animal husbandry” 牧业 and “fisheries” 渔业 (see Table 9).

Table 10 provides a clearer picture of the composition of the new age agricultural revolution. As can readily be seen, the output values of vegetables and fruits per sown mu are generally three times that of grain. Thus, in 2010, whereas grains, at 55.9 percent of sown acreage, accounted for just 15.9 percent of total agricultural output value, less than one-third of its proportion of sown acreage, the output values of vegetables and fruits amounted to just about the same as their proportions of sown acreage. In 1980, vegetables and fruits

Table 9. Indices of Output Value of Agriculture, Forestry, Animal Husbandry, and Fishery, 1980-2010 (1952 = 100)

Year	Total output value	Agriculture	Forestry	Animal husbandry	Fishery
1980	224.9	203.6	1,014.8	306.4	1,270.7
1985	333.4	291.2	1,572.1	508.2	2,263.0
1990	420.5	356.7	1,601.1	704.4	4,238.2
1995	602.2	439.7	2,298.8	1,237.7	8,915.6
2000	807.8	549.6	2,808.5	1,811.4	1,4074.0
2010	1,320.2	828.3	4,681.9	3,195.5	2,4198.4

*Source.* *Zhongguo nongcun tongji nianjian*, 2008, 2011: table 6-22.

*Note.* Computed according to comparable prices.

Table 10. Relative Proportions of Sown Acreage and of Output Value of Major Farm Products, 1990-2010

Year	Vegetable sown acreage %	Output value %	Fruit sown acreage %	Output value %	Grain sown acreage %	Output value %	Animal Husbandry output value %	Fishery output value %
1990	4.8%	—	3.5%	—	—	31.4%*	15.8%	5.4%
2000	9.7%	14.4%	5.7%	4.2%	54.6%	17.4%	18.6%	10.9%
2010	18.8%	18.8%	7.1%	7.9%	55.9%	15.9%	30.0%	9.3%

Source. *Zhongguo tongji nianjian*, 2011: table 6-14; *Zhongguo nongcun tongji nianjian*, 2002: table 6-14.

\* This is the "all food crops" figure 粮食作物合计 (which includes potatoes and beans). There is no 1990 figure for just "grains."

amounted to just 3.4 percent of the total sown acreage; in 2010, they made up 25.9 percent. They are the major components of the new agriculture, in terms of planted products (*Zhongguo tongji nianjian*, 2011: table 6-14; *Zhongguo nongcun tongji nianjian*, 2002: table 6-14). As for meats, in terms of output value they have come to account for fully 30 percent of all farm products. If one adds fisheries, which account for 9.3 percent, the total of meats and fish amounts to 39.3 percent of all output value; in 1978, meats-fish amounted to just 17 percent of all agricultural output value. Vegetables + fruits and meats + fish are the main components of the new agriculture that has propelled China's new age agricultural revolution.

### Appropriate Scale Farms

In the projection Philip Huang made with Yusheng Peng in their 2007 article, based on trends in birthrates, in off-farm employment and farm employment, and in changing consumption patterns, they estimated that in twenty-five years time (i.e., ca. 2030), the average Chinese farm will have reached appropriate scales. Those may be considered 15 mu per farm in the old agriculture (of grain, cotton, and oil crops farming), or 3.0 mu of tented vegetables, mushrooms, fruits, nurseries (for flowers and plants) in the new agriculture. With current technologies in the new and old agriculture, those farm dimensions would represent full employment for farming households, and would bring incomes consistent with such employment (Huang Zongzhi and Peng Yusheng, 2007).

We might take the situation in the year 2006 reflected in the second nationwide survey of agriculture as our baseline, given its systematic household-by-household data gathering. A total of 200 million (200,159,127 to be exact) households were surveyed, and their farms broken down into different scales and sizes. The data do not distinguish between old and new agriculture farms. If we use them for an indication only of appropriate scale farms in the old agriculture (amounting to about 70 percent of all sown acreage), we find that family farms of 15 mu or more totaled 15.1 million, or 7.7 percent of all family farms (Zhongguo di er ci, 2009: table 2-7-1). In addition, we have data on “farms with infrastructure” 设施农业, referring specifically to hothouses, and small and medium tents 中小棚 and large plastic tents 大棚, which totaled 11.7 million mu (11,655,000), or 3.9 million farm households (assuming 2 labor units working 1.5 mu each), or about 2 percent of all farms (Zhongguo di er ci, 2008: 7). The total of “appropriate scale” farms in the old agriculture and in new-style “vegetable and others” tented farming, then, amounted in 2006 to nearly 10 percent of all farms. Philip Huang and Yusheng Peng’s projection made in 2007 estimated an increase of perhaps 2 percent of all farm households per year. That would mean 18 percent in 2010, to reach possibly 58 percent of all farms by 2030. These are very rough estimates. For a more complete and accurate picture, we need to wait for the results of the 2016 decennial survey of agriculture.

### A Macroeconomic View

We are now ready to take a macroeconomic look at total investments in agriculture. To be sure, the state has played and continues to play a major role, through its investments in infrastructure 基本建设, research and development of agricultural technology 科技三项费用, and agricultural subsidies 支援农村生产支出 and services 农业事业费. In 2010 those totaled 858 billion yuan (Zhongguo nongcun tongji nianjian, 2011: table 5-1). But if we include just the infrastructural investments (and leave out the remainder, namely agricultural extension services and subsidies and services), those amounted in 2010 to 240 billion yuan, as has been seen. By comparison, agricultural investments in fixed assets (mainly in the new agriculture) by individual peasants/households 农村个体/农户 total about 230.5 billion yuan, as shown in Table 1, nearly comparable to fixed assets investments by the state.

It is in liquid capital investments that peasant households tower above the state and agricultural firms. Since peasant household farms account for by far



the greatest proportion of cultivated land, compared to state farms, which are only about 0.5 percent ( $0.9\text{亿亩}/18\text{亿亩} = 0.5\text{ percent}$ ; Zhongguo zhuyao nianfen guoyou nongchang jiben qingkuang, 2010) of all cultivated acreage, and wage-labor based capitalist farms, only about 3 percent of all labor input, their operating capital investments unquestionably total many times those of the state and private firms.

Total liquid capital investments by peasant households, we have seen, amounted in 2010 to 407.3 billion yuan in the old agriculture, 313.5 billion yuan just in vegetables and apples (the two big items of the new agriculture's planted products), and at least 905.1 billion yuan in the new agriculture's major animal products, to make up a total of 1,218.6 billion yuan.

Unfortunately, we do not have good figures for capital investments by agricultural firms. Some indication of the extent of fixed capital investments by them is given in the data provided by the Offices for Industry-ization of Agriculture 农业产业化办公室 in its 2008 report. According to that report (Zhongguo nongye chanyehua fazhan baogao, 2008: Appendix table 4), the total value of fixed assets of such firms increased at a rate of about 82.5 billion yuan in each of the years 2000-2004, rising from 307 billion yuan up to 469 billion yuan in 2002, and further to 637 billion yuan in 2004. In 2005, there was a dramatic increase of 234 billion in the total value of fixed assets (Zhongguo nongye chanyehua fazhan baogao, 2008: Appendix table 4). If accurate, that would mean that new investments in fixed assets by firms came to equal that year current investments in fixed assets by the state and by peasant households. Unfortunately, there has not been a follow-up volume to the 2008 report (and data after 2005) to date. More exact estimates must await further data.

By the industry-ization of agriculture data referred to above, the so-called "dragon head enterprises" in agriculture are said to have "brought along" 带动 a significant proportion of all farming households into integrated or industry-ized 产业化 farming (87 million farming households according to the data of the Ministry of Agriculture's Offices for Industry-ization of Agriculture, or 43.5 percent of all farming households, if we rely on the 200 million farming households figure from the 2006 decennial survey) (Zhongguo nongye chanyehua fazhan baogao, 2008: appendix table 4; Zhongguo di er ci, 2009: table 2-1-14). But, it must be pointed out, the great majority of those "brought along" households operate under "contract farming" (合同、订单、契约) arrangements. In those, it is the family farm, not the agribusiness firm, that bears the expenses for the operating capital investments. In the main, only enterprises based on wage labor bear the operating capital expenditures and those, we have seen, amount to just 3 percent of all labor input in agriculture. State farms, of course,

occupy ~~an even smaller percentage~~ a total of just 0.5 percent of the cultivated area. Peasant family farms, clearly, account for the overwhelming majority of the total cultivated acreage, and our estimate of their total capital investments in agriculture, as has been seen, is more than 1,693.1 billion yuan. That total dwarfs those of the state and of private firms.

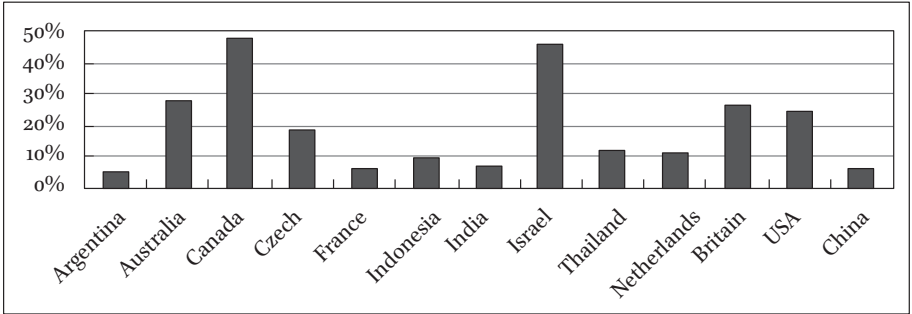
### **Government Investments/Financing of Agriculture**

Chinese government expenditures for agriculture (as a percentage of agricultural GDP) are quite low by comparison with developed Western countries like the U.S., Britain, Australia, Canada, Spain, and Norway, almost all in the 20 percent or above range (see Figures 9 and 10). To be sure, the Chinese government has in place a relatively highly developed irrigation system and agricultural extension network, but its subsidies for agriculture fall well below those of the developed countries. Substantial increases in total government expenditures for agriculture during recent years, up to about 10 percent by 2006, have brought those in line with countries like Thailand, Indonesia (in 1996), and Russia (in 2006). Such expenditures had been even lower than in India in 1996 (at about 7-8 percent), but have since increased considerably, surpassing India by a considerable margin by 2006. At the same time, beginning in 2004, the government drastically cut agricultural taxes and fees, eliminating agricultural taxes completely by January 1, 2006. That too had a major effect. But total investments in agriculture remain comparatively low, especially considering the high proportion of the population engaged in agriculture. Just how low can be dramatized by the fact that, in 2010, while farming accounted for 26 percent of all employed persons in China, state investments in fixed assets in agriculture totaled just 2.8 percent of all state investments in fixed assets (Zhongguo 2010 nian quan shehui guding zichan touzi tongji, 2010).

By comparison with the developed countries, including Taiwan and South Korea, another striking difference is the underdevelopment of rural finance. Until very recently, it was well-nigh impossible for Chinese peasants to obtain credit from formal financial institutions—i.e., the state's banks. They have had to rely instead on informal networks and institutions—family, friends, and neighbors or rural usurers.

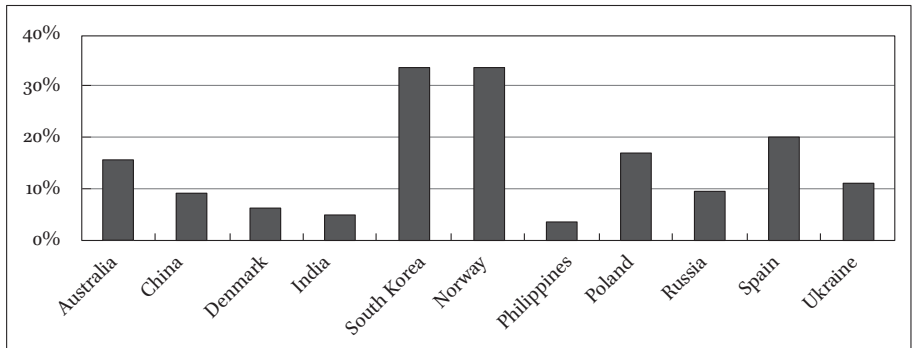
Nevertheless, Chinese agriculture has modernized dramatically in the past fifteen years, as has been seen, compiling a record of a 6 percent annual increase in output value, dwarfing in dimensions the much-touted “green revolution” of the 1960s and 1970s. Our analysis above suggests that the burden for

Figure 9. Government Expenditures for Agriculture in Selected Countries, as a Percentage of Agricultural GDP, 1996



**Source.** From Guo Yuqing, 2006, based on Zhu Gang, Zhang Yuanhong, and Zhang Jun, 2000: 131.

Figure 10. Government Expenditures in Agriculture as a Percentage of Agricultural GDP, 2006



**Source.** IMF, 2008, International Monetary Fund, statistical tables under various countries; World Bank, 2008: table 4-1.

the capitalization or modernization of agriculture has been borne mainly by the 1,693.1 billion yuan of total capital investments by peasant families, coming mainly from their off-farm wage incomes (totaling about 5,000 billion yuan in 2010). Unfair as that employment has been to the peasants, it has brought the unintended consequence of making traditional handiwork in farming obsolete, replaced by modern farm machinery and herbicides in the old agriculture. This has happened along with investments in modern fixed assets (plastic tents, structures, orchards), along with greater operating liquid capital investments

to sustain the new agriculture of higher-value agricultural products. The result has been an agricultural revolution as profound as it was unintended. Much more can be done, however.

## Conclusion

What is most surprising from this inquiry into data about investments in agriculture is the great importance of peasant household investments, coming mainly from wages earned through off-farm employment. That has in fact been a major engine in China's agricultural development in the past fifteen years. And it is a commonly neglected source of capitalization of agriculture.

But it has occurred with little proletarianization in agriculture itself, in the sense that wage laborers remain a very low percentage of total agricultural employment—only about 3 percent (Huang, Gao, and Peng, 2012), though very much accompanied by what might be called “semiproletarianization” in the sense of off-farm employment of some member(s) of the household as wage workers. The majority of peasant households today are in fact what Philip Huang has termed “half worker half cultivator” 半工半耕. It is that semiproletarianization of household members in off-farm wage work (not in farmwork), with the households combining farming with off-farm employment, that has not only transformed rural life and rural communities, but farming itself.

Given such a degree of peasant investments in agriculture, it becomes abundantly clear that peasant families need to be seen as a major creative force in agricultural development. Yet that force has not yet been properly recognized, much less harnessed to the extent it could be.

It is time to look for ways to harness the creative energy that peasant “human resources” 农村人力资源 have demonstrated, with their capacity for self-directed contributions even under the most unfavorable and adverse conditions of urban employment, the more so because of the gross inequities that now exist between urban residents and peasants (by registration), cities and countryside, regular urban employees and peasant migrant workers (nongmingong).

What would be truly transformative for all of the countryside, however, would be a program targeting mainly the small peasant farm, especially those comparatively high-earning peasants who may be able to reach appropriate scales, either with farms of 15 mu or more in the old agriculture or in the smaller labor and capital dual intensifying new agriculture. Such family farms have already contributed greatly to China's agricultural modernization, and they can do much more. Then and only then, would the present gap between

city and countryside, and urban employees and rural peasants, be closed. And then and only then, could a domestic market of tremendous depth be generated to sustain stable and long-term Chinese economic development.

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