Reviewing the 2016 benchmark revisions carried out in Chinese agricultural statistics, and their implications for global market uncertainty

Gary S. Eilerts[1]
geilerts@usaid.gov
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Abstract

There is a clear reason for the intense global interest in, and concern about, official agricultural statistics in China. China represents a huge share of the global demand for food, and its increasing entry into global markets to meet those growing needs has had significant impacts on global prices and stock levels. Yet far too often, the need for timely and accurate production information has been frustrated by statistical reporting which is perceived as weak, opaque, or intentionally mis-leading. Following the third national agricultural census in 2016, and based upon benchmark measures generated in those censal surveys, China retroactively revised some part of its existing 2007-2016 agricultural production estimates. As in the past, the new revisions have stimulated renewed market uncertainty. But is it warranted? A comparison of these recently revised area sown estimates with pre-revision estimates presents a double opportunity to assess both the statistical processes that are used to measure them, as well as the underlying patterns of growth and decline in Chinese agriculture that they trace over time. One of the questions answered here is the degree to which revised major crop[2] area estimates at both national and first sub-national levels of reporting[3] have changed previously described patterns of growth in area sown. The newly affirmed trends in area sown also provide revised evidence for the question, not answered here, of China's continuing concern to feed its people, in the midst of huge social and economic change, both inside the country, and out. Finally, the new Chinese estimates are compared with international perceptions of China's agricultural performance to see the degree to which market uncertainties might be calmed, or exacerbated, by the new numbers.

Background

The means for cheap and rapid global transmission of market information are now present in the smallest and most distant markets. And the costs of a lack of it are painfully obvious, especially for the poor. Poor households all over the world may spend far more than 70% of their total income buying food in the market, at prices which would arguably be much less, with more broadly disseminated market information.

This review has been undertaken in the same spirit as other initiatives that have arisen in recent years to try to improve the evidence base regarding the nature of the global food supply in closer to "real-time" terms. One of the largest and most persistent uncertainties in measuring the global food supply is the dimension of China's food production, and the degree that it will need to meet its needs through the

[1] Surge Officer, USAID FEWS NET Activity; Consultant, UMd/NASA Harvest Consortium. The conclusions presented here are the author's own and do not reflect those of eith USAID or the uMd/Harvest Consortium

[2] "Major crops", in the Chinese context, usually include wheat, maize (corn), rice, sorghum, barley, millet, other grains, soybeans, other oil-seeds, tubers and beans, and cotton and tobacco.

[3] The first-level reporting units considered here include twenty-two provinces, four municipalities (large cities), and five autonomous territories. Three Special Administrative Regions (Taiwan, Hong Kong, Macao) are not included in the analyses here. For the convenience of the reader, they will all be referred to in the text as "provinces".

market. The great advances the country has made in virtually eliminating famine in its territory and providing an adequate diet for its people can't be ignored. But the size of its demand on the global food market that it is increasingly relying upon, becomes a critically important variable for the whole world when it chooses to enter that market.

Controversy has followed some of its annual agricultural production estimates in the recent past, especially following benchmark revisions made retroactively to multiple-years of statistics, when too little basis was shared for the market to trust them. These will be treated later in this text. But this same problem has not been confined to the agricultural domain:

> "*In 2006, China's National Bureau of Statistics undertook a benchmark revision of national income and product accounts statistics based on the findings of the 2004 economic census. … the 2004 economic census results validate the provincial aggregate output values and invalidate the centre's national ones. … sectoral nominal values were revised but real growth rates of some sectors remained unchanged. That is not plausible… the benchmark revision raises questions about the quality and meaning of a large body of official statistics. Ultimately, it casts doubt on the professionalism and sincerity of China's statistical authority"*[4]

The occasion of the 2016 agricultural census[5], and revisions made in China's 2007-2016 agricultural statistics using new benchmark factors derived from agriculture census surveys, therefore offer another challenge for market certainty regarding the perceptions and the reality of China's progress in increasing its food production to meet its growing needs. This analysis looks at one key component of the new revised estimates, changes in area sown, to see the degree to which they answer, or raise, more questions about China's role and impacts in the global food market, and about the trust that external observers may put into the state's measurements its food resources and any deficits it may experience in those.

Data Sources

This review is primarily based upon two sets of agricultural production statistics, both produced by the Chinese Central Bureau of Statistics (CBS), or by its provincial offices. One set of un-revised data, consisting of area, yield and production data for 30 provinces and territories in mainland China was aquired in 2016 and early 2017 from the CBS website (http://www.stats.gov.cn/english/Statisticaldata/AnnualData/ before the revised statistics were publicly available.

The second set of agricultural statistics is a compilation of revised agricultural statistics published both by the CBS on its website and by each province and territory in their own annual statistical yearbooks. The 2018 versions of the central and provincial statistical yearbooks first presented the revised area, yield and/or production estimates based upon results derived from the 2016 Agricultural Census. Although all provincial yearbooks include a chapter on agricultural results, they tend to vary in format

[4] China's 2004 Economic Census and 2006 Benchmark Revision of GDP Statistics: More Questions than Answers, Carsten A. Holz, The China Quarterly, 2008

[5] Agricultural censuses occur in years ending in "6", and the 2016 census is the third to occur.

and content, and particularly in which historical agricultural statistics they provide. CBS website agricultural statistics were extracted in early 2019 for use in completing historical data series for all the major crops of 30 provinces and territories for the 2000-2017 period. Only minor data gaps remain.

In order to compare national-level CBS agricultural statistics with those of the key international agricultural statistic reference sources, FAO and USDA, national-level crop statistics for China (1980-2018) were also collected from the FAO's FAOSTAT web-site application (http://www.fao.org/faostat/en/#data/QC, and from the PSDOnline application maintained by the US Department of Agriculture at (https://apps.fas.usda.gov/psdonline/app/index.html#/app/advQuery.

Reference Map: China's first-level reporting units (provinces, territories, special administrative units)

1. Discussion: National-level impacts of previous benchmark revisions in Chinese area sown estimates

It would be difficult to independently identify and differentiate the timing and impacts of "benchmark" revisions[6] in the agricultural statistics record for any country, because they might look like a host of other causes of change in area planted, yield and/or production statistics. And even if the benchmark revisions shifted many crop results substantially upward or downward from previous trends, it could still be difficult to distinguish them from a series of very good or bad years, or from naturally occurring structural shifts in the type and volume of agriculture being practiced in any area.

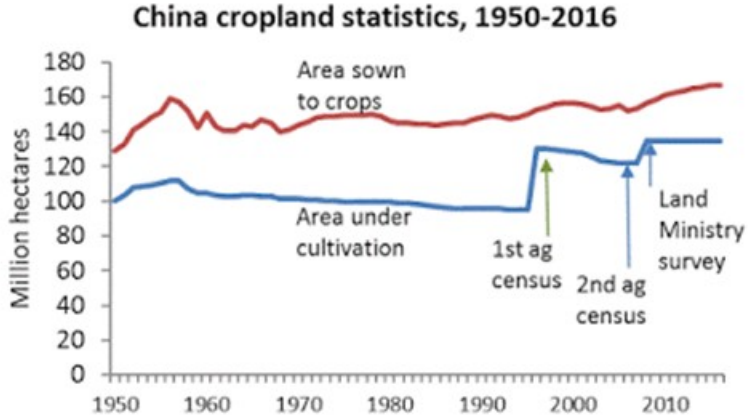


Figure 1

"Gyrations in estimates of China's farmland since the 1990s are an indicator that no one really knows exactly how much land China cultivates. Statistics reported a steadily declining stock of cultivated land starting in the early 1960s that reached 95 million hectares in 1995. At the time, everyone knew this was an understatement, which was confirmed by the 130 million hectares reported by the first agricultural census for 1996 (it took several years to report this number, probably because of bickering behind the scenes). The second agricultural census found a seemingly plausible shrinkage in farmland to 122 million hectares in 2006. However, the Ministry of Land Resources survey in 2008 reported an even larger 135 million-hectare estimate of farmland which has been reported as the cultivated land area in each statistical yearbook since then". -- http://dimsums.blogspot.com/2017/12/chinas-new-ag-census-statistical-fog.html

But because the benchmark revision process is regular in China, if one has a supply of annual statistics from before and after benchmark revisions have been applied, then those impacts can be easily discerned -- as they have been in the country's two previous benchmark revisions of its agricultural statistics (see Figure 1).

Figure 1 provides a simple picture of how much two post-census revisions modified statistics describing the area under cultivation in China during the 1950-2016 period. The size and direction of the benchmark-related changes, in each case, raised serious concern and doubts among external users of these measures. And no wonder why they did; the revisions reversed the inflection of the area sown curve from a downward trend that lasted from the mid-1950s until the 1996 revision, and then another one shown between 1996 and 2006, to a positive one.

The commentary which accompanies the graph shown in Figure 1 is representative of many of the critiques of the new estimates raised at the time. Are the results plausible? Have they been driven by

[6] A benchmark revision periodically re-anchors survey-based estimates to more or better counts of the universe being sampled. The benchmark helps to control for sampling and modeling errors in the estimates.

real increases in area sown? Are they instead reflections of weaknesses in the previous sampling and measurement practices? Or, do they reflect a political story with an agenda?

The administrative practice in China which stipulates when the revisions are to be carried out, also "requires"[7] that retro-active changes be applied in earlier years. As will be seen later, Chinese statistical reporting, post-2016 census results, notes in many specific cases that retro-active revisions have been made to the 2007-2016 results which had been published before the revisions became public in 2019[8]. But the remaining basis to evaluate whether there was indeed a history of doing so after the first two agricultural censuses, is limited.

Note, however, that the graph in Figure 1 seems to show that the impacts of the revisions that occurred following the 1996 and 2006 censuses are quite large and visible ***after*** the census years, but less so before. Did any occur? The downward trend in area sown before the 1996 census seems to have been consistent and steady until a quite abrupt shift upward following the 1996 census, suggesting no retro-active changes. Before the 2006 revision upward, there does appear to be a lessening of the downward trend for a few years before the large 2006 correction, so it seems that there might have been retro-active changes. Beyond the simple question of why retro-active changes were, or not, made following the first two agricultural censuses, it is clear that if the annual basis for the retroactive changes is not spelled out, then there is less chance for other observers to follow the "logic" of the changes made.

As a first step in tabulating the degree to which retro-active revisions have been made to 2007-2016 pre-revision agricultural statistics, a comparison of national-level major crop[9] area sown statistics for the longer 2000-2016 period was carried out. It used pre-revision statistics, extracted during 2017 and 2018 from China Statistical Yearbook tables accessible on the CBS website (before the revised estimates were available), to compare with revised estimates compiled from both the central CBS website, and from 2018 Statistical Yearbooks from all the provinces. Figure 2 shows the results.

The story told by the revised statistics is different from the unrevised statistics immediately in 2007, when a separation appears and continues to grow between the two trend lines through 2016 (see Figures 2 and 3, below). Substantial retroactive revisions then, were apparently made in this period. Over the course of the 2007-2016 period, the retroactive revisions added a net 25.9 million additional hectares over the previous (un-revised) estimates of area sown. By 2016, the revised estimates have diverged from previous estimates by approximately 4.5 million hectares in that year (141,754,312 vs 146,336,971).

The availability of pre-revision statistics allows a more resolved view of the impacts of the revisions, both at the level of individual crops, and at the provincial level. It also affords interested external parties more information about how, if one is interested, to remotely look for, detect and confirm the

[7] "Based on results of the second agricultural census 2006, Beijing Municipal Bureau of Statistics and NBS Survey Office in Beijing revised related historical statistics during 1997-2005 as required by the Agricultural Census Office of the State Council and in accordance with the international practice" – Beijing Statistical Yearbook 2018, page 234.

[8] "Data for 2006-2017 are revised based on the results of the agricultural census" – Hunan Statistical Yearbook 2018, page 302.

[9] This tabulation includes most of the crops referred to as "major crops" by the CBS, including barley, corn, cotton, millet, peanut, rapeseed, rice, sorghum, soybean, sunflower, flue-cured tobacco, vegetables and wheat. Potatoes, other tubers, and beans are additional "major crops" in China which are not considered here.

changes which reportedly drove the revisions[10]. If trust in area sown statistics is an important way to reduce global market uncertainty, then formally providing this information at the time revisions are made would certainly be a useful step.

Figure 2

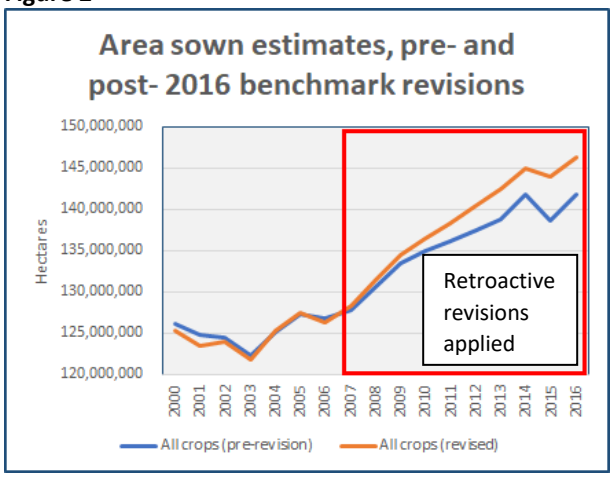
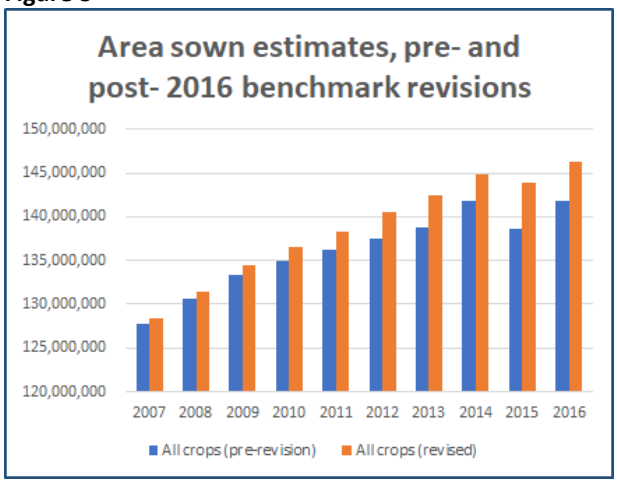


Figure 3



Note: crops included in both figures: barley, corn, cotton, millet, peanut, rapeseed, rice, sorghum, soybean, sunflower, tobacco, vegetables, wheat.

2. Discussion: Crop-specific impacts of China's 2016 benchmark revisions on national area sown estimates

The discussion above reveals a net positive impact from the 2016 census-based revisions on 2007-2016 Chinese area sown estimates. The revised estimates result in approximately 4.582 million additional hectares being sown in 2016 than estimated by pre-revision figures, and approximately 26 million net additional hectares being estimated as sown across the 2007-2016 period. The following analysis will tabulate how those revisions are distributed across the country's crops, and then, by province, crop and year.

Table 1, below, reveals that, overwhelmingly, the largest portion of the country's net increase in revised area sown figures over the 2007-2016 period came from the country's corn crop. The revision added almost 28 million new hectares during the 2007-2016 period, which represents approximately 13 million more hectares of corn sown in 2016 (42,989,048 HA) than in 2007 (29,777,756 HA), representing an average annual growth rate of 4.4%. The soybean and rice crops followed the corn results distantly, with net positive increases in the revised area sown figures in the low millions over the 2007-2016 period. The sunflower and sorghum revised figures were only modestly positive over the same period.

The crop areas which were revised downward the most for the 2007-2016 period included the cotton crop (-3.211 million HA), vegetables (-1.866 million HA), and peanuts (-1.415 million HA). The country's

[10] "Data on the sown area of major grain was collected by satellite remote sensing; data on grain yield were gathered through sampling survey." Beijing Statistical Yearbook, Chapter 11, page 234.

important wheat crop was also revised downward by approximately 880,000 HA for the period. Rapeseed, millet, tobacco and barley followed with relatively minor decreases applied to previous area sown estimates.

Figure 4, below, shows interesting patterns in the way that the revised area sown figures relate to underlying annual growth rates of the 3 crops whose area sown figures were revised upwards.

Table 1: Crop-specific Impacts of Revisions of Area Sown Hectarage

Crop	Area Sown (HA)	Total Net Change (HA), 2007-2016
Corn (pre-revision)	339,924,240	27,939,493
Corn (revised)	367,863,733	
Soybean (pre-revision)	83,434,800	3,561,243
Soybean (revised)	86,996,043	
Rice (pre-revision)	298,834,346	2,197,593
Rice (revised)	301,031,939	
Sunflower (pre-revision)	9,704,460	204,350
Sunflower (revised)	9,908,810	
Sorghum (pre-revision)	5,690,203	11,821
Sorghum (revised)	5,702,024	
Barley (pre-revision)	5,473,240	(12,130)
Barley (revised)	5,461,110	
Tobacco (pre-revision)	8,969,391	(62,650)
Tobacco (revised)	8,906,741	
Millet (pre-revision)	7,832,721	(131,920)
Millet (revised)	7,700,802	
Rapeseed (pre-revision)	71,647,160	(421,309)
Rapeseed (revised)	71,225,851	
Wheat (pre-revision)	240,940,670	(879,531)
Wheat (revised)	240,061,139	
Peanut (pre-revision)	44,894,460	(1,414,582)
Peanut (revised)	43,479,878	
Vegetables (pre-revision)	197,181,285	(1,865,971)
Vegetables (revised)	195,315,314	
Cotton (pre-revision)	46,912,890	(3,211,865)
Cotton (revised)	43,701,025	
Net Change in Area Sown (HA)		25,914,543

The revisions only further enhanced the steady and relatively large increases that have been seen in the growth of hectarage planted to corn since the early 2000s. Beyond key policy changes introduced in 2004 to favor increased grain production[11], observers generally attribute the strong growth in area sown to the corn crop to at least two other factors: 1) corn's role as a feed crop for animals, and the increasing demand for meat from a more affluent and quickly-growing Chinese urban population; and 2) the demand for alternate energy sources, and particularly for corn to produce ethanol. The revised estimates are in this sense very plausible, and certainly could be tested further by looking at corn imports, animal production and pricing over the period. Nevertheless, the increases in corn area appear, on their face, plausible and explainable by other variables, in addition to whatever second opinion confirmation might be available using remote sensing products.

Note that in 2007, corn surpassed rice in terms of total area sown nationally. During the 2007-2016 period, modest annual revisions to the rice crop hectarage added a total of 2 million hectares, but its underlying growth trend was modest, growing less than 1% per year over the period.

More interesting, however, are the distinctive trends seen in the revisions and annual growth figures of the soybean crop. The revisions to annual hectarage estimates are relatively large, consistently reaching 500,000 additional hectares or more over each of the years between 2007-2014. But the underlying

[11] An analysis of China's grain production: looking back and looking forward, Li, W. et all, 2013

growth trend for the crop was steeply downward over this same period. No revisions were applied in 2015, but for 2016, both the pre-revision estimate and the revised figure chart a very steep rebound of approximately 1.4 (revised) to 1.8 million (pre-revision) hectares in that year.

For much of the 2000-2012 period, global soybean prices were moving steadily upward, almost quadrupling in dollars per bushel during that time. Since 2012, they have moved from a high of almost $18/bushel to just over $8 in August 2019. The unusual slopes therefore suggest that something more is needed to understand the curves seen here. Perhaps they also reflect a more substantial technical correction in the estimation process than was seen for other crops? Nevertheless, what might generate such a sharp inflection between decline and growth is not immediately clear, and this case probably merits more investigation.

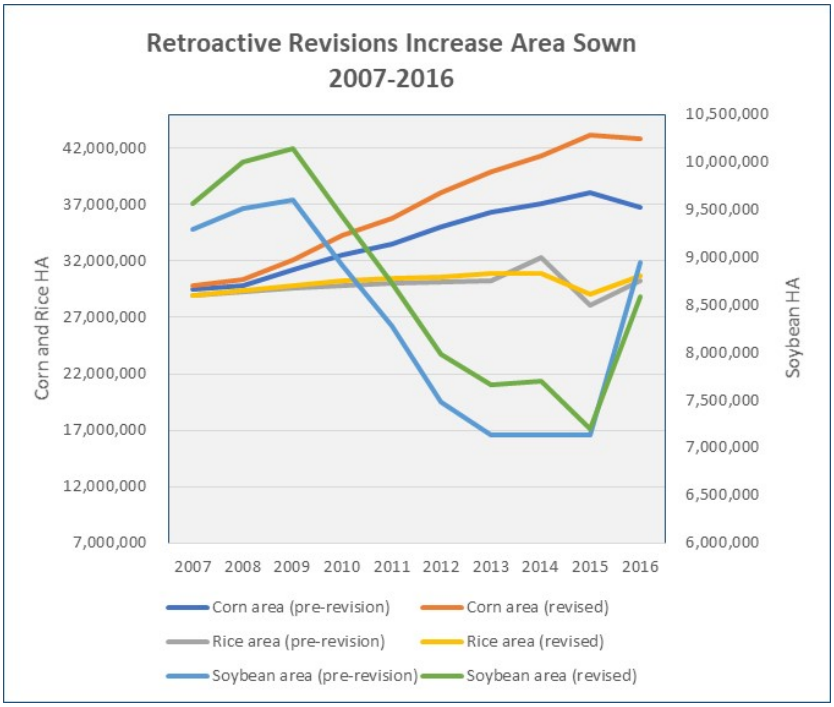


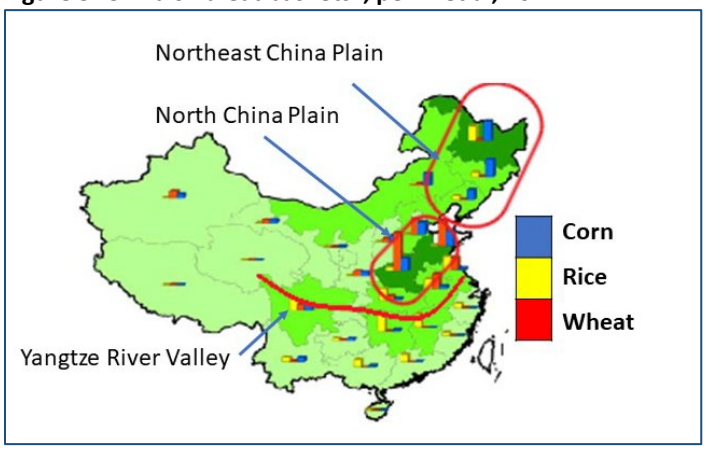
Figure 4: Benchmark revisions applied to 2007-2016 crop statistics substantially increased the area sown estimates for three crops: corn, rice and soybean.

Summing up, the crop-specific impacts of revised estimates of area sown for the longer 2000-2016 period raised the average annual growth rate from .8% to 1% per year. For the period of most interest here, 2007-2016, the average annual growth rates were slightly higher at .086 and 1.15%. Very striking, however, are the number of crops with almost no growth, or negative trends over the period. The declining trends in many crops are not new and are explained fairly easily by most external observers. In this sense, as well, the revisions do not appear to enhance in a non-technical manner some fairly worrisome trends about the nation's ability to feed itself.

3. Discussion: Province-level impacts of China's 2016 benchmark revisions on area sown estimates

Did the 2016 agricultural census-based area sown revisions discussed above have differential impacts at the province-level? If so, how did they change the pre-existing patterns of crop distribution and hectarages across the country, and are they plausible?

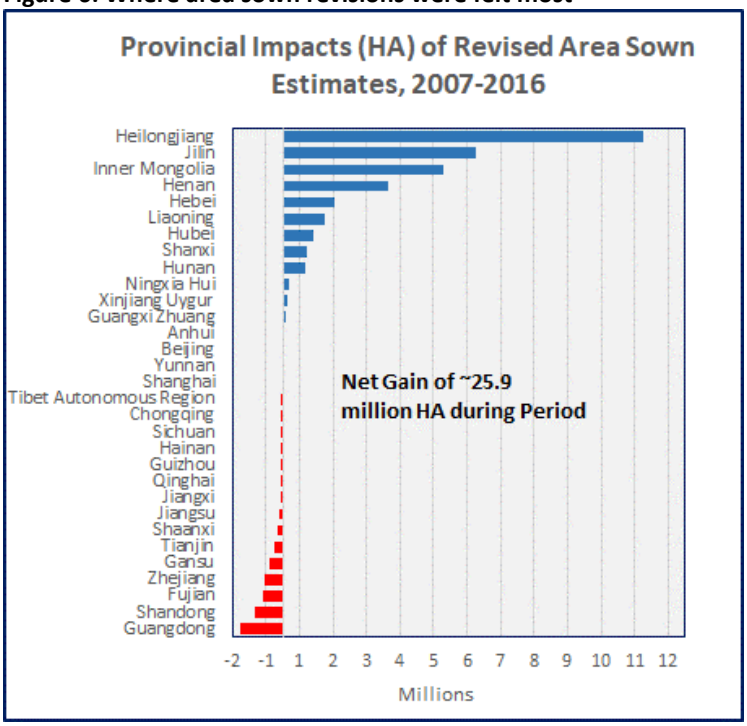
Figure 5: China's "breadbaskets", per Li et al, 2014



The three most important regions of crop production in China are the Yangtze River Valley (YRV), the North Central Plain (NCP), and the Northeast China Plain (NECP), shown in Figure 5.

Yangtze River Valley agriculture, and especially its rice production, has been equated with China's very survival for millennia. The provinces of Shanghai, Jiangsu, Anhui, Hubei, Chongqing, Sichuan and Yunnan comprise the valley. The North China Plain is the heart of China's wheat production, and comprises the provinces of Beijing, Tianjin, Hebei, Shandong, and Henan. The Northeast China Plain, previously known as Manchuria, is a relative newcomer as a breadbasket. But since the 1950s, government policies and investments have created a huge new center of corn and rice production for the country. The Northeast Plain includes the provinces of Heilongjiang, Jilin, and Liaoning.

Figure 6: Where area sown revisions were felt most



An analysis and comparison of revised area sown figures with pre-revision estimates for the 2007-2016 period is shown in Figure 6. It shows that of the almost 26 million additional hectares added by the benchmark revisions, a large majority of them are found in the three northern-most provinces, Heilongjiang, Jilin, and Inner Mongolia. The provinces where revisions produced the greatest decreases in area sown included Guangdong, Shandong, Fujian, and Zhejiang.

Figure 7, below, shows the geographic location (at the province-level) of the greatest increases and decreases at the provincial level due to revised estimates. The provinces which saw the largest decreases are almost all found on the populous coast of the country. Approximately 81 per cent of the

nation's net gain in hectarage due to revised estimates, almost 26 million HA of them, is found in the Northeast China Plain (17.780 million HA; 69.2%) and North China Plain (3.183 million HA; 12.3%) breadbaskets that are described above. Inner Mongolia is another noteworthy province in which the revisions added more than 5 million hectares over the period.

Figure 7: Locations of largest increases and decreases in area sown due to revisions of estimates

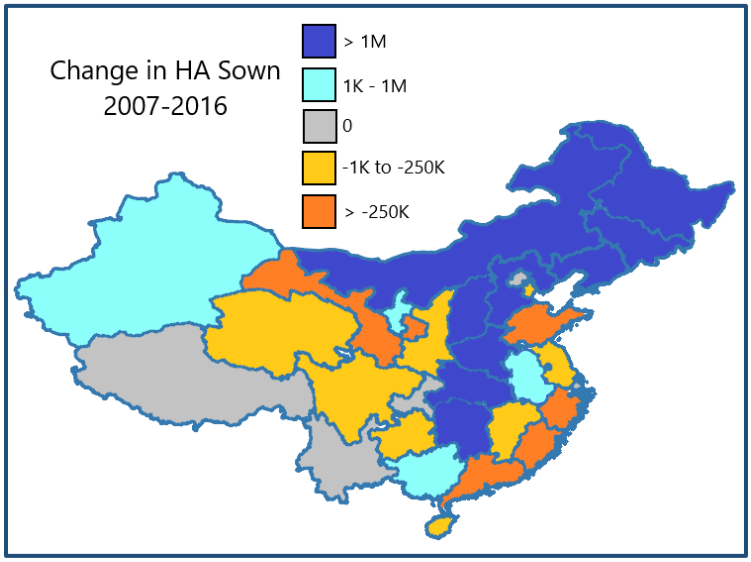


Table 2, below, provides the basis to look at how the 2016 provincial revisions relates to two key issues: a) whether the revisions occurred where they might most be expected; b) how the revisions compared with each province's average annual rate of growth in major crop area sown over the 2007-2016 period[12], and especially how they affected the three principal breadbasket regions (YRV, NCP, NECP). These issues are described below.

Did the revisions occur where they might most be expected: In general, downward revisions in area sown were seen most in provinces with comparatively lesser amounts of area sown, while the upward revisions occurred more often in provinces with higher amounts of area sown. Revisions in these areas might reflect an earlier benchmark which assumed too low a rate of loss of area sown due to land use conversion and rural-to-urban migration rates, especially in the smaller, older and more populous coastal provinces. The positive revisions seem to reflect the greater availability of new farming lands and lesser populations found in the geographically larger provinces of the north, west, and south-west parts of the country. In their dimensions (rather small) and consistency with some of the most often discussed hypotheses of the dynamics affecting changes in area sown in China, they are more plausible than not.

How did the revisions compare with each province's average annual rate of growth in area sown: Table 2 also shows that only 3 of the 15 provinces found in one of the country's three key "breadbaskets" saw negative rates of annual growth in area sown. Of the twelve others with positive rates of growth, 6 did not see average annual rates that surpassed 1 per cent per year. The same was true for non-

[12] The average annual growth rate was calculated using a 3-year average at the beginning (2007-2009), and the end (2014-2016) of the 2007-2016 period, to minimize the impacts of single-year variations due to weather, etc..

breadbasket provinces, where 12 of the 24 provinces saw positive rates which were, nonetheless, less than 1 per cent. Because the average annual growth rate in population size for China as a whole is only .5 per cent[13] (.5%), such a rate is nominally keeping ahead of the population, but only if food production, especially from corn, were not being increasingly diverted to both ethanol production and for animal feed to meet the urban demand for protein.

Table 2: Relating 2016 revisions in, and average annual growth rates of, Area Sown, to the amount of sown area in each province, and to the national agricultural breadbasket regions

"Breadbasket" Region	Reporting Unit	Area Sown (HA)		Average 2014-2016 Area Sown (HA)
		2007-2016 Revision (%)	Avg Annual Growth Rate, 2007-2016 (%)	
Other	Tibet	(0.00)	0.18	89,180
NCP	Beijing	0.04	(4.54)	157,551
YRV	Shanghai	-	(1.52)	274,383
Other	Qinghai	(1.45)	1.88	361,090
NCP	Tianjin	(5.36)	(0.02)	423,787
Other	Hainan	(0.06)	0.37	648,913
Other	Ningxia Hui	2.75	0.12	680,505
Other	Zhejiang	(2.91)	(1.22)	1,704,791
Other	Fujian	(3.34)	(0.02)	1,753,343
YRV	Chongqing	(0.00)	1.43	2,439,071
Other	Gansu	(1.62)	1.02	2,626,573
Other	Shanxi	2.47	0.67	3,133,625
Other	Shaanxi	(0.48)	(0.04)	3,381,420
Other	Guangdong	(3.25)	0.12	3,710,335
Other	Guizhou	(0.06)	2.09	3,768,233
NECP	Liaoning	3.41	1.53	4,066,963
Other	Jiangxi	(0.13)	(0.84)	4,215,453
Other	Xinjiang Uygur	0.35	3.65	5,003,323
YRV	Yunnan	-	2.56	5,143,964
Other	Guangxi Zhuang	0.15	0.53	5,180,427
NECP	Jilin	11.67	1.87	6,069,040
YRV	Jiangsu	(0.15)	0.15	7,127,793
Other	Inner Mongolia	8.53	4.18	7,137,420
YRV	Hubei	1.38	1.16	7,221,067
Other	Hunan	0.92	1.87	7,766,267
YRV	Sichuan	(0.00)	0.36	7,806,800
YRV	Anhui	0.00	0.03	8,297,033
NCP	Hebei	1.92	0.48	8,304,223
NCP	Shandong	(0.83)	0.37	10,452,969
NCP	Henan	2.39	0.69	13,885,374
NECP	Heilongjiang	9.05	2.18	14,155,903
	China	**1.86**	**1.01**	**146,986,822**

Note: Breadbasket regions are: "YRV" = Yangtze River Valley; "NCP" = North China Plan; "NECP" = Northeast China Plain

At a provincial level, with minor exceptions, the most notable increases and decreases in area sown over the 2007-2016 period have occurred in the same three crops noted in national-level analyses above:

[13] World Bank, https://data.worldbank.org/indicator/SP.POP.GROW

corn, rice, soybeans (see Table 3 -- largest increases highlighted in green, largest decreases in orange[14]). Table 3 differs from Table 1 in tabulating the provincial changes (increase/decrease) in area sown over the ten-year period, while Table 1 showed changes in area sown due to retroactive revisions in the statistics. Table 3 provides a province-level view of the national trends shown in Figure 4.

Table 3: Changes in provincial area sown, selected crops, 2007-2016 (revised estimates)

Province	Corn 2007-2016		Rice 2007-2016		Soybean 2007-2016	
	Add'l HA	Avg. Ann. Growth (%)	Add'l HA	Avg. Ann. Growth (%)	Add'l HA	Avg. Ann. Growth (%)
Anhui	463,930	2.16	46,750	0.07	(318,490)	(1.10)
Beijing	(206,000)	(4.72)	(768)	(5.73)	(16,610)	(6.26)
Chongqing	45,624	0.33	62,335	0.31	73,127	3.04
Fujian	43,540	3.98	(332,620)	(1.33)	3,520	0.21
Gansu	1,415,630	8.29	(3,120)	(1.89)	(76,660)	(2.64)
Guangdong	37,026	0.84	(274,597)	(0.47)	(57,060)	(3.56)
Guangxi Zhuang	301,160	1.99	(400,970)	(0.63)	12,800	0.46
Guizhou	73,460	0.33	(33,950)	(0.16)	26,460	0.70
Hainan	(53,680)	(10.00)	(25,350)	(0.27)	(310)	(0.36)
Hebei	2,023,493	2.28	(11,095)	(0.45)	(198,020)	(3.65)
Heilongjiang	8,331,000	6.79	4,199,000	5.52	(3,615,000)	(2.94)
Henan	3,915,150	4.61	29,120	0.16	(355,420)	(2.50)
Hubei	887,330	6.04	865,860	1.42	138,780	4.03
Hunan	300,010	4.04	853,600	0.71	(77,000)	(2.91)
Inner Mongolia	4,575,000	6.50	(26,000)	(0.84)	(40,500)	(0.17)
Jiangsu	142,430	1.20	164,240	0.25	(81,840)	(1.19)
Jiangxi	43,180	9.13	(1,684,620)	(1.73)	(39,830)	(1.29)
Jilin	3,653,300	4.10	331,700	1.65	(1,482,600)	(5.48)
Liaoning	2,371,000	3.89	(474,000)	(2.48)	(223,600)	(5.37)
Ningxia Hui	257,820	4.09	(8,040)	(0.34)	(21,459)	(4.08)
Qinghai	71,500	-	-	-	28,500	-
Shaanxi	118,420	0.35	14,900	0.42	(207,700)	(3.83)
Shandong	1,713,833	1.98	(50,453)	(1.27)	(85,363)	(1.72)
Shanghai	(1,200)	(1.03)	(34,820)	(1.07)	(11,240)	(7.19)
Shanxi	1,523,480	3.72	(1,209)	(3.22)	(153,587)	(2.51)
Sichuan	1,196,000	2.83	(382,000)	(0.63)	78,000	0.58
Tianjin	148,120	3.04	4,060	0.89	(12,710)	(4.07)
Tibet AR	2,050	1.81	(20)	(0.07)	(750)	(7.14)
Xinjiang Uygur	1,118,670	6.69	(3,760)	(0.18)	(82,580)	(2.76)
Yunnan	594,050	1.50	361,910	1.19	457,550	13.42
China	**35,105,326**	**3.81**	**3,186,082**	**0.28**	**(6,339,592)**	**(2.10)**

[14] Both the additional hectares sown, and the average annual growth rate were calculated using a 3-year average at the beginning (2007-2009), and the end (2014-2016) of the 2007-2016 period, to minimize the impacts of single-year variations due to weather, etc.. Qinghai province changes have been omitted for crops whose production is recent.

Assuming for the moment that increased area sown figures show some form of economic, social, policy or environmental-based "popularity", resulting in increased area sown, and that decreased hectarage means the opposite, what do the revised statistics reveal about the most and least popular crops in China over the 2007-2016 period? Table 4 shows a ranked crop versus crop comparison of "popularity". This analysis compares the average annual growth rate for every crop in a province, against the growth rates of all the other crops in the province (e.g. corn vs peanut, corn vs soybean, etc.). Each time one crop showed a positive annual growth rate, and the other crop did not, a point was given to the crop with the positive growth rate. The maximum score a crop could garner in this analysis is 330 (30 provinces x 11 crops), if a specific crop's growth rate was positive and all the other crop growth rates in all the other provinces were negative.

The order of the most "popular" crops is therefore seen by reading downward in the first column of the table, and the most popular, by this measure, is corn. Reading across the first data row to the right, corn was more popular than all the other crops, by nine more provinces in the case of peanuts, and by 24 more provinces in the cases of both cotton and barley.

Table 4: Crop "winners" and "losers" (by changes in area sown), on a province-by-province and crop-by-crop basis

	Corn	Peanut	Sunflower	Sorghum	Rapeseed	Wheat	Rice	Millet	Tobacco	Soybean	Cotton	Barley	Popularity Score
Corn		9	11	13	14	14	16	16	19	20	24	24	**180**
Peanut	-9		2	4	5	5	7	7	10	11	15	15	**81**
Sunflower	-11	-2	0		3	3	5	5	8	9	13	13	**57**
Sorghum	-13	-4	-2	0		1	3	3	6	7	11	11	**36**
Rapeseed	-14	-5	-3	-1	0		2	2	5	6	10	10	**26**
Wheat	-14	-5	-3	-1	0	0		2	5	6	10	10	**24**
Rice	-16	-7	-5	-3	-2	-2	0		3	4	8	8	**4**
Millet	-16	-7	-5	-3	-2	-2	0	0		4	8	8	**1**
Tobacco	-19	-10	-8	-6	-5	-5	-3	-3	0		5	5	**-30**
Soybean	-20	-11	-9	-7	-6	-6	-4	-4	-1	0	4	4	**-40**
Cotton	-24	-15	-13	-11	-10	-10	-8	-8	-5	-4		0	**-84**
Barley	-24	-15	-13	-11	-10	-10	-8	-8	-5	-4	0		**-84**

What does the popularity score show? Four of the five most popular crops produce oils, and all of the five most popular crops can serve as animal feed crops. The two main industrial crops, cotton and tobacco, have seen large decreases in area sown over the period, and have a growth profile that is only more favorable than barley.

Very notable in the popularity ranking are the mediocre scores that three of the traditional main staple crops, wheat, rice and soybeans, received. What the ranking means in these cases is that there are 14 and 16 provinces respectively, where the area sown to corn is growing at a positive annual rate, and the areas given to wheat and rice in those same provinces are declining. There are also 20 provinces, two-thirds of the country, in which soybean hectarage is declining at the same time the corn hectarage is increasing. Given the growth profiles of peanuts, sunflower and rapeseed, which would not seem to differ much compared to soybeans in terms of the crops utility for human consumption, animal feed, and industrial uses, it is more difficult to explain the poor fortunes of this crop.

4. Discussion: Consistency of China's revised area sown estimates with those of other international references

The above discussions have largely focused on the crop and province-level features and internal consistency of revised benchmark estimates with unrevised estimates of area sown for the 2007-2016 period. In the past, external evaluations of these estimates have sometimes questioned their accuracy, and the question to examine now is how the new estimates compare with other expert sources of opinion on this matter. Below, the revised official Chinese estimates of area sown will be compared to estimates from the two pre-eminent international reference sources for global agricultural estimates, the US Department of Agriculture (USDA), and the UN Food and Agriculture Organization (UN FAO).

The new Chinese area sown estimates are based upon benchmark statistical measures which were derived from information and data gathered during the 2016 China agricultural census. As is the practice in China and elsewhere, the creation of the new benchmarks has led to a retroactive revision of previous annual estimates for the 2007-2016 period. Above, the principal revisions carried out have been identified both by the crops and provincial locations where they occurred.

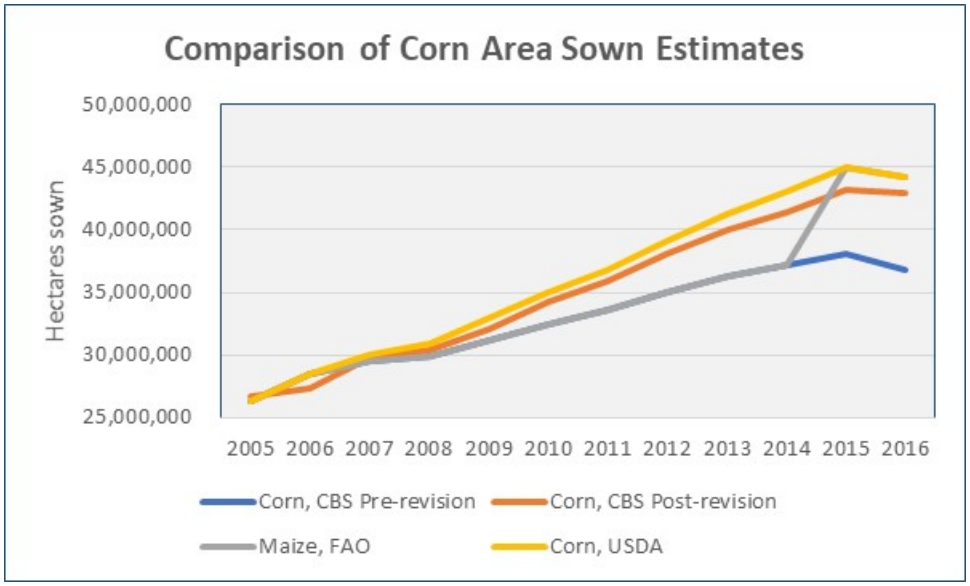
The new time-series and trend patterns that they trace have also been lightly examined to determine where they might diverge from expected patterns, given features of China's population, economy, and policy orientations, as well as international trends and market conditions. Contrary to earlier criticisms that were raised in the past, this analysis of the new area sown estimates has found little that would suggest anything but a professional, informed attempt to describe reality, over time, in a very large, complex and changing country. But are those efforts confirmed by external expert sources?

Using data extracted in August 2019 from the UN FAO FAOSTAT database, and from the USDA PSD Online data repository, all major crop agricultural statistics relating to China for the 2000-2016 period were extracted and compared with the revised CBS statistics for those crops. In many, but not all cases, crop definitions and area sown figures are consistent among all three sources, so that direct crop-by-crop estimates are possible. This is true of the corn, rice and soybean crop estimates which have been the focus of most of this analysis, because of the dimension of the revisions carried out in those crops, and because of their importance in the nation's food supply and economy.

Looking at the first of those three crops, corn, which since 2007 has been the crop that occupies the largest area sown in China, Figure 8 compares the area sown estimates of FAO and USDA with the new CBS revised estimates. The previous divergence in estimates between the CBS unrevised estimates and those from USDA is very evident starting in about 2009 and continues through 2014. In 2015, FAO abandoned using CBS estimates and ratcheted its own estimate up by almost 8 million hectares, to join USDA's 2015 estimate at approximately 6.8 million hectares higher than China's. Certainly, the large and increasing divergences found in the 2009-2015 period would have had to be a major source of concern in world markets and likely contributed to the critiques leveled at Chinese agricultural statistics delivered over that period.

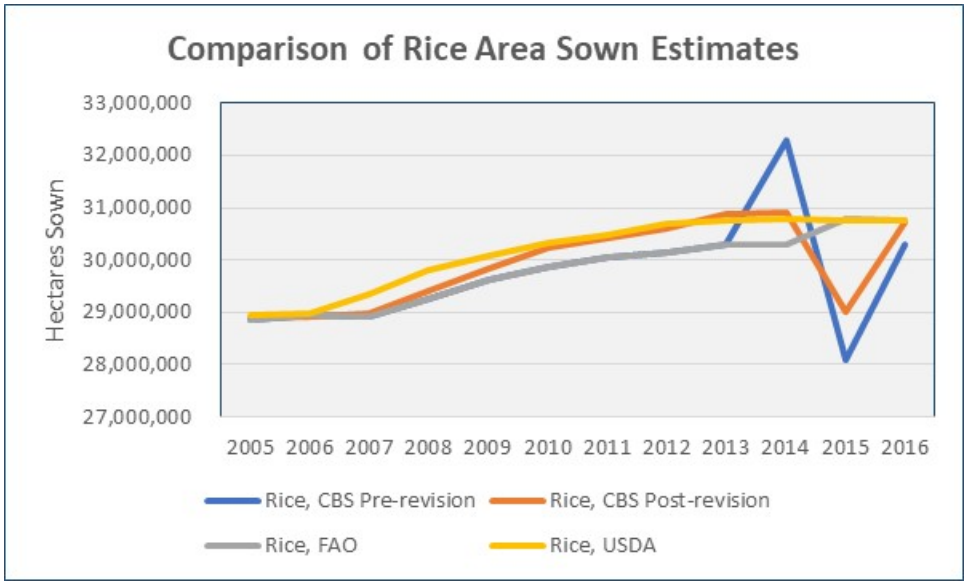
However, with the retroactive 2007-2016 revisions in corn area sown, the divergences between CBS estimates and those of FAO and USDA have narrowed to around one million hectares, and the trendlines even appear to show an agreement among these bodies about a lessening of the crop's previously aggressive and steady upward rate of growth.

Figure 8: Previous divergences in corn area sown have substantially narrowed



For the rice crop (see Figure 9), the divergences between China's official area sown figures and those of USDA were not as large as for the corn crop, but they held steady at a difference of approximately 500,000 hectares per year, a difference that had to contribute to market uncertainty over the true hectarage involved. Note that the revised CBS area sown statistics for rice have largely eliminated the differences from about 2010. They have also corrected a wild swing upward in the unrevised CBS figures for 2014, but only partially so for 2015, when again the FAO decided to accept the USDA figure instead of the CBS estimate. As with corn, for 2016, it appears that all parties agree on how much rice has been sown in China.

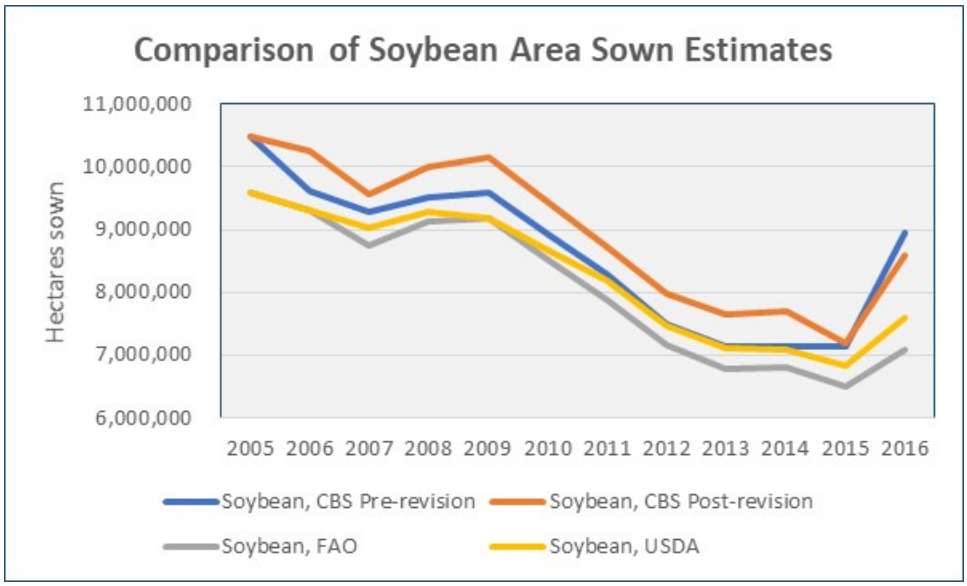
Figure 9: Previous divergences in rice area sown have substantially narrowed



The analyses above have drawn attention to the curious shapes of the trends in China's un-revised and revised estimates of the area sown to soybeans across China. Recall that the revised CBS estimates retroactively added several million hectares sown to soybean over the 2007-2016 period, even while the overall trends in soybean hectarage were strongly negative between 2009 and 2015. Looking at global soybean prices for a hint of why the severe negative trend, no conclusive answer was found, and note was made that this anomaly perhaps deserved more study.

Looking at Figure 10, which shows a comparison of the CBS revised statistics with those of both FAO and USDA, it appears that all parties must equally well understand what the reason is for the curious trends, and they are in agreement how they have interpreted the record over time. But there are, nevertheless, strong differences of opinion about the amount of annual hectarage being planted to soybeans, good year or bad, from at least 2005 to 2016, and none of the parties has yet been convinced by the other.

Figure 10: Agreement on the trends, differences in the number of hectares involved



5. Conclusions:

This desk review of official Chinese agricultural area sown statistics was intended to provide insights on new official statistics showing how Chinese agriculture has changed over the course of the 2007-2016 period, and draw some rather tentative conclusions about whether they would lead to more, or less, market uncertainty about Chinese agricultural prospects. Those statistics were then examined by crop, at the provincial level and in comparison with expert external analyses. None of the analyses found any reason to doubt the expert technical basis they are supposed to faithfully represent. As of 2016, the views of China and the principal global arbiters of agricultural production in the world are quite close in their evaluation of China's contribution to global food supplies, and similar in their estimations of the factors which will be used to predict China's potential demand for those supplies to meet their own internal needs.

SOURCES

China Agricultural and Grain Statistics, National Bureau of Statistics, China, Ministry of Agriculture, China. http://www.stats.gov.cn/english/Statisticaldata/AnnualData/

2018 Provincial Statistical Yearbooks, published by National Bureau of Statistics provincial/territorial offices, China Statistics Press, 2018:

- Anhui Statistical Yearbook, 2018
- Beijing Statistical Yearbook 2018
- Chongqing Statistical Yearbook 2018
- Gansu Development Yearbook, 2018
- Fujian Statistical Yearbook 2018
- Guangdong Statistical Yearbook 2018
- Guanxi Statistical Yearbook 2018
- Guizhou Statistical Yearbook 2018
- Hainan Statistical Yearbook 2018
- Hebei Economic Yearbook 2018
- Heilongjiang Statistical Yearbook 2018
- Henan Statistical Yearbook 2018
- Hubei Statistical Yearbook 2018
- Hunan Statistical Yearbook 2018
- Inner Mongolia (Nei Monggol) Statistical Yearbook 2018
- Jiangsu Statistical Yearbook 2018
- Jiangxi Statistical Yearbook 2018
- Jilin Statistical Yearbook 2018
- Liaoning Statistical Yearbook 2018
- Ning Xia Statistical Yearbook 2018
- Qinghai Statistical Yearbook 2018
- Shaanxi Statistical Yearbook 2018
- Shandong Statistical Yearbook 2018
- Shanghai Statistical Yearbook 2018
- Shanxi Statistical Yearbook 2018
- Sichuan Statistical Yearbook 2018
- Tianjin Statistical Yearbook 2018
- Tibet (Xizang) Statistical Yearbook 2018
- Xinjiang Uygur Statistical Yearbook 2018
- Yunnan Statistical Yearbook 2018
- Zhejiang Statistical Yearbook 2018

http://www.fao.org/faostat/en/#data/QC

https://apps.fas.usda.gov/psdonline/app/index.html#/app/advQuery.

Yuxuan Li, Weifeng Zhang, Lin Ma, Liang Wu, Jianbo Shen, William J. Davies, Oene Oenema, Fusuo Zhang & Zhengxia Dou; An analysis of China's grain production: looking back and looking forward; Food and Energy Security 2014; 3(1): 19–32

http://dimsums.blogspot.com/2017/12/chinas-new-ag-census-statistical-fog.html

http://usa.chinadaily.com.cn/a/201712/18/WS5a371404a3108bc8c67352d7.html

Crop Acreage Measurement by using remote sensing in Chinese Agricultural Census 2016, ZHOU Wei weizhou@263.net; Department of Rural Surveys, National Bureau of Statistics of China

China's 2004 Economic Census and 2006 Benchmark Revision of GDP Statistics: More Questions than Answers? Carsten A. Holz; China Quarterly, March 2008; doi:10.1017/S030574100800009X

http://usa.chinadaily.com.cn/a/201712/18/WS5a371404a3108bc8c67352d7.html

China Agricultural Census Design and Data Collection: Issues and Lessons, 2002-05-20 10:20, Luigi Biggeri, Senior Project Advisor, China/Italy/FAO Projects, University of Florence, Italy; http://www.stats.gov.cn/english/SpecialTopics/IntConferenceOnAgCensus/200205/t20020520_29928.html

He, Z.H., S. Rajaram, Z.Y. Xin, and G.Z. Huang (eds.). 2001. *A History of Wheat Breeding in China*. Mexico, D.F.: CIMMYT.

Agricultural land-use in China: a comparison of area estimates from ground-based census and satellite-borne remote sensing. STEVE FROLKING, XIANGMING XIAO, YAHUI ZHUANG∗, WILLIAM SALAS and CHANGSHENG LI Institute for the Study of Earth, Oceans, and Space, Morse Hall, 39 College Road, University of New Hampshire, Durham, NH 03824 USA. E-mail: steve.frolking@unh.edu, xiangming.xiao@unh.edu, bill.salas@unh.edu, changsheng.li@unh.edu, ∗Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, PO BOX 2871, Beijing 100085, China. E-mail: zhuangyh@sun.ihep.ac.cn

Frolking, S., J. Qiu, S. Boles, X. Xiao, J. Liu, Y. Zhuang, C. Li, and X. Qin, combining remote sensing and ground census data to develop new maps of the distribution of rice agriculture in China, Global Biogeochem. Cycles, 16(4), 1091, doi:10.1029/ 2001GB001425, 2002.

Statistical Communiqué of the People's Republic of China on the 2018 National Economic and Social Development National Bureau of Statistics of China, February 28, 2019

World Bank, https://data.worldbank.org/indicator/SP.POP.GROW